Prêt-à-Loger

Home with a Skin

Improve your house. Preserve your home.



Project Manual #7

3rd November 2014

www.pretaloger.nl

The material and energy flows from the built environment to the ecosystem have failed to respect the latter's integrity and balance. Looking into the future, the team firmly acknowledges the need to counter this violation. We believe that it is possible to correct the wrongs. That it is possible to take our built environment into the future. That it is possible for all of us to co-exist and thrive with the eco-system again. Prêt-à-Loger is determined to turn this possibility into reality. Visit our website for more information: **www.pretaloger.nl**

TU Delft Delft University of Technology

Solar Decathlon Europe

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RULES AND BUILDING CODES COMPLIANT CHECKLIST

Rule Description	Content Requirement(s)	Drawing(s), Report(s)
3.2 Team Officers and Contact Information	Team officer's contact information completely fulfilled in Table 1 (SDE WAT)	DEL_PR#6_2013-11-01
4.3 Lot Conditions and attribution	Drawing(s) showing the storage and unloading areas and corresponding load's calculations	HS-001
4.3 Lot Conditions	Calculations showing the structural design remains compliant even if there is a level difference, and drawing(s) showing shimming methods and materials to be used in case	ST-001/PM#6 pp.161-191
4.4 Footings	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	ST-101/ST-111
4.4 Footings	Drawing(s) showing the location, contact area and soil-bearing pressure of every component resting directly on the ground	ST-101/ST-101/ST-111
4.7 Construction Equipment	Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site and specifications for heavy machinery	SO-001-SO-223
5.1 Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	AR-101/AR-102
6.1 Structural Design Approval	Structural drawings and calculations signed and stamped by a qualified licensed professional	All ST-XXX drawings /PM#6 pp.161-191 and pp.705 - 888
6.1 Electrical and Photovoltaic Design Approval	Electrical and Photovoltaic Drawings and calculations signed and stamped by a qualified licensed professional	All EL-XXX and PV-XXX drawings / PM#6 pp.199-243
6.1 Codes Design Compliance	List of the country of origin codes complied, properly signed by the faculty advisor	PM#6 pp.12
6.2 Architectural Footprint	Drawing(s) showing all information needed by the Rules Officials to digitally measure the architectural footprint	AR-014
6.2 Architectural Footprint	Drawing(s) showing all the reconfigurable features that may increase the footprint if operated during contest week	AR-041
6.3 Measurable Area	Drawing(s) showing the Measurable Area	AR-051
6.4 Entrance and Exit Routes	Drawing(s) showing the asccessible public tour route, specifying the entrance and exit from the house to the main street of La Cité du Soleil®	PT-001/PT-101/PT-102/PT-201/PT-202
7.3 PV Technology Limitations	Specifications and contractor price quote for photovoltaic components	PM#6 pp.901
7.4 Batteries	Drawing(s) showing the location(s) and quantity of stand-alone, PV powered devices and corresponding specifications	N/A

7.4 Batteries	Drawing(s) showing the location(s) and quantity of hard wired battery banks components and corresponding specifications	N/A
7.6 Thermal Energy Storage	Drawing(s) showing the location of thermal energy storage components and corresponding specifications	ME-031/ME-011
7.7 Desiccant Systems	Drawing(s) describing the operation of the desiccant system and corresponding specifications	N/A
7.8 Humidification systems	Specifications for humidification systems and corresponding certifications of the different elements	N/A
8.1 Containers locations	Drawing(s) showing the location of all the water tanks	PL-001
8.2 Water delivery	Drawing(s) showing the fill location(s), quantity of water requested at each fill location, tank dimensions, diameter of opening(s) and clearance above the tank(s)	PL-001/PL-101
8.3 Water Removal	Drawing(s) showing the quantity of water to be removed from each fill location, tank dimensions, diameter of opening(s) and clearance above the tank(s)	PL-001
8.5 Grey water reuse	Specifications for grey water reuse systems	PL-011/PL-103
8.6 Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	PL-011/PL-103
8.8 Thermal Mass	Drawing(s) showing the locations of water based thermal mass systems and corresponding specifications	N/A
8.9 Grey Water Heat Recovery	Specifications for grey water heat recovery systems	N/A
9.1 Placement	Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system	AR-002
9.2 Watering Restrictions	Drawing(s) showing the layout and operation of greywater irrigation systems	PL-011/PL-103
10.2 SDE Sensors' Location and wire routing	Drawing(s) showing the location of bi-directional meters, metering box, sensors, cables and feed-through to pass the instrumentation wires from the interior to the exterior of the house	ID-001[f]/ID-001[g]
11.2 Use of the Solar Decathlon Europe Logo	artwork and content of all communications materials, including signage	PM#6 pp. 397-454
11.3 Teams's sponsors & Supporting Insitutions	Drawing(s) showing the dimensions, materials, artwork and content of all communications materials, including signage	PM#6 pp. 422
11.4 Team Uniforms	Drawing(s) showing the artwork, content and design of the team uniform	PM#6 pp. 406 - 421
12.4 Public Tour	Drawing(s) showing the public tour route, indication the dimensions of any difficult point, complying with the accessibility requirements	PT-001/PT-101/PT-102/PT-201/PT-202
20.0 Contest 6: Drying Method	Drawing(s) showing clothes drying method and the place where the clothes will be dried	IN-001

20.0 Contest 6: House Functioning	Appliances and corresponding technical specifications	PM#6 pp.1253
36.5 Photovoltaic systems design	Specifications of PV generators, inverters, wiring, cables, protections, earthing systems, interface with the electricity distribution network	PV-001
36.5 Photovoltaic systems design	Inverters' certificates	PM#6 pp.230
36.5 Photovoltaic systems design	Maintenance plan for PV generators, supporting structure, inverters, wiring, cables, protections, circuit breakers in case of fire and earthing system. Fire protection systems for PV DC wiring	PV-021/PV-031/PM#6 pp. 206-243
36.5 Photovoltaic systems design	The corresponding table "design summary" must be filled out	PM#6 pp.207
51.3 Fire Safety	Specifications for Fire Reaction of Constructive elements, extinguishers and fire resistance of the house's structure	FP-001 - FP-002
51.3 Fire Safety	Drawings showing compliance with the evacuation of occupants' requirements and fire extinguishers location	FP-001 - FP-002
51.4 Safety against falls	Specifications of compliance with the slipperiness degree classes of floors included in House tour	PM#6/H&S plan
51.4 Safety against falls	Drawing(s) showing compliance with conditions for uneven flooring, floors with different level, Restricted Areas stairs, Public Areas Staircases, Restricted Areas Ramps and Public Areas Ramps	PM#6/H&S plan
51.4 Safety for avoiding trapping and impact risk	Drawing(s) showing compliance with conditions for avoiding trapping and impact risk	PM#6/H&S plan
51.4 Safety against the risk of inadequate lighting	Specifications for level of illumination of house tour areas light fittings	PM#6/H&S plan
51.5 Accessibility for People with Disabilities and Special Needs	Interior and exterior plans showing the entire accessible tour route	PT-101
51.6 Structural Safety	Specifications for the use of dead loads, live loads, safety factors and load combinations in the structural calculations	PM#6 pp.705-888
51.7 Electrical and PV Systems	Complete the "Electrical System Design PV Chart and Checklist" Rule 48	DEL_ELEC#4_2014-06-01
51.7 Electrical and PV Systems	Specifications of the wiring, channels, panels and protections of the electrical installation	PM#6 pp.1041 - 1203
51.7 Electrical and PV Systems	One-line electrical diagram and drawings showing the grounding, execution and paths	EL-001/EL-501

Date 28-02-2014

Our reference AD-140228-01
Your reference -
From AAJF van den Dobbelsteen
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Subject Certification of compliance

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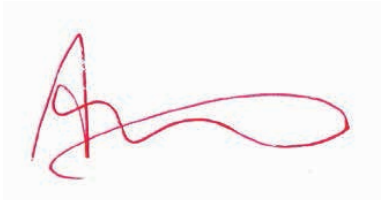
www.bt.bk.tudelft.nl

To Solar Decathlon Europe organisation

Dear organisation,

As faculty advisor of the TU Delft Solar Decathlon team I certify that the team's Prêt-à-Loger house complies with the building codes of the Netherlands. The house will be safe for the public to enter if it has been built as designed

Yours sincerely,
With kind regards,



Prof. Andy van den Dobbelsteen, PhD MSc

Primary faculty advisor to the TU Delft Solar Decathlon team
Professor of Climate Design & Sustainability, Head of Department of Architectural Engineering + Technology
Delft Energy Initiative theme coordinator for the built environment

CONTEST SUPPORT DOCUMENTS

1 URBAN DESIGN, TRANSPORTATION AND AFFORDABILITY REPORT

1.1 Urban design strategy

1.1.1 Global picture

The major ambition of Prêt-à-Loger is to make a difference for individuals, families, streets, neighbourhoods, towns and entire societies. Our goal is to set in motion a process that can globally change the way we perceive living and the related sacrifices that we tend to find normal. Currently we are slowly starting to realize what is the impact of our behaviour and the exhaustion of the natural resources of the world, our home. We have only one world, only one home. We better keep it organised, clean and habitable for our children and grandchildren, the future generations. This is what sustainability is all about; living current life to the fullest extent, without jeopardizing the life of future generations. However, if the current construction and resource consumption patterns are kept the challenge of supplying and sustaining the existence of our world seems to be beyond humanity's strength in long-term projected future. Therefore, Prêt-à-Loger addresses the urgent necessity of reconsidering the global development and promoted lifestyle of today.

Ecological footprint

In order to measure the effects of the human impact on Earth tools such as the Ecological Footprint, tracking humanity's demands on the biosphere by comparing humanity's consumption against the Earth's regenerative capacity, or biocapacity (Ewing, 2010), have been introduced in the recent decades. Both the Ecological Footprint and biocapacity are expressed in a common unit called a global hectare, where 1 gha represents a biologically productive hectare with world average productivity. According to the estimation of the Global Footprint Network (2012) there is an explicit negative trend of growing 'ecological overshot'. The steady decline of the Earth's biocapacity per capita due to the increase of the global population (e.g. more people have to share the Earth's

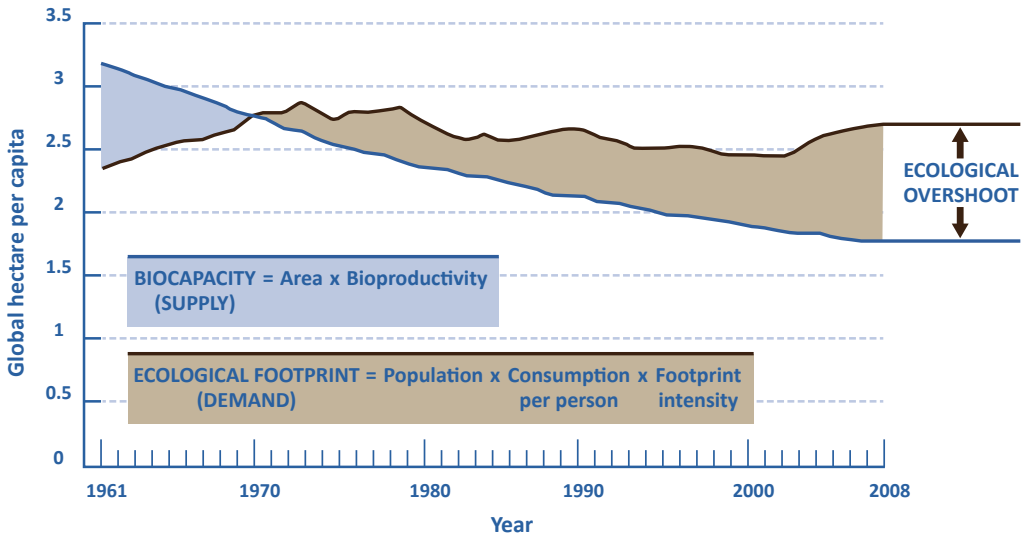


Figure 1.1 — *Global Ecological Overshot; Data Source: WWF Annual Report (2012)*

resources) determined and ecological overshot reaching 50% deficit in 2008. By this year the Earth's total biocapacity is 12.0 billion gha (1.8 gha per capita), while humanity's Ecological Footprint was 18.2 billion gha (2.7 gha/cap). This disparity means that it would take 1.5 years for the Earth to fully regenerate the utilised resources humanity consumes in one year.

However, the ecological footprint per capita produced by different countries around the globe varies significantly depending on a number of factors including the quantity of goods and services which are consumed, the resources and the wastes generated to provide these goods and services. In fact, the main negative impact which reflects on the today's ecological overshot is produced by the developed regions and economies and the lifestyle of consumption that they promote. For example, if all of humanity lived like an average Egyptian only one-third of the planet's biocapacity would be utilised. On the other hand, if all of humanity lived as an average inhabitant of the Netherlands (5.8 gha per capita), a total of 3.2 Earths would be required to regenerate humanity's annual demand on nature.

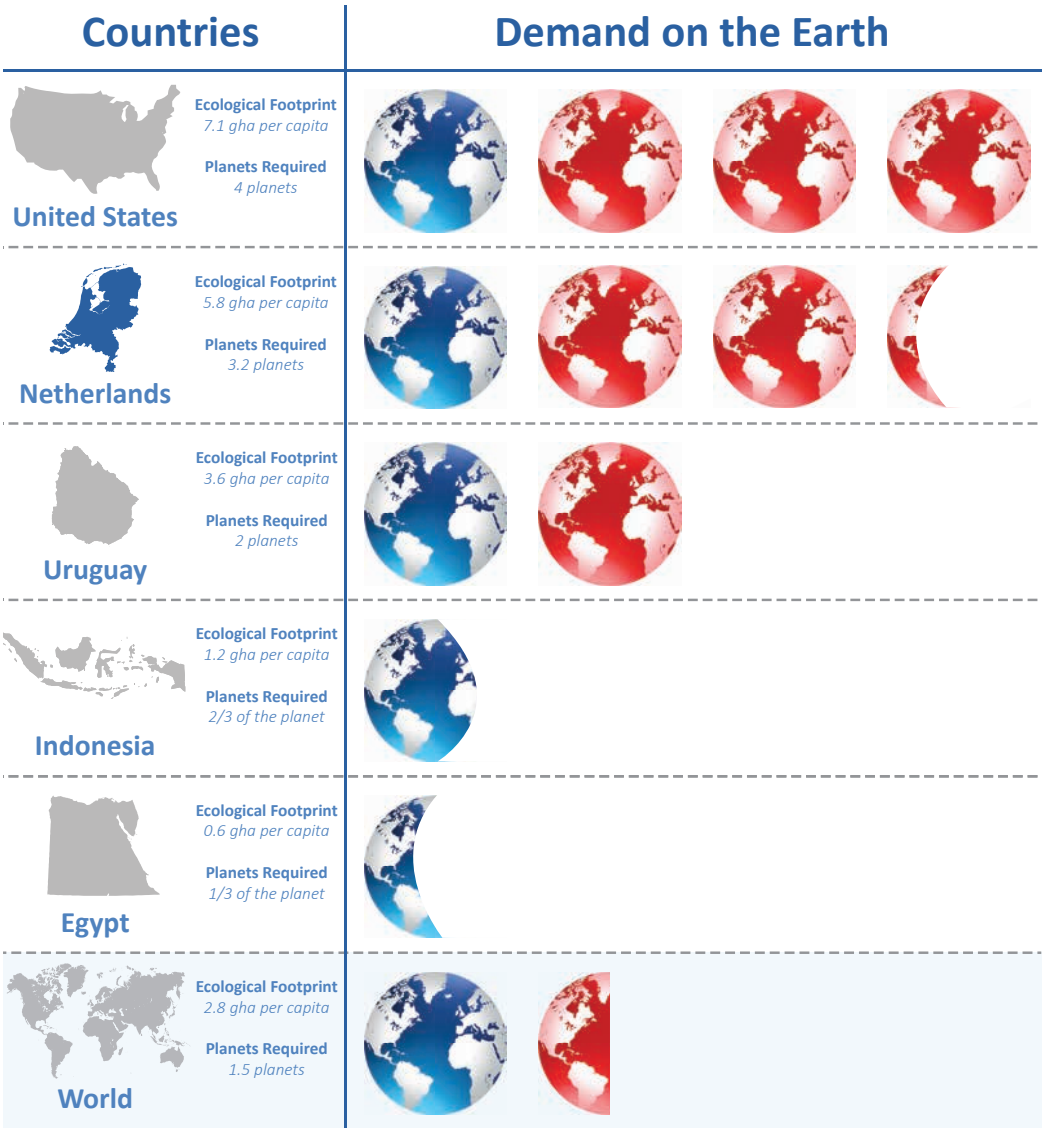


Figure 1.2 — *Demand on the Earth e.g. how plannets required if everyone lived like a resident of these countries*

The presented data facilitates the clear message that humanity is simply demanding more than the Earth can provide. Therefore, individuals and institutions globally must reconsider the current negative impact of humanity on nature. The ecological limits of the planet should become central to our decision-making at the various different scales seeking new ways to live, within Earth's bounds. This major challenge demands further development and integration of new types of technologies and infrastructures that will allow us to operate in a resource-constrained world (WWF, 2012).

While speaking about the sustainable future of the Earth it could not be neglected that the human population dynamics and their accommodation are major elements which affect the environmental pressures (WWF, 2012). Our world is undergoing an unprecedented process of global urbanisation. Cities have been growing, both spatially and demographically, and are projected to accommodate almost all of the world's population in 2050. This seems to determine that the global effort for sustainability will be won, or lost, in the world's cities. Striving to deal with these issues the existing building stock and transportation networks, which serve the ever changing urban lifestyles, demand certain adaptations. The assumption that urban design might influence over 70 per cent of people's Ecological Footprint by means of planning decisions, spatial organisation and technology (Wackernagel et. al., 2006) underlines the crucial importance of urban development in respect to the human impact on the Earth.

In order to fulfill the ambitions of more sustainable global future a substantial number of old houses all around the world are being torn down to make room for new, energy-efficient buildings. However, we do not immediately realise that by doing so, a tremendously high price is paid. We do not only waste additional energy and resources required for the new constructions but also the emotional bond is lost, which defines a house as a home is broken and the historical and cultural values that are attached to the existing fabric and neighbourhoods. These values are certainly important anchors that preserve the social and cultural identity of urban inhabitants and their environment. Since the urban areas are long-lasting structures there is a necessity of exploring different alternatives for sustaining the existence of our world.

Indeed, a conversational approach towards the urban fabric could be employed as a tool for general spatial development strategy in order to foster a sustainable prosperity and the quality of life in cities. However, the physical preservation must also incorporate and emphasise an energy conservation and renewable resources utilisation strategy because in the long-run, the effects of restoration projects may be harmful in terms of environmental sustainability. By respecting the material and energy flows between the built environment and the ecosystem it is possible to take the existing homes and neighbourhoods into the future. The essence of this concept is the belief that future urban demands could be met on the basis of the richness of the past with the application of the right means. This suggests an urban design approach with a high appreciation of the local context aiming to contribute to more general and global issues.



Figure 1.3 — *The practices of simply replacing urban fabric by destroying existing houses has a negative impact not only on the environment but also on the socio-cultural heritage of urban areas. Photo Credit: Lisa V. Taylor*

1.1.2 The context of the Netherlands

In the Netherlands every year 13 thousand houses are demolished. Those that are left consume a massive amount of energy and are being considered as environmentally unsustainable. Currently less than one percent of the seven million homes in the country are replaced by new houses. Furthermore, the economic crisis of the recent years has led to a serious reconsideration of the general practice. This defines the Dutch context as a suitable one for the utilisation of innovative means of space (re)production such as architectural preservation in order to build up a brighter urban future comprising of sustainable homes and communities.

Dutch urbanisation

The Netherlands is a highly urbanised country where 83.2% of the Dutch population live within urban areas. The major part of both total and urban inhabitants in the Netherlands is located in the Dutch 'metropolis', e.g. Randstad spatially defined by the area between the four largest cities in the country (Amsterdam, Rotterdam, The Hague and Utrecht) in the Western part of the nation. The process of urban growth has been significantly accelerated since the end of the late 1960s until the beginning of 21st century similar to the other modern industrialized countries in Europe. The period 1960-80 in the Netherlands was especially dominated by substantial urban deconcentration (Ottens, 1990). These years were characterised by a steady economic growth increasing the population's incomes which has coincided with the massive introduction of the automobiles in the country enhancing the individual possibilities of mobility. Initially the new expansions have taken place within the small municipalities. In the 1980s and 1990s, deconcentration was less dramatic, partly because of the emphasis on new construction within and close to existing urban centres. But housing and employment continued to grow in suburban areas in the periphery around the large cities of the Randstad and succeeded in relocating more and more of their population overspill (Dieleman & Jobse, 1997).

Figure 1.4 — *The position and extent of Randstad within the territory of the Netherlands*



Figure 1.5 — *Growth of the urban, semi-urban and rural structures in Randstad (Netherlands)*

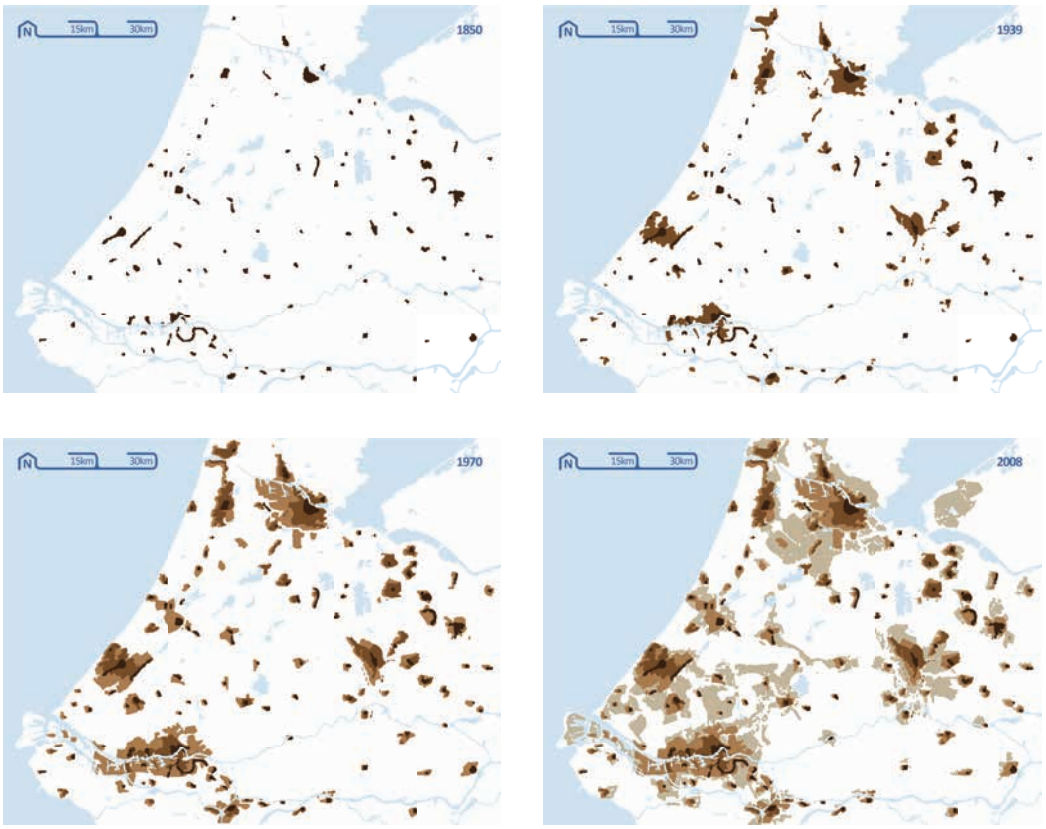
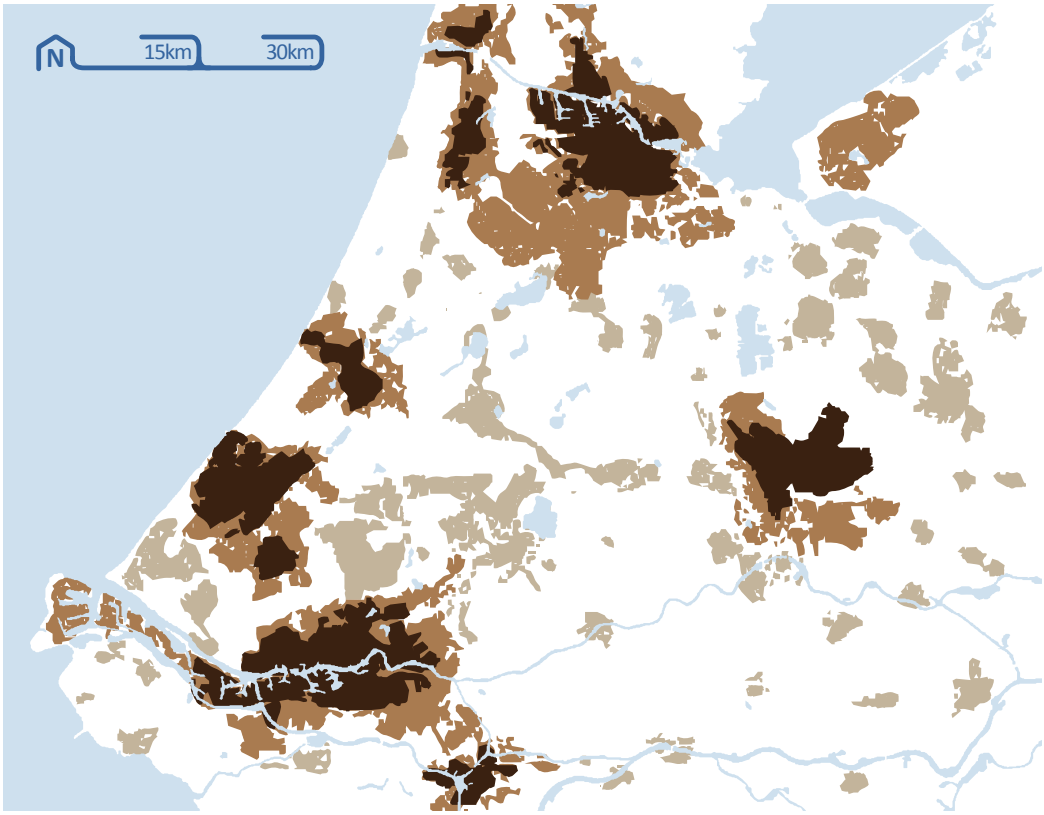


Figure 1.6 — *The typology of the different urban settlements within Randstad (Netherlands)*



The consequence of this process is that today, Randstad is home to about six million people who live in a large number of medium-sized cities and even larger number of small towns and villages. This defines a regional structure which has a ploycentric appearance and highly depends on commuting between the urban, sub-urban and rural areas (OECD, 2007). In order to facilitate a brighter future of this urbanised region, a considerable attention should be paid to the improvement of the performance of the large cities as well as the small towns and the efficient connection between them. Within the perspective of sustainability very often the impact of the semi-urban and rural areas in equation is being underestimated. However, in the case of Randstad these structures seem to be fairly essential for the sustainable prosperity of the region.

Row houses in the Netherlands

In order to outline representative features of the urbanisation within the Netherlands it is necessary to delve into more specific characteristics of the Dutch lifestyle and housing typologies. According to Eurostat (2011) 61.2% of the residents in the Netherlands inhabit semi-detached or row houses, more than any other European country e.g. six out of ten Dutch (see Figure 1.7). This defines the row house as a typical example of a Dutch home. In respect to this report the professor at TU Delft, Kees Dol states 'the row house is part of the Dutch culture; there is a large market for apartments and flats in the country but the majority of the people prefer to have a house with a garden' (Dol, 2013).

Figure 1.7 — *Graph indicating the percentage of residents who inhabit the certain typologies in the Netherlands; Data: Eurostat (2011)*

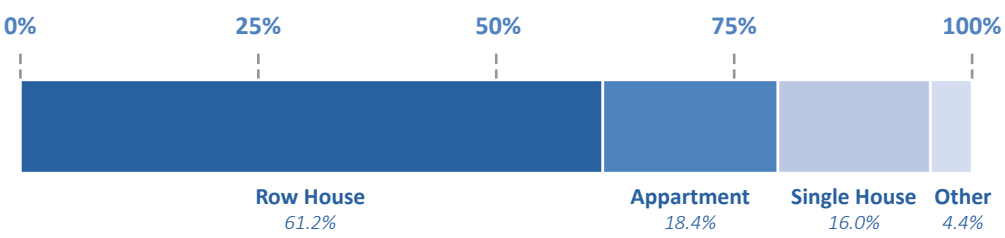




Figure 1.8 — *The typology of the row houses represents essential part of the urban fabric within both urban and rural areas in the Netherlands; Photo Credit: www.domica.nl*

Furthermore, the row houses in the Netherlands also make up 42% of the current building stock. Interestingly enough, approximately half of them have been built as a response to the post-war shortage that required fast, inexpensive housing solutions for the pre-dominant middle class in the period between 1946 and 1965. This represents the total number of 1.4 million post-war dwelling which do not satisfy the present-day demands mainly in terms of energy efficiency (Heijneman & Ham, 2004). Indeed, the substantial amount of existing energy inefficient houses from this typology represents a massive challenge in front of Dutch planning as well as a mass market for the application of a possible technological solution which then can have an essential impact on the sustainability of Dutch urban, semi-urban and rural areas.

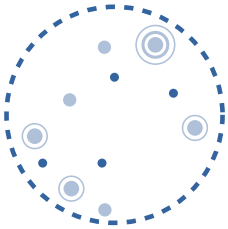
Figure 1.9 — *Emotional Bond*



Case selection

The previous paragraphs outline some main notions regarding sustainability, on the basis of which strategic interventions in the contexts of the Netherlands can be undertaken with the ambitions of contributing at local, regional, national and even global scale. However, in order to develop a design strategy that can be applied in practice a suitable urban context should be specified utilising the aforementioned assumptions that pre-determine three major criteria for case selection:

Figure 1.10 — *Small Town within Randstad*



(1) a location where the emotional bond between the urban area and its inhabitants can be explored in detail;

(2) small town located within the boundaries of Randstad and

(3) the existence of sufficient amount of row houses built up in the post-war period (1946-1965).

Based on these three criteria this project addresses the case of Honselersdijk, a residential town (7500 inhabitants) located in the municipality of Westland in-between the greater metropolitan areas of The Hague and Rotterdam (Randstad, Netherlands). More precisely, the team focuses on a neighbourhood where the predominant urban fabric consists of post-war, energy inefficient row houses. Last but not least, we could avail a historical and emotional proximity to the place through a member of our team whose family has been living in one of the houses since the 1960 – shortly after the neighbourhood was built. This connection has provided the team with information that cannot be acquired by glancing at statistics.

Figure 1.11 — *Row Houses*













Figure 1.12 — *Google Earth views zooming on Stompersdijk 10 (above)*



Figure 1.13 — *Aerial view of the Westland greenport and the Port of Europe (right above)*

Background

Honselersdijk is a small industrial and commuter town with a population of 7500. It lies in the south of The Hague as part of the Municipality of Westland, which is one of the main greenports of the Netherlands. Well known for its horticultural industry, satellite views reveal a vast area of green-houses in and around the towns. The area is so large, that the illumination of the greenhouses lights up the night sky on a cloudy night. This impressive yellow glow is visible even from the surrounding cities including Delft. The greenhouses supply substantial amount of fruits, vegetables, herbs and flowers to the local regions as well as the rest of the world due to the proximity of the port of Rotterdam, the largest one in Europe. In addition, the municipality is surrounded by significant natural assets such as the North Sea coast in the west and the attractive natural landscape of Midden-Delflands in the east.

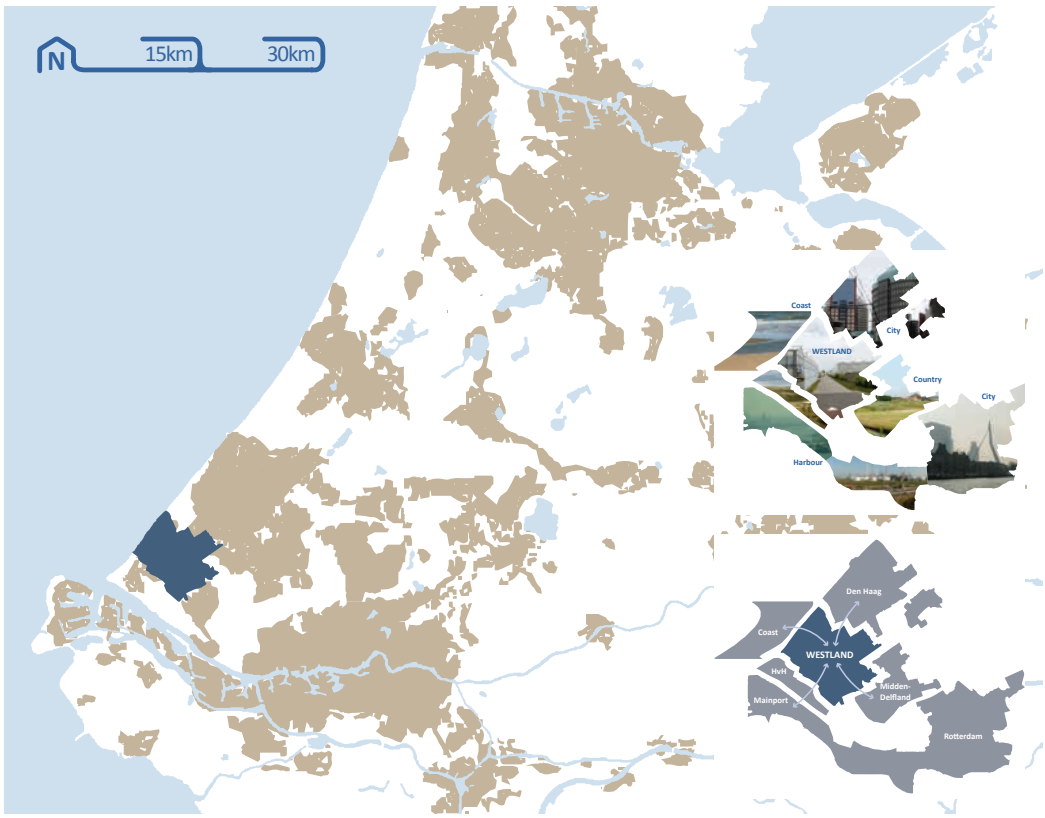


Figure 1.14 — *Location of the municipality of Westland within Randstad*



Figure 1.15 — *Honselersdijk in the seventies. Car use, transportation and the greenport is already significant*

Existing house and neighbourhood

The built environment of Honselersdijk is dominated by row houses since a substantial amount of the urban fabric has been constructed in the post-war period. The building stock varies from different shapes and sizes. In our particular case study within Honselersdijk e.g. Stompersdijk street 5/6 houses stand occupied by residents of various ages, backgrounds, financial possibilities and interests. The neighbourhood represents one of the densest areas within the whole municipality. Typically, the post-war row house neighbourhoods are among the relatively affordable ones and therefore, the inhabitants are from various social clusters including the fairly lower-income ones. In general, due to the functions of the town as a satellite area around the large cities of Randstad South Wing, the car use is highly practical, determining the private motorised vehicle ownership which is approximately 1.35 private vehicles per household (CBS Statistics, 2013). However, the car use is more significant in the context of commuting to the surrounding cities; within the inner areas of Honserlersdijk the vehicular circulation on the streets is considerably lower compared t the alternative mobility modes such as cycling and walking.

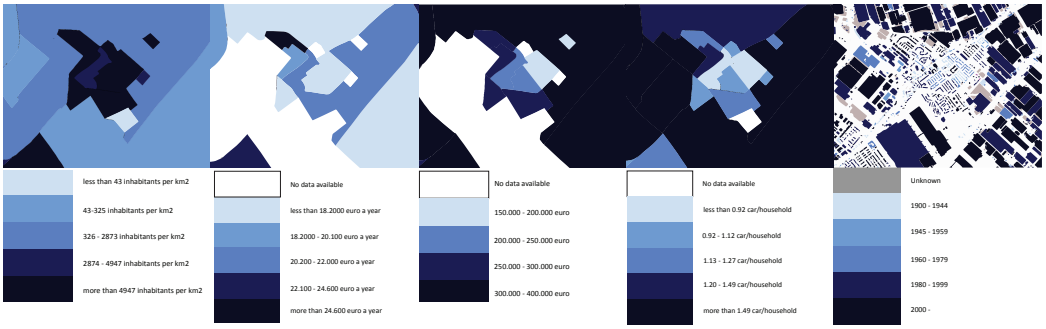


Figure 1.16 — *Population density, income, dwelling price, car ownership and building ages in Honselersdijk (from left to right)*



Figure 1.17 — *The building year of the row-houses stock within Hoselersdijk*





Figure 1.18 — *Street panorama with parkings, the semi-private spaces and Stompersdijk 10*

On the other hand, the purely residential area features a very low foot-fall, which is mainly caused by trips to the supermarket by car, or only walking the dog. But there is potential for much more in the space available. If realised, the separate neighbourhoods could reclaim an extra shared public space that can encourage the encounter and interaction between the residents and transform a street into a community. Addressing specifically the spatial organisation of the case street (e.g. Stompersdijk) some major notions can be outlined. First of all, the street itself has rather excessive dimensions accommodating occasionally passing by pedestrians, cyclists and parked cars. The remaining space between the street and the row houses consists of private front gardens which vary in terms of functions and design. This leads to the assumption that the private owners have considerably different appreciation and vision towards their front gardens in respect to their interest and commitment to maintain these spaces.

Figure 1.19 — *Three generations of IJsselstijn family have grown up on Stompersdijk 10*



Emotional bond

As it was stressed above, the emotional bond between people and urban fabric is a crucial element defining the liveability of particular urban spaces. Unfortunately, this aspect is very often underestimated. The approach of Prêt-à-Loger is to preserve this essential connection and further build up a future upon this great asset. The case study on which this project is developed has been a home of Prêt-à-Loger's project architect Dennis IJsselstijn. Three generations of family members have grown up in the house on Stompersdijk since 1963, the year when the urban fabric was constructed. This provides us with valuable insights regarding the emotional bond between the local people and their homes throughout the decades; details which are utilised as fundamental for the development of a coherent design strategy on local scale. Having this consideration in mind allows the design team of Prêt-à-Loger to project a future vision for the whole area supported by rigorous statements and apply the concept in different cases with necessary certain adaptations.



Figure 1.20 — *Green house facade from the road to Honselersdijk*

Unsustainable food production

Although being a small town in the urban periphery of the large cities of The Hague and Rotterdam it could not be underestimated that Honselersdijk and Westland in general have their impact with respect to global issues of (un)sustainability especially in terms of food production. Nowadays, the global approach towards food production is mainly about money and policies: cheap labour, mass production and national subsidies. This often results in international transportation, even with the Netherlands through its greenports is the second largest vegetable exporter in the world. On the other hand, the country imports substantial amount of the same products from other parts of the globe. The whole market of food production and consumption has led the sector to a situation of high vulnerability to food crisis. What is more, refrigeration, travel time and conditions decrease the food quality in terms of nutrition as well. Ironically, the residents of Honselersdijk who are highly knowledgeable, work in the sector of food production and export their products all around the world are being supplied with vegetables in the same way as everybody in the world - via regular markets and shops where the stocks, very often, are imported from other countries.

Figure 1.21 — *SWOT analysis summarising the main conclusions regarding the existing situation of the selected case*

STRENGTHS

There is an interest in improving homes in aspects such as:
- the amount of space
- living quality
- comfort and costs

WEAKNESSES

Insufficient financial means

Lack of interest regarding sustainability topics

OPPORTUNITIES

Energy savings could be used for investment

Providing experience for people

THREATS

Technological solution needs to be simple

Certainty is desirable

"The adaptation of the existing urban structures and lifestyle is the frontier where the battle of sustainability will be won or lost"

- Dirk Sijmons, TU Delft

1.1.4 'Max Town' concept

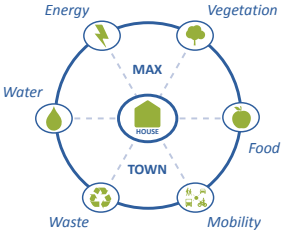


Figure 1.22 — *Concept of 'Max Town' promotes optimal use of the urban resources and future development that balances the food, water, vegetation and energy consumption with minimized waste production and simultaneously connects adequately Honselersdijk with the metropolitan network and economics*

Prêt-à-Loger seeks a solution where sustainability is not just about creating energy efficient and comfortable spaces, it is also about promoting a lifestyle in balance with the environment. Related to the Prêt-à-Loger's Renovation Toolbox an 'Urban Toolbox' is created. This comprises of various solutions the municipalities and residents can choose from including urban gardening, waste / water management features, energy and mobility organisation etc. The strength of this concept is the combined and enhanced performance of the various tools in assisting the development of an approach which can be applied in diverse contexts.

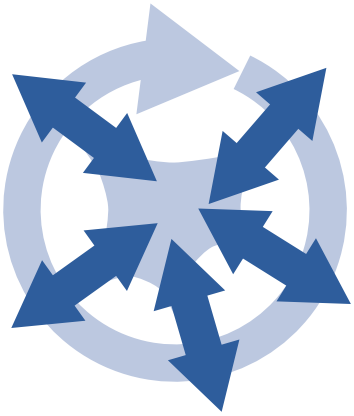
In particular, for the Solar Decathlon Europe 2014, Prêt-à-Loger introduces the concept of 'Max Town'. The idea leads all interventions to reach a certain maximum from energy to food production as well as a minimum in terms of waste for example. Thus, the new green zones to be implemented provide the citizens with food by fruit trees and bushes and various vegetable plants on the ground level. The fact that the region is known for food production is an important reference point that Prêt-à-Loger would like to build on and exploit.

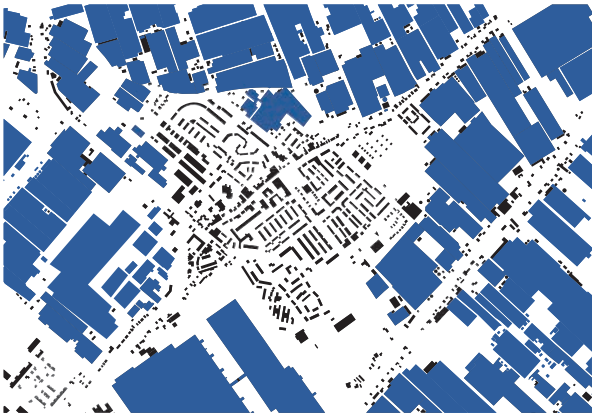
Prêt-à-Loger seeks a concept extending beyond the scope of the Solar Decathlon by attempting to make a real difference on the ground, in the neighborhood where people live. In this sense, the design does not only concern the house but the entire street and the entire block as well. This is where the idea of the Skin comes in. Reduction and reuse of energy, food and water is essential in making a home 'ready-to-live'. The seamless integration of technology such as photo-voltaic panels and glasshouses plays a crucial role in the design of the technological solution on the basis of which the energy self-sustaining unit e.g. house is elaborated in terms of architecture and engineering.

Planning framework

In order to facilitate the aforementioned concept of 'Max Town', the development of a comprehensive planning framework is required aiming to outline the concrete target objectives on diverse scales. The construction of such a framework and creating awareness regarding the conceptual vision of 'Max Town' is the first necessary and essential step towards the formulisation of a workable approach that will guide the application of the proposed design strategy. By paying sufficient attention and effort on this issue the team

Figure 1.23 — *Smart connection between different industry and housing (above)*





Aspects / Scale	Neighbourhood Scale *Small (**S**)*	Urban Scale *Large (**L**)*	Metropolitan Scale *E**X**tra **L**arge (**XL**)*
Energy	**House Skin** *including public and private space*	**Smart Grid** *collection and re-distribution of single energy generators*	**Metropolitan Grid** *regional energy provision and re-distribution*
Food	**Urban Gardens** *private and shared production*	**Urban Farms** *larger conurbation of urban gardens*	**Industrial Production** *utilisation of glasshouses*
Mobility	**Local Network** *motor vehicles access and communal parkings*	**Urban Network** *public transport, sharing (car/bycicle) systems; parking strategy*	**Metropolitan Network** *regional transport strategy connected with the national transport corridors*
Water	**Individual Water Storage** *permeable surfaces and reuse in gardens*	**Collective Water Storage**	**Regional Water Network** *water system flows and locks control*
Waste	**Local Garbage Disposal** *provision of specalised garbage disposal units for private/local waste*	**Collective Waste System**	**Mobility / Energy System Exchange**

Figure 1.24 — *Multi scalar planning framework regarding the concept of 'Max Town'*

would like to emphasis not only on what the future should be, but also how the defined vision could be implemented with at least a modest level of flexibility and generaliseability. Prêt-à-Loger strongly believe that these aspects of the spatial design strategies are crucial for modeling a future which can make an impact to the global battle for sustainability.

Vegetation



In the Netherlands the term Urban Heat Island is not among the most concerning aspects due to the relatively numerous green spaces and surface, water presence in the cities as well as the wind from the North Sea that cleans the urban air. However, in many areas the increase of impermeable surface in the past decades has hampered the local micro-climate. In the rural areas such as the Westland the vast amount of glass surface (greenhouses) contributes to a changed environmental quality both aesthetically and physiologically. Therefore, Prêt-à-Loger initiates the maximisation of green-permeable surface in the open spaces and new roofs in order to attempt the further reduction of air temperature locally and improve the appearance of the neighbourhoods. Vegetation-oriented planning would also lead to the improvement of the regional green corridors, which in the densely paved areas is vital.

Water



The flat Dutch land, metres below sea level confronts several water related problems, from which this concept primarily addresses by improving the surface water level and quality. The western region of the country is built up on two main levels below the sea. The boezem canals are the main water-collectors of the polder system that is responsible of the supply of the mainland and primary collection of rainwater (Figures 1.25 & 1.26). Without crucially intervening with the network 'Max Town' rather focuses on changes of the environment that reduces the amount of rainwater pressing the sewage and polder system resulting in better climate control, increased surface water quality, enhanced groundwater recharge rate and improved wildlife habitat:

(1) Green roof – rain water harvesting

(2) Direct use of rainwater in the built environment (e.g. toilets, garden infiltration)

(3) Permeable hard and soft surface

(4) Surface water collection locally – water as spatial element



Figure 1.25 — *Section of the operation of the water system*

Figure 1.26 — *Main and supporting water system (left)*

Figure 1.27 — *Rain-water harvesting and management on local scale (right)*





On the individual level one house collects 52.5 m^3 rain water from the available 68,3 m^3 annually (rest is absorbed on the roof) from which 29.47 m^3 is directly used in the house also saving 18% of consumed drinking water other than of storm water management. This means that in applying the skin on 25% of the post-war row house stock of Honselersdijk 13,000 m^3 rain water can be excluded from the surface and sewage systems yearly as shown in Figure 1.27. Meanwhile, an additional 5,000 m^3 can be absorbed by the roof vegetation in a year.

Waste

Within the concept of desired sustainability (elaborated in the Market Viability Chapter - see 1.2) the importance of comfortable durability is emphasised. Waste management on the individual level is one of the most important aspects of sustaining lifestyles. Therefore, Prêt-à-Loger seeks solutions for maximising the possibility of recycling from collecting materials and composting organic waste in the dwelling's garden. An average Dutch citizen produces 550 kg of waste per year, while a household of three people in Honselersdijk creates an average of 712 kg of residual and 292 kg of vegetable, fruit and garden waste (CBS, 2014). After collection, the natural garbage is degraded and fermented into compost (GFT, 2014; Bruijn et al., 2011). If 400 kg of compost can be created from 1,000 kg of organic waste, it can be assumed that an average household is responsible for generating 116.8 kg of compost per year. Extrapolating this model it can be concluded that the enormous transportation effects of 512 tons of natural waste could be saved by local composting. This approach holds the possibility of reducing or even eliminating the need for chemical fertilizers in the front and back gardens by the 200 tons compost realized only through the post-war terraced houses (US EPA, 2013; Gemeente Westland, 2014).

In order to handle residual waste, the spatial approach on the street and neighbourhood facilitates collector zones that are comfortably accessible from the blocks and ensure the hygienic and clean storage of reusable and generic household waste. Zones in the flexible open space (elaborated later) are available for local biogas production and collective garbage disposal in underground storage. In the perspective of a multiscalar framework individual and collective waste collection must enable the possibility of transforming garbage into energy on the large scale.

Food concept

Aiming to solve the complex conflicts of food production and distribution Prêt-à-Loger is mainly engaged in the bottom-up direction. Hence, consumer's awareness towards the original and seasonal consumption of fruits and vegetables is being created. Inhabitants are reminded of the negative impact of mass food production while local initiatives are promoted. The improved quality of consumption will be leading to a healthier and thus

happier population. As it grows more rapidly, albeit from a small base, the local food production has a potential to play a greater role in the provision of sustainable food consumption (Saltmarsh, Meldrum & Longhurst, 2011).

Apart from this, the approach is a powerful bottom-up engagement and educational tool which can be utilised as an element of community building while establishing a society in balance with the surrounding environment. As such this urban development feature is capable of optimising the land-use within cities as well as increasing well-being of participants, skills development, and provision of local employment and volunteering opportunities (Budge et. al., 2010; Saltmarsh, Meldrum & Longhurst, 2011).

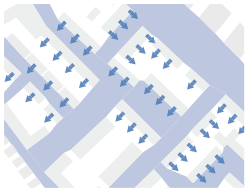


Figure 1.28 — *Placement of the skin maximising solar irradiation*

Energy concept

Prêt-à-Loger addresses resource efficiency onto the urban level driven by the individual transformation. The team's urbanism concept is building up a completely special dual process where the top-down and bottom-up initiatives coexist and enhance each other. Prêt-à-Loger believes in a future where sharing resources will be the basis for the establishment of balanced and cohesive communities instead of reinforcing the competition between the different social classes that leads gradually to a more social as well as spatial segregation in cities.

On contrary to the usual approach, Prêt-à-Loger develops the house and its street together in a well-framed concept of an energy positive food-producing city. This very well defined town concept is later being added to the regional context where a sustainable mobility framework is tailored in the metropolitan region (Regio South-Holland). The

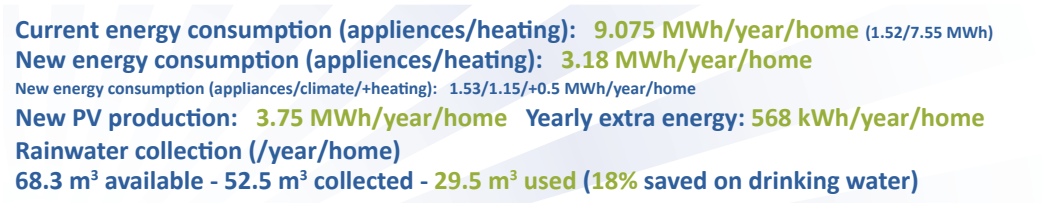
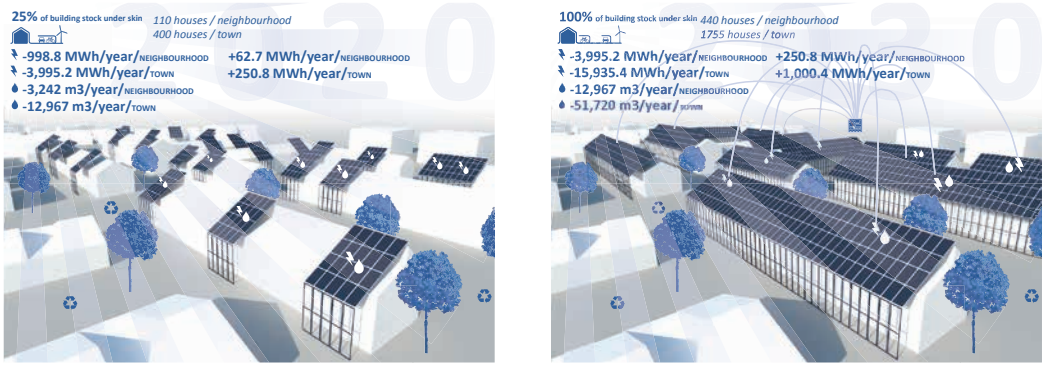


Figure 1.29 — *Energy neutralisation of the individual house*



Figure 1.30 — *Energy neutralisation on neighbourhood scale where 75% of the building stock implements the technological improvements (projected 2025)*

Figure 1.31 — *Energy neutralisation on neighbourhood scale where 25% (2020) and 100% (2030) of the houses execute technological adaptations*



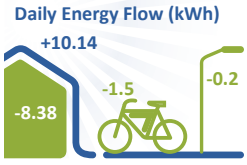


Figure 1.32 — *Support for the streetlights and electric bicycles by the skin's produced energy*

strategy relies on individual adaptations of the building stock in order to reach energy neutralisation impact on the urban scale. The individual neutralisation concept is based on the introduction of house skin equipped with solar PVs. Since this design is explicitly climate performance driven, the orientation of the skin in respect to the house is pre-determined on it geographical position (establishment on the South, East or West facades) in order to maximise the solar irradiation and energy production efficiency respectively (see Figure 1.28). Further details concerning this structure is developed in terms of architecture, engineering and market feasibility in the other chapters of the manual.

The current average energy consumption of a single household is 9.075 MWh per year from the national grid serving the domestic appliances and heating demands. According to the team's estimation, by introducing the technology of the dwelling's skin, a single house can self-sustain its energy demands and even support different systems as shown in Figure 1.29. Driven from a daily basis, the Skin can supply at least one electric bicycle considering full charging every day (0.3 kwh for 5h) and the respective street light (0.6-0.9 kwh/pole/day shared with 3-5 other dwellings).

On the larger scale three scenarios assume different degree of the concept implementation on neighbourhood and urban scale (from 25% to 100% of the building stock, projected for the period 2020-2030). This determines the adaptation of 110 to 440 houses on neighbourhood scale and respectively 400 to 1,755 dwellings within the whole town of Honselersdijk. Considering these possible amounts, the reduction of neighbourhood's needs from the national grid can reach 3,995 MWh per year. On the other hand, Honselersdijk's capabilities can reach 15,935 MWh reduction in complete energy need.

In conclusion, 1,755 households (row house blocks), the respective streetlight system (residential and commercial streets as well) and a fair percentage of the future mobility system can be energy self-sustaining by solar production. These numbers illustrate the powerful impact of the proposed concept if aggregated on a larger scale. For full description of the summarised estimations see Figures 1.29 - 1.31.

Figure 1.33 — *Vision concept regarding self-sustaining future*



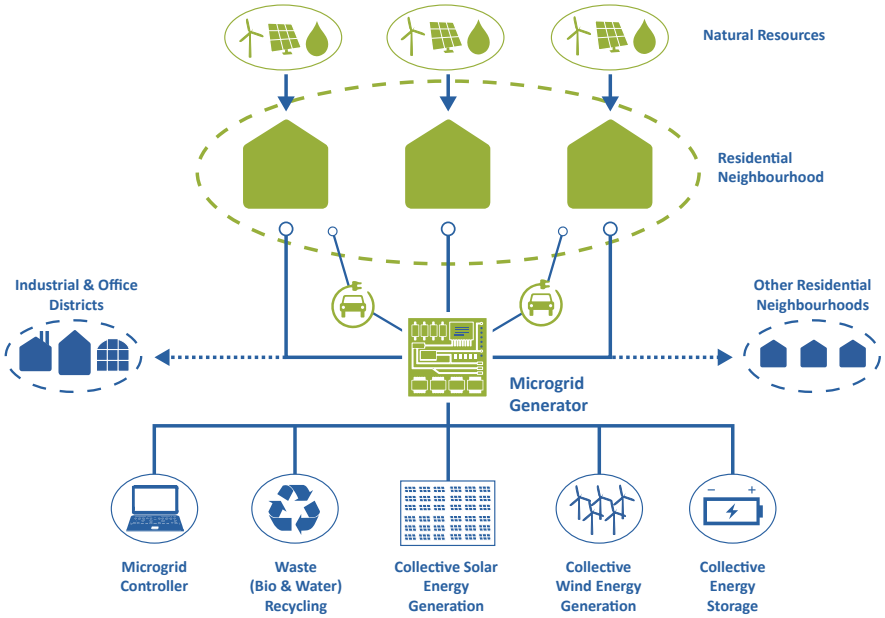


Figure 1.34 — *Distributed energy generation concept*

Distribute energy generation network



Figure 1.35 — *Energy network*

According to Prêt-à-Loger's beliefs, it is beneficial to have energy neutral buildings for the society but this does not seem sufficient. On the basis of the energy self-sustaining houses the team aims to create self-sustaining streets and neighbourhoods which will be part of a collective energy grid. By doing so Prêt-à-Loger would like to promote distributed energy generation, storage and re-distribution where local residents will be actively involved in the production and management of the electricity.

The major motivation underlying in the establishment of decentralised, renewable energy technologies is that they can be located closer to the demands. In this way the distribution and transmission costs and consequently energy and capacity losses are reduced (Lovins, 2002). In addition, since solar panels produce energy during daytime, they reduce the need for energy generation during peak hours, which is more expensive than the base load energy. The purpose of this concept is to invoke public awareness and shared responsibility regarding energy production and consumption. By utilising this approach teams's long-term vision seeks for neighbourhoods which will be relying on local energy grids that all together can service larger areas and even whole cities.

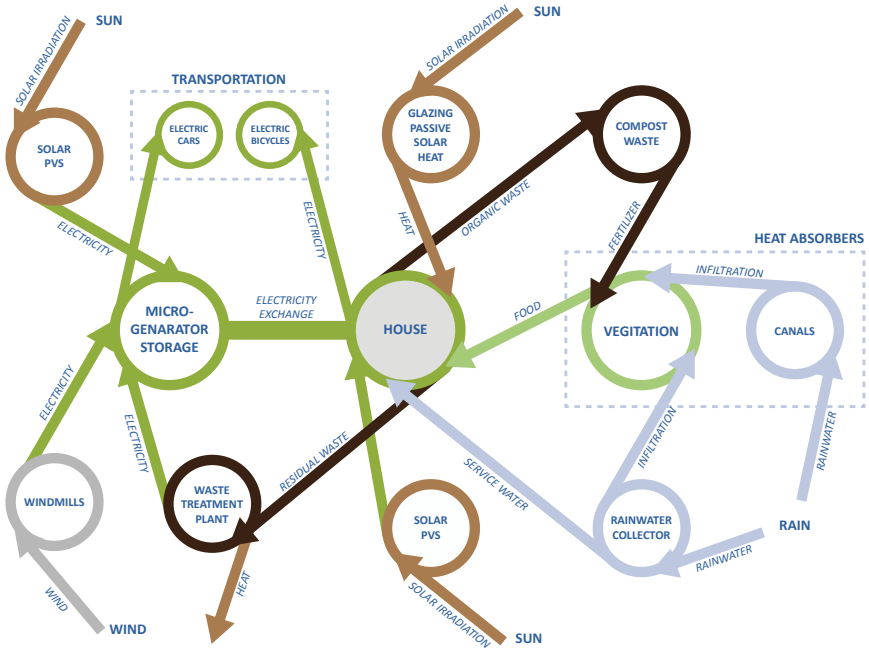
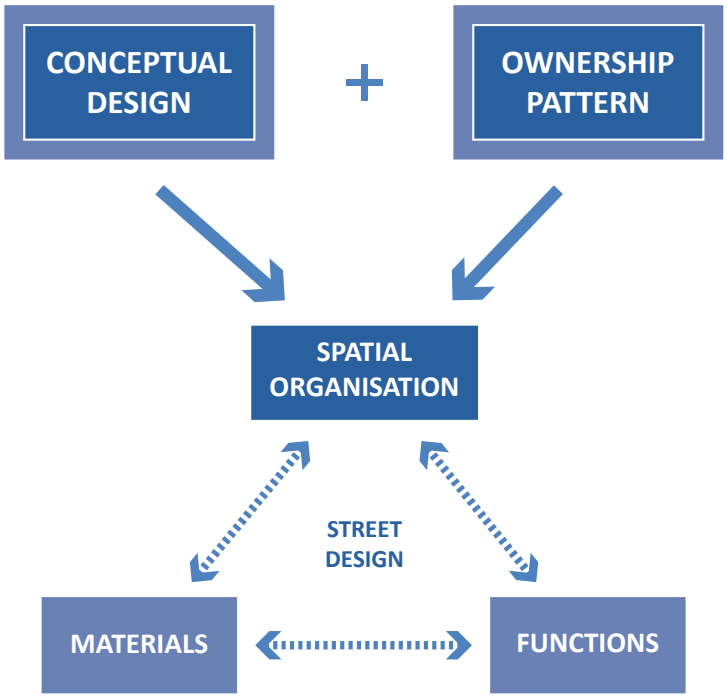


Figure 1.36 — *In particular, the presented 'Max Town' concept aims to establish a feedback loop where the incoropared major elements in the design framework could support each other as illustrated in this figure*

1.1.5 Urban design toolbox

When speaking about urban planning and design issues, one of the major shortcomings of the current practices is the strict designs that professionals produce lacking flexibility in terms of physical and functional aspects. This restricts to certain extents the possibilities for adaptations by the users and, respectively, hampers the general utilisation of the urban spaces. Accepting this issue as a starting point Prêt-à-Loger has developed a parametric approach determined by the freedom of inhabitants' choices for executing and implementing local designs. Furthermore, the incorporation of the urban toolbox within the planning framework, by outlining certain design aspects, aims to achieve positive sustainable impact in a long-term and on large scale. It is important to clarify that the following toolbox elements provide only a general structural framework for plausible street design where major considerations are defined by top-down actors. In the end, the decisions are made by collaboration with local residents. Four major sets of toolboxes are identified: 'conceptual design', 'ownership pattern', 'functions' and 'materials'.

Figure 1.37 — *Parametric design framework*



Conceptual design

Essentially, the outcome towards which the different toolboxes collaboratively lead is the creation of a street design that satisfies both local citizens and institutional parties. The first means for achieving this final result is the 'conceptual design' toolbox. It aims to establish a scheme based on main design aspects and their variations which have a substantial impact on the spatial organisation of the street. The different aspects could be combined in different variants on a matrix principle and result in diverse conceptual scenarios regarding the street design. Ideally, the decision-making should be an outcome of the local inhabitants' desires and choices in respect to the defined design aspects. In Prêt-à-Loger's case, the latter are (see Figure 1.38):

(A) Motor Vehicle Access – Full (01) or Limited (02) – determining the roads' width;

(B) Mobility Flow – Central Artery (01) or Dispersed (02) – determining the paths' organisation;

(C) Public Space – Collective (01), Scattered (02) or Mixed (03) – determining the location of the public amenities and communal activities.

The significant benefit of this parametric design of toolbox is the possibility for the participants in the decision-making process to realise in advance the impact of a particular preference made on the spatial organisation of the street.

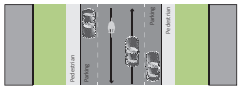
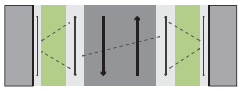
Design Aspects	Variation	Representation	Remarks
A. Motor Vehicle Access	(01) Full		⊕ Easy automobile access and sufficient parking space for the households ⊖ Substantial part of the public space is being occupied by automobiles ⊖ Constant motorised vehicle on the street bringing traffic insecurity and pollution
	(02) Limited		⊕ Provision of additional space able to facilitate extra urban functions ⊕ Enhanced safety on the street ⊖ Loss of the unlimited access and visual control over the private automobiles
B. Mobility Flow	(01) Central Artery		⊕ Clear indication of the mobility flows on the street ⊕ Coherent organisation of the streetscape ⊖ Lack of flexibility of the movement circulation
	(02) Dispersed		⊕ Creation of movement hierarchy defined by paths with diverse characteristics ⊕ Higher flexibility in terms of street's functionality ⊖ Lack of coherence of the street's spatial organisation
C. Public Space	(01) Collective		⊕ Sufficient space for provision of public amenities independently of private ownership rights ⊕ Possibilities for locating public facilities which require larger spaces ⊖ Collective public spaces do not suit the profile / composition of every street
	(02) Scattered		⊕ Do not demand involvement of large amount of actors for their creation ⊕ Generic solution for the provision of public amenities ⊖ Possible visiual and functional conflicts between different residents
	(03) Mixed		⊕ Possibilities for creation of various public spaces in terms of functionality ⊕ A more flexible approach which can be adopted in large variety of streets

Figure 1.38 — *Conceptual urban design toolbox*

01	A01	B01	C01	*Centrally flowed, car-orientated street prioritising collective functions*
02	A01	B01	C02	*Centrally flowed, car-orientated street prioritising neighbouring / individual functions*
03	A01	B01	C03	*Centrally flowed, car-orientated street prioritising mixed functions*
04	A01	B02	C01	*Dispersedly flowed, car-orientated street prioritising collective functions*
05	A01	B02	C02	*Dispersedly flowed, car-orientated street prioritising neighbouring / individual functions*
06	A01	B02	C03	*Dispersedly flowed, car-orientated street prioritising mixed functions*
07	A02	B01	C01	*Centrally flowed, green mobility-orientated street prioritising collective functions*
08	A02	B01	C02	*Centrally flowed, green mobility-orientated street neighbouring / individual functions*
09	A02	B01	C03	*Centrally flowed, green mobility-orientated street prioritising mixed functions*
10	A02	B02	C01	*Dispersedly flowed, green mobility-orientated street prioritising collective functions*
11	A02	B02	C02	*Dispersedly flowed, green mobility-orientated street prioritising neighbouring / individual functions*
12	A02	B02	C03	*Dispersedly flowed, green mobility-orientated street prioritising mixed functions*

Figure 1.39 — *Conceptual design scenarios based on matrix principles between the different design aspects*



Ownership pattern

Another aspect which is important regarding the urban design of the typology of row house streets in the Netherlands is the space destined for private gardens in front of the dwellings. It is impossible to ignore its significance while speaking about the general design of the street and the transition between public and private spaces. Furthermore, in the smaller Dutch towns such as Honselersdijk and rural areas these front gardens are typically large. However, the perception of the private owners in respect to these spaces varies substantially. Some residents demonstrate higher motivation to maintain the yards in front of their houses, whereas others either do not have either the desire or the time to take care of these areas and consider them as spaces for occasional use, mainly sitting.

Based on these assumptions the Prêt-à-Loger's Urban Toolbox includes the possibility for people to lend or loan parts of their privately owned front gardens depending on their personal attitudes. The landowner will keep the potential of utilising the space while at the same time the renter will lose her rights of using the additionally acquired areas if these latter are not maintained properly. This proposal aims to optimise the use of both private and public spaces on the street by creating 'win-win' conditions for the residents as well as for the local government. By implementing this concept:

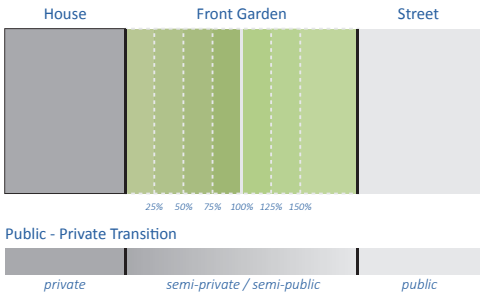
(1) the relationship between people and urban fabric will be enhanced and

(2) there will be possibilities for the provision of new communal amenities.

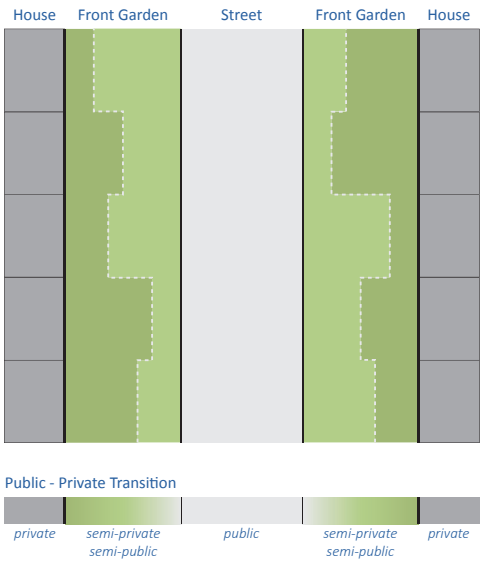




Figure 1.40 — *Photos illustrating the diverse perceptions of the different individual concerning the maintenance of their private front garden*



A. Individual



B. Collective

Figure 1.41 — *The 'Ownership Pattern' toolbox on individual and street scale*

Functional toolbox

The first two toolboxes focus on the spatial dimension of the public space seeking to define the physical organisation of the street design. The next two address the functional aspect of the spaces and their materialisation. For the purpose of the project, a study concerning the use of the front gardens in the Netherlands was conducted in order to create a set of functions which can be organised in a toolbox (see Figures 1.42-1.51). Afterwards these functions can be applied to various street designs on the basis of the local conditions, inhabitants' demands and preferences. The idea behind the development of such a set list is to provide explicit impressions for the residents to imagine possibilities for numerous uses of their street that can be both individually or collectively organised.

Materialisation toolbox

The materialisation of the designs is tightly related to the chosen functions for every particular street. For example, soft surfaces for children playgrounds, green spaces and soil for the food production etc. However, an essential component for the material selection is their sustainability and durability qualities approved by the NL Green Label (see www.nlgreenlabel.nl). In addition, two major principles for the utilisation of the products are defined:

Figure 1.42 — *(left)*
Source: Google Street view



Decorative Garden

Figure 1.43 — *(right)*
Source: Google Street view



Greenery

Figure 1.44 — *(left)*
Source: www.sustainab-lecitiescollective.com



Food Production

Figure 1.45 — *(right)*
Source: Google Street view



Low-maintenance Garden

Figure 1.46 — *(left)*
Source: Pret-a-Loger Team 2014



Sitting Spaces

Figure 1.47 — *(right)*
Source: www.ijreka.nl



Playground

Figure 1.48 — *(left)*
Source: Google Street view



Automobile Parking

Figure 1.49 — *(right)*
Source: Pret-a-Loger Team 2014



Bicycle Storage

Figure 1.50 — *(left)*
Source: Pret-a-Loger Team 2014



Garbage Disposal

Figure 1.51 — *(right)*
Source: Google Street view



Empty Space

(1) Re-utilisation of existing materials within the urban space as much as possible. This underlines a more sustainable approach towards design with respecting the physical fabric similar to the architectural concept of the project (see Chapter 6.5 for more info).

(2) Introduction of considerable amount of permeable materials in order to ensure high water absorption since the water collection has been identified as a main issue within the territory of Westland. In this way the local, small interventions can contribute to the general improvements on a larger scale.

Solid Materials:



Zennewijnen Wienerberger

Paving bricks Zennewijnen Wienerberger are lasting result of the deliberate use of fire, water and clay (proven renewable resource). Natural products with unprecedented longevity, colorfast and durable.



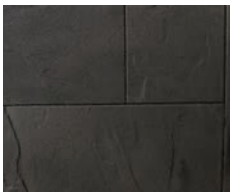
Exclunatura Basic

Sustainable choice in standard paving. Through a specially devised production and use of renewable and recycled raw materials is the standard paving. It is also possible to old concrete pavement e.g. broken tiles or waste can be used again to produce new tiles.



GeoSenza Ardesia Mare

The GeoSenza Ardesia Mare MBI Beton is really a tile on the principle of nature. Mare stands for the sea. MBI Concrete has the shells that are used in the tile from the North Sea. All the raw materials used in this tile comes from Dutch soil.



Geosteen

Each stone has a mineral coating. The color of the top layer is determined by the base material used. Examples of the top layer are sustainable Savile Grey or Solid Black. The production of these tiles are as environmentally friendly as possible.



Greensand Olivine

Greensand half curing the mineral olivine in gravel form is one of the most environmentally friendly substances there is. Olivine is known to bind the CO2. So olivine provides a simple, natural solution to the climate problem.



Bamboo X-treme Decking

Bamboo X-treme is made of pressed bamboo fibers together. It is produced by a special , heat (thermo) undergoing treatment Through this unique process the hardness and stability (shrinkage / swelling) of the material are sharply to a level superior to the best tropical hardwoods, without compromising the environment. The Bamboo X-reme is CO2 neutral over the life cycle.

Green Elements:



Ebony Fruit Trees

Ebony tree nursery specializing in the sustainable cultivation of all kinds of trees, including fruit trees. Good examples of appropriate fuit trees are the quince, apple and pear. The cultivation of trees provides fresh fruits for local consumption.



Garden Boxes

Square foot urban gardening boxes are consisted of 120×120 or 90×90 cm. above-ground wooden boxes. Filled with high-quality soil and divided into square-foot sections they allow optimal spacing between plants to be cultivated.



Ryegrass

Ryegrasses contain some species which are important grasses for both lawns, and as pasture and for grazing and hay for livestock, being a highly nutritious stock feed. Its utilisation mantains the greenery within urban areas with high water permeability.



Fleur Robuste

Fleur Robuste is a full planting concept of Lageschaar Plantations (NL) that helps with the responsible use of perennials in public spaces, parks and large gardens. After planting, the vegetation can sustain at least ten years without high maintenance costs.



Prairie Plantation

The prairie vegetation is a low maintenance planting system where there is a natural balance between the plants. Due to the large variety of plants that can be cultivated this plantation approach is defined by high aesthetic qualities attracting a large biodiversity including bees, butterflies etc.

1.2 Market viability of the product

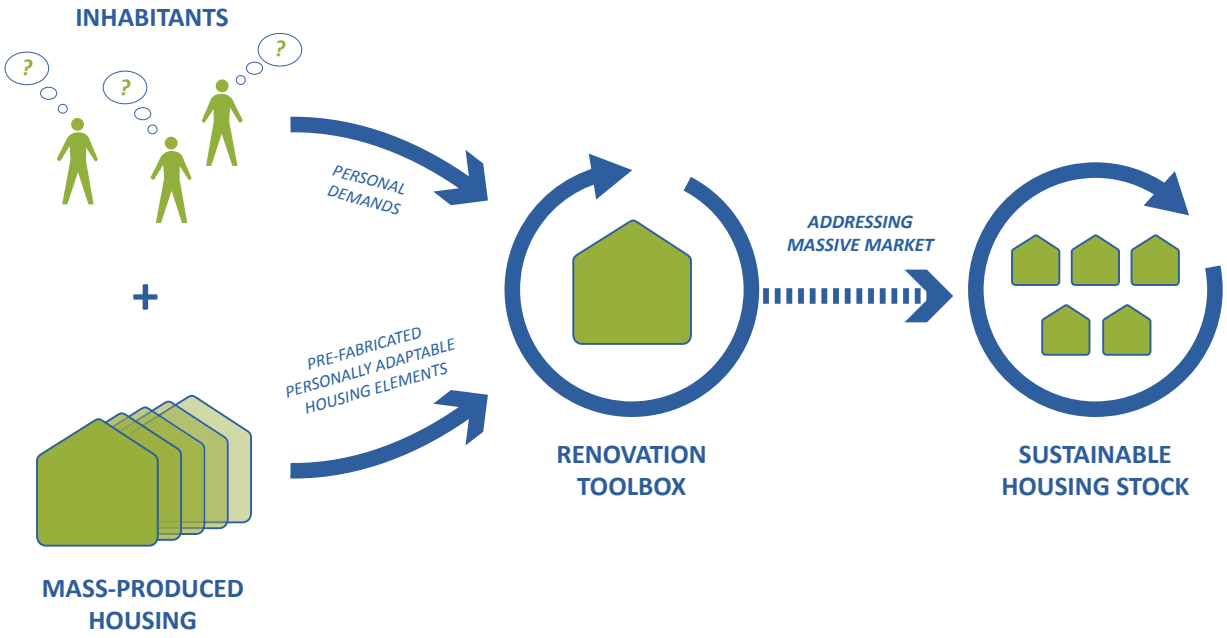


Sustainability has widely become accepted as a matter of undeniable importance. However, there is still little discussion about the gravity of its effects and the path leading towards a more sustainable world, which is still filled with obstacles. A difference can be discerned between the belief that changing the mindset of people towards acting sustainably is the way of reaching a sustainable world, while others argue that sustainability should be about meeting the current and future demands, but in a sustainable way. Prêt-à-Loger adheres to the philosophy that sustainability is dependent on both steering and meeting demand and at the same time to progress at a firm pace. The team's design focuses on the problems of existing homes, making them not only more sustainable but also improving simultaneously the quality of life. The innovative design and the quality that it provides will then ignite an interest for sustainability from its inhabitants. This chapter focuses on the issues regarding who lives in row-housing, what the demands of the inhabitants are, what characteristics these houses have and finally how Prêt-à-Loger can meet the diverse range of demand and supply seen in everyday life to achieve our ambition of a more sustainable world.

1.2.1 Market

When designing any product the first thing to take into account is the end user demands and the end user characteristics. This sub-chapter explains the broad spectrum of people and desires Prêt-à-Loger can serve with a flexible and adaptable design. Prêt-à-Loger has targeted the inhabitants of row-housing, as they make up 60% of the Dutch population. When considering our ambition of making a contribution to a more sustainable world, it seems logical to address housing that provides a roof for the majority of Dutch citizens. The ambition of the project is to take into account something as personal as an individual home and develop a single product, i.e. Renovation Toolbox, that would be able to transform a majority of houses by incorporating inhabitants' personal requirements. In the case of row-house typology this approach addresses a massive market in the Netherlands which accommodate more than 10 million people in the country and, respectively, could contribute substantially to the establishment of a sustainable housing stock on a large scale if successful. However, it seems to be a senseless and

Figure 1.52 — *Conceptual market approach*



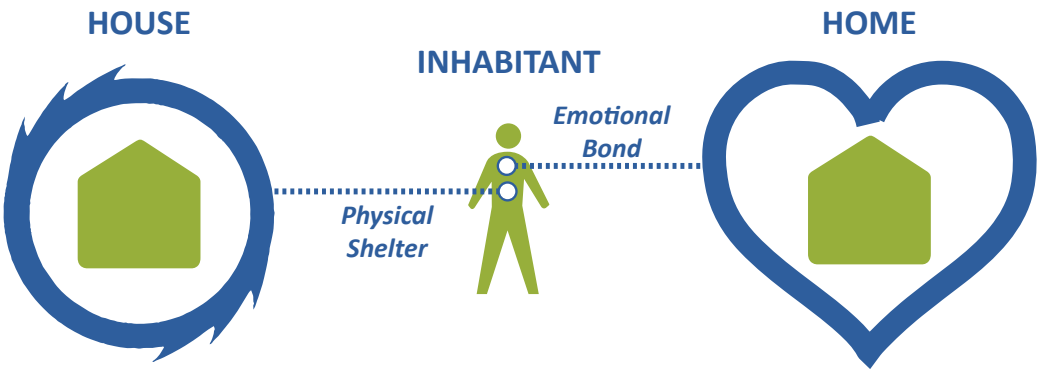


Figure 1.53 — *Conceptual connection between an inhabitant and a dwelling*

impossible task to identify a particular range of people who inhabit the row-houses in the whole Netherlands. In order to deal with this challenge Prêt-à-Loger focuses on the common ground of Dutch residents on the one hand and what factors make each inhabitant unique on the other.

Everyday life, a house and a home

When discussing the potential market regarding Prêt-à-Loger's proposal it is important to specify the connection between the major objects of project's interest: (1) the dwellings that the team aim to renovate and (2) the affected population, potential buyers of the design. There are two essential functions these dwelling have: a house and a home. The house as a technical shell, providing shelter and a controlled climate, has a considerably different meaning than the home as a place of emotions, an environment within memories are born and relationships are formed. The house is place where a person can safely go to bed and sleep; where one can store her belongings and has private comfort when desired. The house functions as a central hub in daily activities such as going to work, going to school or taking care of the house, meaning that almost every day will start and end under the roof provided by the house. The home, on the other hand, is about the people and the emotions under that same roof provided by the house. A home can be an environment where people share with their families and beloved ones; a surrounding where after a long day at work or school they can relax and unwind in the instilled security provided by what is called a home.

The inhabitants of Dutch row-housing

A broad range of cultures, a broad range of ages and even a broad range of incomes define the people inhabiting row-housing. The Netherlands has about 16.8 million inhabitants, according to the central bureau for statistics (CBS) this number will rise to an estimated 17.8 million in 2040. Around 10 million of these people are between the 20 and 65 years of age and another 2.8 million elderly above the 65 years. The average household contains 2.2 persons which means that the Dutch households counts up to almost 7.6 million households (CBS, 2014). Aiming to achieve the sustainability housing goals outlined by the European Commission the local residents need to be motivated towards sustainable renovation of their homes and incorporating technical solutions which can ensure meeting these ambitions. First of all, it is crucial to understand the underlying motivation for renovation within the socio-cultural context of the Netherlands.



Figure 1.54 — *There is a large variety of residents who inhabit the existing row-houses stock*

Motivation for renovation

For Prêt-à-Loger it is important to realise what can motivate all these inhabitants to renovate their homes. Platform 31, a department of the Dutch ministry of Interior and Kingdom Relations, has devoted itself to stimulate developments that make the housing market sustainable. In executed research by the organisation a randomly assigned group

Figure 1.55 — *The positive (left) and negative (right) emotions of the inhabitants associated with their houses* (Kleijn & van Leerdam, 2013)



of residents (Kleijn & van Leerdam, 2013) is analysed on the concept of energy neutral house which would be payed by a cash-flow that previously went to their energy bill. The inquiry particularly aims to identify the positive and negative emotions related to renovating their homes.

The results illustrate that the increase of usable space is outlined as one of the most important factors worth improving inhabitants' existing housing along with a general enhancement of quality, comfort and reduction of energy costs. On the other hand, negative emotions refer to aged aspects of the dwelling such as wall decorations, kitchen and bathrooms and maintenance of roofing, for example. Furthermore, neighbours are seen as a problem due to privacy aspects in the garden and dysfunctional noise insulation. Climate problems such as draft and moisture are also considered as a major problem (see Figure 1.55).

In addition, on 22nd March 2014 Prêt-à-Loger organised a public consultation with local residents of Honselersdijk (for more information: *www.pretaloger.nl/pictures/honselersdijk-event*). On this event, a workshop with random participants, e.g. inhabitants of row houses, was executed. A selection of cards representing various values such as sustainability (ecological & financial), neighbourhood community, space, maintenance etc. were arranged by the participants in respect to their personal priorities concerning eventual renovation (see Figures 1.56 & 1.57). It is fair assumption that the collected data is not representative for millions of home-owners within the country because of the limited amount of participants. However, the majority of the interviewees have shown a considerable interest in the concept and appreciated highly the possibilities for personal choice and the ease of its implementation in practice:

> *"I would love to have more space to eat outside, just like in the glasshouse"*
>
> *"I would like to be more sustainable but i do not have the time and energy, I like the idea of not really having to put in much effort and enjoy the benefits"*

Figure 1.56 — *The project's values prioritised by residents in Honselersdijk (left)*

Figure 1.57 — *Receiving local feedback regarding the design of Prêt-à-Loger (right)*





Motivation for sustainability

Due to the financial crisis there has been much greater emphasis on renovation over the past few years, especially in Europe. During this period the number of governmental subsidies has also dropped because of the lack of public funds. The amount of private income available as a surplus on normal expenses by inhabitants is also hardly present. This implies the notion that in order to get residents towards desirable improvement of energy efficiency a more complicated motivational approach than simply subsidising should be developed.

A study of van Hal (2011) shows that the focus on energy efficiency of building professionals is primarily about technical and financial attributes. The impact of aspects such as image, architecture, communication and a demand-oriented approach towards the target group is often neglected because of the limitation for implementing a considerable impact. Van Hal (2011) concludes out of several articles that there are several do's and don'ts in relation to sustainability and motivating people (see Table 1.1).

Do's	Dont's
☑ *Take consistently the existing interests and fascinations of the parties as a starting point*	☒ *Money is very important. Especially lack of money. However, do not assume that money is always the decisive factor. Other factors may also play a major role*
☑ *Provide as much certainty as possible*	☒ *Do not mainly emphasize the interest for the common good (the contribution to an improved environment in particular). The interest for the common good is for most people only secondarily a motivating factor*
☑ *Make a careful distinction between target groups (make programs 'custom')*	☒ *Do not assume that people think and act rational economic*
☑ *Strive for simplicity and action perspective*	
☑ *Provide (a limited amount of) choices*	
☑ *Ensure that the parties involved in the campaigns are seen as reliable by the audience*	
☑ *Strive to give many possibilities for the audience to experience the offered measures and their impact*	

Table 1.1 — *Setlists of do's and dont's in relation to sustainability*

In particular, the information, summarised in Table 1.1, illustrates that if people are provided a clear idea which can be adaptable on the basis of their preferences, allowing them to incorporate individual's input renovational practices tend to be considered as more desirable by the inhabitants. Indeed, the Prêt-à-Loger's design approach relies firmly on this assumption. In order to understand the cash-flow that is available for a sustainable renovation in the following paragraphs the manual describes the average Dutch population and at the amount that can be saved from the energy bill.

Available income and energy expenses for the average Dutch household

In 2010 the average expenses of a Dutch household were 31,497 Euro while the average income of a household was 33,200 Euro (CBS, 2011). This numbers illustrates clearly that during the years of economic recession the average household does not possess a sufficient amount of available financial resources to invest in their home without making concessions in other areas. The difference between expenditure and income, 1,703 Euro, is generally saved. However, Prêt-à-Loger believes that a partly share of these funds can be also used to invest into your own house instead of storing them in a saving account.

On the other hand, the average energy bill in the Netherlands is 1,900 Euro (Milieu Centraal, 2014). When the cash-flow, previously given to the energy supplier, could be redirected towards investing in an energy neutral home new possibilities open up. In case of

the renovation would be energy efficient a substantial saving and thus possible investment is provided. Prêt-à-Loger's ambition is to emphasise that the spared funds in long-term future should be considered by the inhabitants as available investment resources.

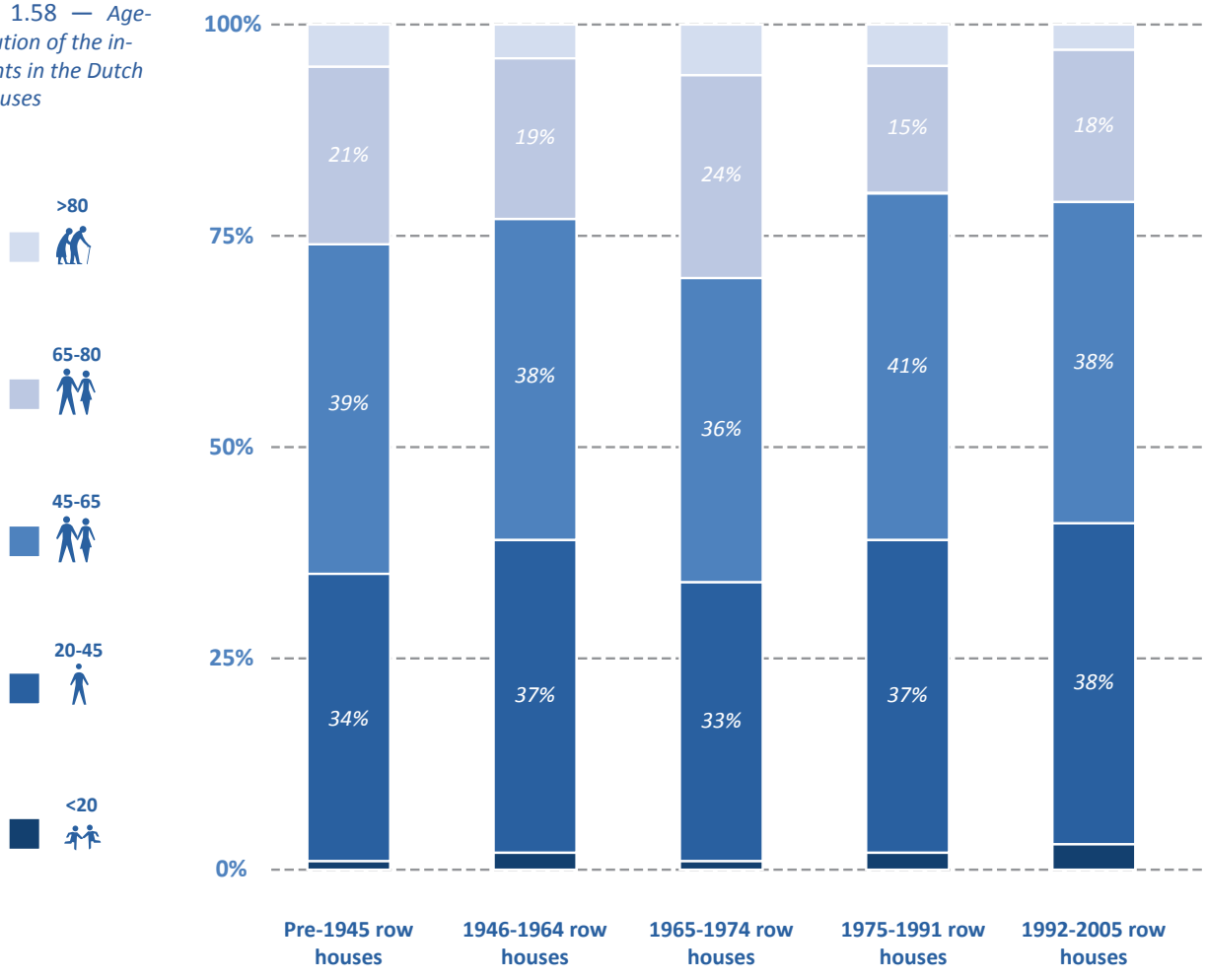
Age structure of the average Dutch population

Another factor influencing the target market of the project is the age distribution of the row-house inhabitants. As it was already mentioned the large scope of the population who resides within this typology makes it difficult to specify a particular target group. Therefore, this observation adopts as a starting point the statistics concerning the holistic demographic profile of the Dutch residents. In recent years the age structure of the population has changed (CBS, 2011). It seems that the relative amount of youth has halved over the past 20 years. The amount of elderly has doubled from 6 percent to almost 15% at the same time because of the enhanced health care standards. The average age expectation has therefore raised past 57 year with almost 8,5%. This could mean that demands specific for elderly have become more important. Besides general information it is also needed to look as specific demands of sub groups. In order to make the range of inhabitants more tangible an analysis outlining several age groups of inhabitants and their characteristics is presented (see Figure 1.58).

Inhabitants younger than 20 years

This target group mainly consists children and young adults living with their parents. Typical daily activities are playing, inviting friends over and making homework. They will not make renovation related decisions but their parents can make decisions such as safety measures for really young children or sound insulating doors for teenagers.

Figure 1.58 — *Age-distribution of the inhabitants in the Dutch row-houses*



Inhabitants between 20 and 45 years

The population between the 20 and 45 years can be seen as one of the main target groups. Because the range of 20 to 45 is relatively large, this population can also be divided into several smaller groups with different needs. First, some requirements that can mostly not been found in the other age groups will be shown. These requirements are generally applicable for all groups within the range of 20-45 years:

(1) Because this is the major working share of the Dutch population, this group has to be able to work also at their home since the new flexible working environment is introduced more often by companies in the Netherlands.

(2) This age group can also been seen as the technological generation. Many people in these ages have gained much knowledge around technological innovations. The usage of electronic devices is for them not a very big step to undertake because they are relatively quick learners.

(A) Starters/single person household



This group just entered the housing market and does not possess a substantial financial capital. Most of them rent their home and spent most of their personal time at their workplace in stead of home. The dwelling comfort is not considered as the most important requirement. Howover, this group can generally be more interested in sustainability as they grew up with the ideology seeking the sustainable world. Much of the starters are in some sort of entrepreneurial business they set up their own. Eventually this starts at their home as small working office and moves if they business grow. Thus, the possibility to have flexible space is very important quality as criterion for their home. The stay in this office has to be comfortable and provide the opportunity to invite a business client into a nice atmosphere in your own house are among the requirements in repsect to this target group.

(B) Two person household

This population group may want children and stay, may be leaving because possible lack of comfort or space or want to improve their home. If they are already sustainable minded and are willing to invest, the solution proposed by Prêt-à-Loger could be an attractive option. For this target group, many of the aforementioned requirements regarding the starters overlaps.

(C) Young family



For this group, the lack of space and comfort can aggravate their annoyance about their house. They want to give their children's room to play and grow up and because of the children, most of the people stay at home more often. If they spent more time in a lacking comfort zone, this shortage can result in serious discomfort for this group which could eventually result in a decision for moving to another place.

(D) Middle-aged family with adolescent children



The representatives of this target group often already lives in these dwellings for longer time and is more unlikely to move out. They tend to keep in mind that their children could leave and live on their own in few years. Financially much more is possible than, for instance, a two person household. Also this group is still young enough to understand the importance of sustainability for the future.

Inhabitants between 45 and 65 years

This population range is at the last stage of their career. Therefore, most of the families are splitted and the parents live with two right now. Financial opportunities are possibly getting greater and so their desire for a new or improved house. In this case, the residents tend to start considering what their house can provide for them after retirement and maybe even what happens when the house is inherited by the children.

Inhabitants between 65 and 80 years

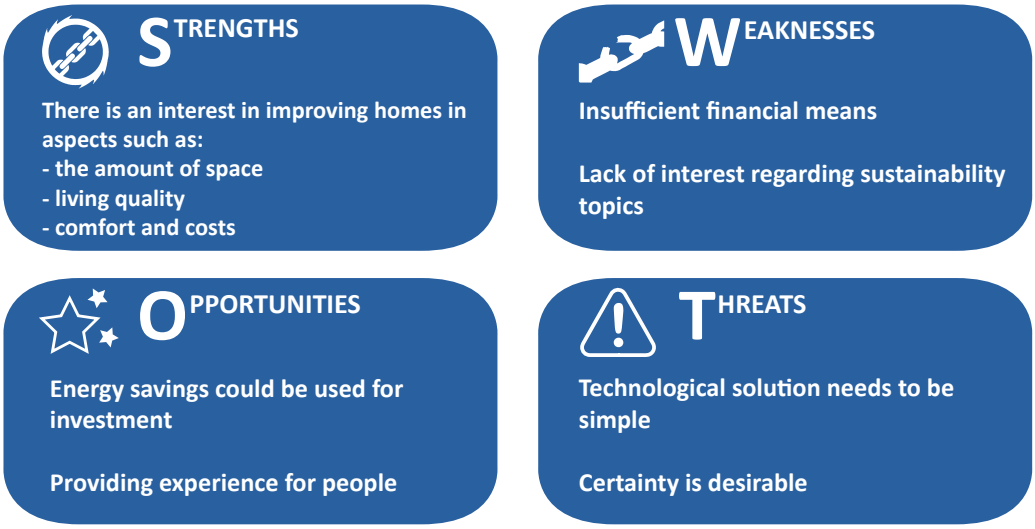


This age is referred as elderly. The statistics shows that the elderly increased relatively to the less aged population (CBS, 2011). This increase is due to the baby boom after World War Two and the gradual enhancement of the health care system. This tendency is projected to grow stronger by time. In 2011 the population above 75 years was around 1,1 million, while in 2040 this will increased to 2,5 million people. This will definitely result in increased demands for houses. In addition, this generation is partly raised in the dwellings used in this project. Therefore, they sometimes have summed up an emotional relation with their home. This target group can be particularly interested in increasing space and comfort because they will be spending more time in their homes. Furthermore, they will be inviting friends and family over generating the desire for some extra space to sit, as it could be provided by the glasshouse.

Inhabitants older than 80 years

Above 80 years, a lot of elderly are in need of health care and supervision. Therefore, much of this group are forced (due to the necessity of extra conditions) to move out. Although they will be reasonably uninterested in making investments for longer periods of time they might be interested in higher comfort and specific solution for elderly such as the removal of door barriers. These kind of solutions could provide them with a few extra good years in their homes.

Figure 1.59 — *SWOT inhabitants analysis*



Exemplary consumer profiles

In order to specify in a greater detail the rather broad target group of buyers three exemplary consumer profiles are developed. They represent three diverse families which aim to capture the larger scope of the potential buyers of the Prêt-à-Loger's design concept:



Figure 1.60 — *Young and sustainable family with limited finances; Source: www.united-familiesinternational.wordpress.com*

<u>Family I:</u>

The first example is a young and very sustainable-minded family (adults in their early thirties possibly having small children) that takes advantage of all new possibilities. They cannot afford yet their own car and ride the public transport, whose inefficiency is constantly a psychologically exhausting problem. The couple is looking for the possibility of how to have a car still after moving to a satellite town due to affordable housing. In the everyday life garbage recycling and local food production are activities they are interested in since they also want to teach the kids about nature and awareness for their surrounding. They grew up in times of great technological advances; the computer came in their lives when they were teenagers and cope easily with the newest technologicy.

Family II:

The second family represents a middle aged couple with adolescent children and it is an important target of Prêt-à-Loger. Some children may or may not have flown out but the parents are highly conscious about the future. The family does not take particular attention to sustainability at the moment but is aware of the future challenges and ready to take steps when the right opportunity comes. The average gross income per month is around 3000 euros. They drive at least one private car but are continuously keen on seeing some transportation developments for the region especially because of the school-year children.



Figure 1.61 — *Middle-aged family with average interest in sustainability and funds available; Source: www.mywellnesstools.com*

Family III:

The third example models a family or couple over 60 years old. Keeping in mind the third generation of the family they are willing to take steps for a sustainable future but only if it comes in a highly affordable form and by external guidance. However, by now they are tired of the discomfort of the house climate for which reason they consider moving away. One solution they do not prefer due to the memories and habituation of the house and region. Even though, they continue cycling for shorter distances for health reasons, they insist on driving their own car. Some couples are already concerned that giving up the car will result in losing mobility and freedom in the context of the current transport routes. Technology is of little interest as they feel that learning about new technologies is not really of use for them.



Figure 1.62 — *Older family with more financial possibilities; Source: www.realsimple.com*

Row-houses distribution

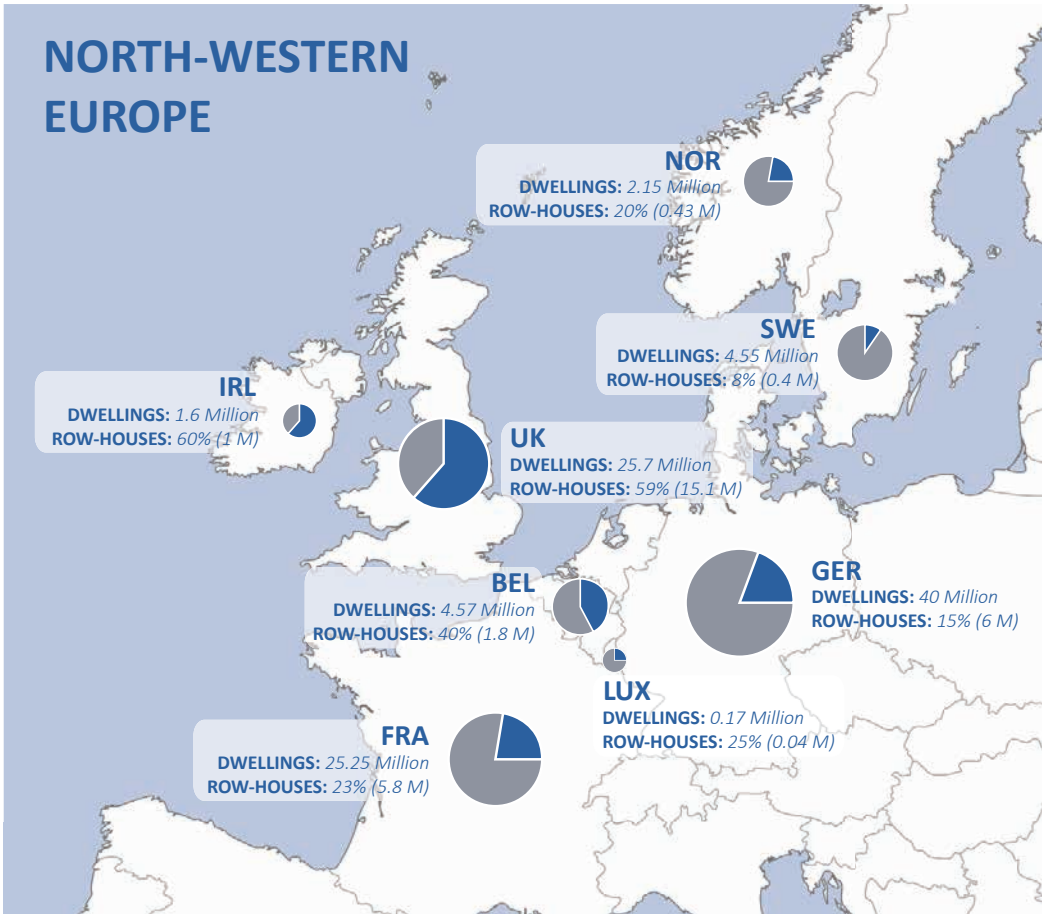
After discussing the profile of the potential consumers of the Prêt-à-Loger's design it is crucial to elaborate in greater details the target market that the project focuses on. Since the design concept addresses the issue of renovating existing row housing supply, the location of the project cannot be pre-determined by the Prêt-à-Loger team but it is rather specified by the geographical distribution of the existing building stock. In this chapter a summary of the locational characteristics of the terraced houses including their amount and main features within the Netherlands is presented.

As it was already mentioned the share of the terraced (row) houses within the Netherlands is considerable in respect to the general housing stock i.e. 42% (see Chapter 1.1.2). A substantial number of this typology has been constructed after the WWII as a cheap solution regarding the great deficit of housing. The Dutch government introduced the row-house as an optimal solution for building the new rise of urban areas, financed by the USA in the Marshall plan. In the total amount of row-houses, constructed from 1946 till 1975 number almost 1,4 million houses (20% of Dutch building stock). However, the terraced house typology is well-represented in the whole North-West Europe region as illustrated in Figure 1.63. Although in different variations the terraced houses are very popular in the United Kingdom and Ireland as well as in some continental Europe e.g. Belgium, France and Germany. This outlines the massive market which the total sum of this typology represents and the large impact that successful interventions with them could have.

Within the Netherlands the major characteristics of the terraced house and their energy performance could be outlined in respect to different periods when they have been built:

"*Thinking of Holland I see long rows of homes in an infinite lowland*"
- Pieter Hoexum

Figure 1.63 — *The share of the row-house dwellings and their total number in the region of North-West Europe; Data Source: Eurostat (2011)*





Total amount of dwellings: 501.000
Usable surface area: 97,8 m2
Total part of housing supply:7,5%
Ownership: 63% privately owned, 21% social rent 16% private rent
Energy label G

Pre-war (before 1946) row-houses

Total amount of dwellings: 669.000
Usable surface area: 95,8 m2
Total part of housing supply:10%
Ownership: 34% privately owned, 61% social rent 5% private rent
Energy label G



Post-war (1946-1965) row-houses



Total amount of dwellings: 654.000
Usable surface area: 106,0 m2
Total part of housing supply: 10%
Ownership: 50% privately owned, 41% social rent 9% private rent
Energy label F

1966-1975 row-houses

Total amount of dwellings: 165.000
Usable surface area: 107,9 m2
Total part of housing supply: 2,5%
Ownership: 71% privately owned, 26% social rent 3% private rent
Energy label D



1976-1979 row-houses



Total amount of dwellings: 469.000
Usable surface area: 98,1 m2
Total part of housing supply:7%
Ownership: 51% privately owned, 39% social rent 10% private rent
Energy label C

1980-1988 row-houses

Total amount of dwellings: 581.000
Usable surface area: 114,0 m2
Total part of housing supply: 10,2%
Ownership: 73% privately owned, 23% social rent 4% private rent
Energy label C



1989-2005 row-houses

From the brief summary of the dwellings from the different periods it can be seen that the amount of newly constructed row houses decreased gradually after 1975. This determines the larger share of row houses stock built before 1980 i.e. post-war period. All these dwellings have an average energy label of maximum D, F or even the lowest label G which defines them as highly energy inefficient buildings. Therefore, these row-houses are considered as a main potential target market addressed by the Prêt-à-Loger.



Figure 1.64 — *SWOT housing stock analysis*

1.2.2 Target Market

In the following sub-chapter an overview of the existing progress and established mechanisms concerning the housing stock development and sustainable demands is presented. An emphasis is put on the main stakeholders including the governmental and the Dutch housing corporations. The latter play a large role in this storyline because of the great amount of dwellings they own. If there is a need for a substantial movement within the housing market, mostly the housing corporations are capable to initiate a similar trend. In addition, the current developments are studied in order to show how Prêt-à-Loger could take its place in the existing market.

Governmental ambitions

For the Dutch society, the government set a deadline for reducing the CO2-emission before 2050 by 80%. This goal has to be achieved by improving energy efficiency, using biomass, capturing and generating energy without direct CO2 emissions. Different Dutch parties (involving investors and companies) have to focus on energy saving investments and a decentral renewable energy-providing sources for their own use. A trias in energetica will be maintained for feasibility, affordability and efficiency by creating and using: energy saving solutions, renewable energy generating solutions and a clean and efficient production of non-renewable energy.

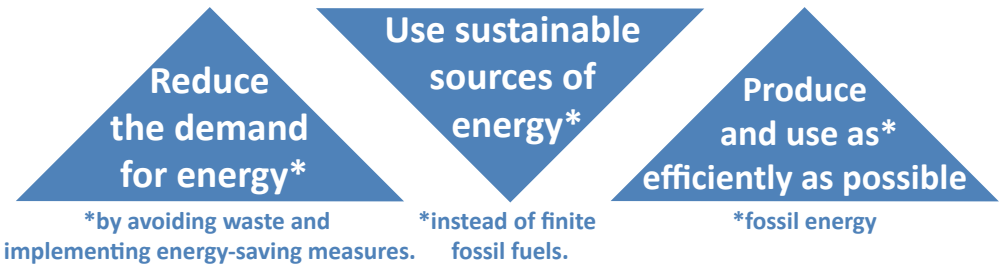


Figure 1.65 — *Trias Energetica concept*

Aiming to achieve the outlined ambitions before 2050 they have been translated into more clearly defined tasks. Concerning the housing sector the following specific tasks are defined:

(1) Every year 300,000 existing dwellings should be improved with two energy-label levels.

(2) All new buildings have to be energy neutral by 2020, for municipality buildings this ambition is set for 2018. All according to EPBD-guidelines (Energy Performance of Buildings Directive).

(3) The average energy label for rental houses has to be energy-label B for social rent, and minimal label C for the private rental sector in 2020.

To help the progress towards the outlined goals the government supports sustainable development in all levels of education, keeping in mind that the students of today are the construction workers and architects of tomorrow. Furthermore, the idea is that the investment in education will also contribute to innovations and more efficient building technology. In an assistance of the previously stated three goals different kind of supportive measures are being undertaken. They vary from little steps (for instance, creating awareness among the population) to massive investment structures accommodating more sustainable solutions.

These supportive measures comprise (BRON: Energieakkoord voor duurzame groei, SER, 6 september 2013):
• Education and guidance, creating awareness;
• Large deployment of smart meters;
• Every house owner or rental house owner will receive an indicative energy label if they have not got one until the year 2014 and 2015. This label will be categorized by one uniform measurement method;
• Sharpening energy performance certificates of buildings. Therefore, finding a better balance between building related and urban area related specifications for the existing buildings;
• Replacement of old systems and other devices;
• Financial help and subsidies for renovating houses;
• The realm opens more mortgage options for Nibud (The national institute for budgeting information) so they can provide help and advice on financial payback structures. In short, their ideas are that with the energy savings, the amount of money usually paid for energy bills will now be available for paying back the investment.

If the goals and this set of ambitions are met, a considerable change could take place and a head start towards a truly sustainably housing stock within the Netherlands.

Housing corporations, goals and problems

During the last decades there has been a shift from government control to market forces that has given many social housing providers more freedom to undertake social activities at local level. This has also challenged the housing organisations to achieve their social objectives with fewer public resources (Nieboer et al., 2012a). Thus, housing organisations have increased the application of business principles in their social housing strategy, in order to become more cost-efficient. This application of business principles, together with the increased focus as a society on sustainability and the slowing down of global warming, made housing associations become aware of the energy efficiency of their housing stock. Housing associations, therefore, have put a substantial effort to sustainably refurbish their real estate.

In the past the only benefit of building's refurbishment was considered to be energy saving (Edmundas Kazimieras Zavadskas et al., 2008). However, it seems that energy saving measures can also improve the entire building's condition and, respectively, increase the living comfort for the residents and the value of the dwelling.

For the inhabitants the energy use and technical improvement are often not the most important reason to opt a refurbishment. It is clear that improvements to the dwelling to reduce the energy costs are in interest of the tenant but a high energy bill is not (yet) seen as a major problem. The daily use and the perception of the home as well as the perception of the neighbourhood are far more important. Comfort, quality of space, social security of the home, the appearance of the accommodation and the directly foreseeable costs are the most essential themes for the residents when it comes to a refurbishment intervention (Nieboer et al., 2012b).

If these houses can be renewed in order to prolong their lifespan, this is not only in the interest of the housing association but also in the interest of the tenant. It happens often that tenants already live for a long time in their current house. They are emotionally attached to their dwelling and have tons of memories linked to their house. Demolishing this building stock is not only unsustainable and more expensive, it also eradicates thousands of memories shared by individuals, families and entire communities. Therefore, the redevelopment of the existing housing stock, with the involvement of its residents is generally an approach which favours sustainable development.

The involvement of residents in the refurbishment of their housing is crucial. The possibilities and the consequences of the renovation should be clear beforehand for the inhabitants. Being able to meet or even surpass the expectation of the residents as a housing association, is often even more important than the outcome of the refurbishment itself (Nieboer et al., 2012b). When a refurbishment takes place, tenants expect a rent increase because if a rent increase does not follow up the refurbishment they feel that the motivation of the housing association might have only been for personal gain. Thus, residents expect to have the opportunity to discuss the measures of the renovation and to be involved in the entire process, even if this involves paying a bit more (Nieboer et al., 2012b).

Current developments in the housing market

In order to see how the goals of the government and housing corporations are being pursued in practice, a study considering the current developments of the Dutch housing market is made and presented in the following paragraphs.

Energiesprong

The innovation program 'Energiesprong' is a project started by Platform31, a governmental organisation, that combines knowledge, science and practice. The purpose of this innovation program is to improve the energy efficiency of the existing building stock. Their core argumentation is that a different way of processing and designing is necessary within the building sector: different demand, better affiliation with supply, more financial opportunities, adjusted law and regulations and a generally new perspective on the subject. The 'Energiesprong' stimulates innovation by searching for specific projects to support. In some cases the ministry finances the distinctive developments after being advised by the 'Energiesprong'. The selection criteria for this type of financing are: high energy ambitions, the size of the project, repeatability and an estimated impact on the renovation practice. Almost all submission for subsidising were done before the end of 2012: for intervention concerning urban area developments, housing, offices and retail projects. In this way the 'Energiesprong' aims to support a large variety of interested actors and ease the relationship between them.



Figure 1.66 — *The major concept of Energiesprong to support the enhancement of the energy efficiency of the existing building stock; Source: www.duurzaamheid-search.nl*

Knowledge and experience sharing

Within the involved skilled parties new knowledge is generated. The 'Energiesprong' facilitates exchange and growth of this knowledge and reveals it publicly. This cognition concerns new understandings, successes, but also learning points, mistakes and failures. Furthermore, the innovation program invent different tools that various organisations can utilise to meet their energy ambitions.

Executed Projects

The 'Energiesprong' has already executed some projects which have brought innovative approaches and stimulated the housing market for further development in the direction of energy efficiency:

- "Lokaal alle lichten op groen" (local lights on green), a program with the goal to stimulate market conditions for energy saving renovations by initiating few experiments in practice. These experiments contain over 120 houses that will be transformed into energy-neutral buildings. The program aims to trigger the active involvement of not only the residents, but also the constructors, government, installers, property managers, banks and many more actors involved.
- "Huis vol Energie.nl", a community platform for house-owners who have the ambition to make their own house energy-neutral. This platform connects them with each other to gain experience and knowledge of their successes and failures. Members of this platform are so called 'Energiepioneers'.
- "EnergielinQ", an online network for professionals in the energy saving construction market. It aims to initiate a constant exchange of experience between the different professionals.
- 'Energiesprong' also finances research in the field of monitoring the energy performace of the building stock. The organisation believes that this activity has a major role within the whole renovation practice.
- Last but not least, the Energiesprong sets up a plan to start energy shops where individuals can use tools to renovate their house within the preferences they have.

Prêt-à-Loger recognises the importance of the developments around the 'Energiesprong'. The team has not only profited heavily from the sponsoring that was provided but also from the networking that the platform provides. It has allowed Prêt-à-Loger to develop ideas and test our assumptions with many parties experienced in the field. In the energy neutral housing environment, created by Platform 31, Prêt-à-Loger can develop further, improves and learns from others' experience as well as provides new information for the platform at the same time.

De Stroomversnelling

The project has been originally initiated by 'Energiesprong' the deal 'de Stroomversnelling' was signed on June the 20th 2013 by four construction firms and six housing associations, in presence of the Dutch minister of housing and civil service. This deal comprises the promise to refurbish 11,000 houses to zero-energy houses. These 11.000 houses are supposed to be the kick start of the refurbishment to zero-energy houses of another 100,000 dwellings. The Stroomversnelling is an ambition to start refurbishing thousands of Dutch row houses in the rental sector in the coming years into so called 'zero energy houses', with an integral approach comprising housing associations, construction firms, consultants, the Dutch government and many more actors.

Zero-energy house

A zero-energy house has perfectly balanced incoming and outgoing energy flows. This means combining energy reducing initiatives in such a way with energy generating initiatives that the net energy usage of the building equals zero. In principles, most households will need more energy in the winter than they can generate, whilst they will be a surplus of produced energy during summer. These energy gaps could be regulated by the general energy grid and the respective provider. Hence, on an annualized basis the energy bill will equal zero. For certain amount of time the housing associations have been trying to refurbish their housing stock whilst improving energy labels from F to B. While many little steps surely aid in reducing the energy usage of buildings, it does not offer sufficient reduction in energy usage to comply with the 2050 energy goals (50% reduction of CO2 emission).

Energy-label improvement

Furthermore, dwellings that have had an energy improvement from a F-label to a B-label are not attractive to further refurbishment during the next years. With the execution of the plans of the Stroomversnelling, energy labels of houses will go right away from F to A, making a considerable leap instead of many smaller steps. This leap ensures more comfortable dwellings, qualitatively better houses and it aids in accomplishing the 2030 energy goals. Basically this business model is possible through the implementation of three ideas: (1) tenants pay their energy costs to the housing association; (2) the housing association invests this money in the refurbishment and (3) contractors deliver sustainably refurbished dwellings, without any energy costs for the tenants.

Integral concept

The Stroomversnelling applies an industrialized approach to the most common dwelling types from mainly the 1950's-1970's. For these houses an integrated concept is needed. The Stroomversnelling starts to develop that concept from a first prototype through testing to a next prototype to little projects and step by step arriving to a concept for the chosen dwelling types.

General Advantages

For the tenants the Stroomversnelling concept is very attractive since they receive their dwelling refurbished going from a relatively bad house with high energy costs to a modern, comfortable dwelling with the same total housing costs. Housing associations can use the cash flows coming from the 'energy bill' to invest in the value of their housing stock and the livability of the neighborhood. They increase the lifespan of their dwellings, reduce future maintenance costs, meet sustainability goals and improve their brand image. Last but not least, by refurbishing the dwellings into zero-energy houses, the housing associations keep the building stock affordable for their target groups and indirectly insure their own income. The Stroomversnelling focuses mainly on rented housing but part of the concept could also be applied on privately owned housing.

Figure 1.67 — *'De Stroomversnelling' deal; Source: www.energiesprong.nl*



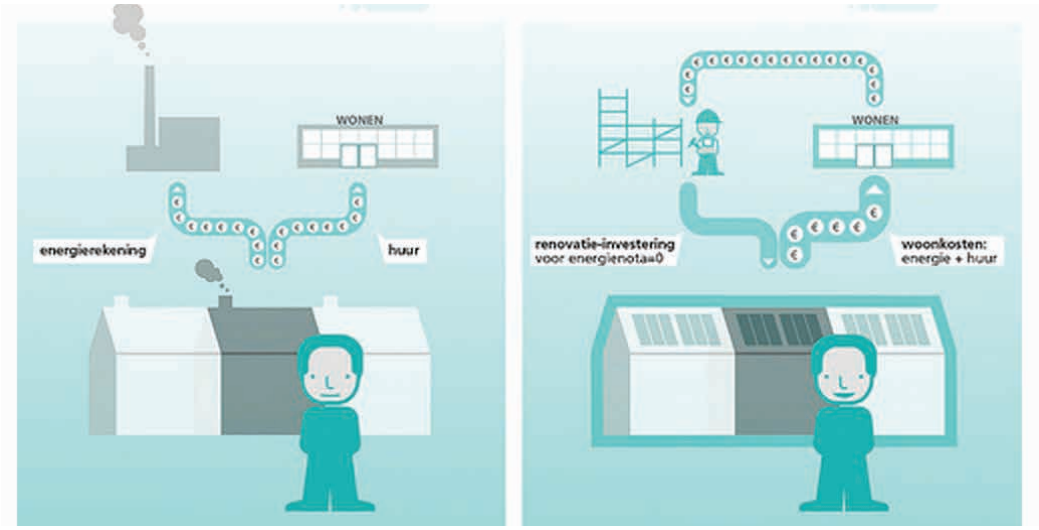
Financial viability

It has been calculated what housing associations can spend when they can capitalize the cash flow of the energy bills. Input for the calculation of the investment space is, based on the remaining lifespan of the building (25-50 years):

- Start value of the building;
- Income consists of rent + energy bills;
- Exploitation costs;
- End value of building.

Therefore, it is an exploitation model that comprises TCO (total cost of ownership). The expected return on investment over this lifespan is 5.25%. With this minimum requirement it is avoided that a finance gap exerts pressure on the investment and thus it is guaranteed that this investment is an economically sustainable one. If the housing association accepts a lower return on investment, for whatever reason (e.g. refurbishment costs decrease), the housing association might decide to lower the total housing costs in the form of a rent decrease. With this investment one can calculate the maximum refurbishment price. The current refurbishment costs are still €80,000/dwelling but it is expected that this will lower over the years as effect of innovation, optimisation and industrialisation.

Figure 1.68 — *'De Stroomversnelling'; Source: www.energiesprong.nl*



The government has set up some ambitious sustainability goals for the Netherlands to accomplish; this will only be possible when all measures are taken serious by all involving actors (meaning all companies but also the inhabitants). For the housing corporations this means that they have to agreed to invest in more sustainable innovations and to make their dwellings more environmentally friendly but if they can make these houses also more durable and let them last longer by the same solution the interest of this group could be considerably increased. Prêt-à-Loger has made a product not only working with the ideas of the Stroomversnelling but becoming part of it. The Stroomversnelling shows the momentum that is currently in the market and at the same time it provides contacts with potential customers and partners. Other solutions currently in the Stroomversnelling improve the technical quality of dwelling but forget to deal with end-user, something Prêt-à-Loger considers to be of impeccable importance.

The building industry

The developments such as 'De Stroomversnelling' have led to several innovations in the building industry. The four prototype dwellings that have already been realised have tested new concepts. The new ideas about industrialising the renovation process are quickly developing and are helping in getting the price and effort down. It seems that these kinds of dwellings will continue to be developed in the coming years leading to the optimisation of the technologies. The end goal is to realise quick and effective renovation methods in which energy wasting dwellings can be made energy neutral and given an extra lifespan of 40 years. Prêt-à-Loger would fit perfectly amongst other solution in the Stroomversnelling and could become part of it. The four big contractors that already realised first prototypes are the BAM, Ballast Nedam, Volker Wessels and Dura Vermeer. To get a clear understanding of the current status a brief analysis of these first four solutio has been executed.

(a) Ballast Nedam has chosen to strip the house of its outer facade and roof and afterwards replace it. They have already concluded that this was not a good idea because of the nuisance for the inhabitant, the price and the time it takes. Innovative about the renovation was the way the drawings were made, the house was measured fully in 3d by a party that could translate them directly into drawings. Furthermore, they integrated the piping in the new prefab facade which made inner house renewed piping installation unnecessary. On the roof heat recovery combined with a heat pump was installed underneath the solar panels. The conclusion at the moment is that the heat pump is too expen-





Figure 1.69 — *Ballast project (left)*

Figure 1.70 — *Dura Vermeer project (right)*

sive however and that an alternative would have to be found. An important conclusion Ballast Nedam made was the importance of communication. A door which they expected unnecessary conflicted with the prefabricated kitchen when it proved unmissable.

(b) Dura Vermeer's vision is to minimize demolition and to only add to the outside, which they did with sandwichpanels. The desire is to integrate all of the installations into the facade panels. The use of sandwich panels allows for choices in regard to for example finishing while still making industrialisation possible. The idea is that in the future solutions such as frame-less windows and an integrated modular panel solution to allow for example for a window roof instead of a solar panel if desirable. Dura Vermeer is also taking into account future energy storage, new prototypes will have either a system making gas which can be used at a later moment or a full electric system. Difficulties arose when the floor on the ground level turned out to be poured directly on sand. To insulate the latter properly it was needed to make the facade longer under the ground to prevent cold bridges and the cavity of 10 cm that existed because some of the sand washed away needed to be filled with insulation pellets. This shows that standardisation is possible to some degree but to deal with adaptability to the always changing situation in real life flexibility is really essential.

(c) Volker Wessels's most important innovation is the creation of an installation portal at the exterior of the house. The idea is that maintenance on the systems can happen without bothering inhabitants, which originates out of remarks made by inhabitants. New piping is also integrated in sandwich panels leading to ease of use and maintenance. Their goal is to standardize connections to efficiently connect non-standard housing type. They emphasize that standardization will help a lot but will never be as effective as for example the car industry.

(d) BAM has integrated direct current in their housing due to energy efficiency advantages. The idea is plausible since the disadvantage of DC over long distance is removed due to local production, problematic at the moment is that appliances are generally not adapted to DC yet. BAM has made deals with the producers that keep the producers owners of the appliances and inhabitants will only pay for the services. Good equipment can earn itself back but due to the high initial investment they are sometimes not accessible. Furthermore, BAM aims to minimise demolition by for example placing glass plates in front of existing bathroom walls and at the exterior they only place new equipment against the facade.





Figure 1.71 — *Volker Wessels project (left)*

Figure 1.72 — *BAM project (right)*

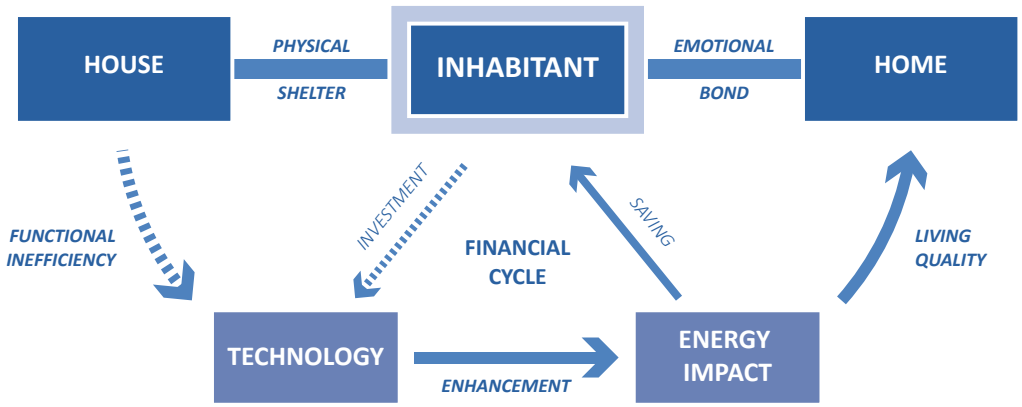


Figure 1.73 — *Prêt-à-Loger's renovation cycle*

Our solution: The Renovation Toolbox

In the Prêt-à-Loger the main aim is not to simply create a single solution for making a house sustainable. The team believes that it does not seem reasonable to create a strict design and assume that could be applied successfully within broad variety of situation and meet a large amount of needs. As stated before the ambition of the project is to develop an approach which could be adopted for renovating a massive amount of houses based on the clients' demands. In order to cope with this objective, Prêt-à-Loger elaborates a certain level of flexibility in respect to the proposed solution. An instrument which is defined as the Prêt-à-Loger's Renovation Toolbox.

In short, to make the design adaptable to the multitude of situations and challenges at hand it should be made flexible. This is comparable with buying a new car, it has to be able to be adjusted to answer to the specific demands of the buyer. The needed properties and goals for this project can be split into three different kind of flexibilities:

(1) Appealing flexibility: *What should be implemented in the toolbox?*

* Innovative components, the newest designs of the elements and the newest technology has to be reachable for those who want it (mostly pioneers/early adapters);
* An efficiency meters with energy providing characteristics about your own house when the renovation is done. Practically an estimate of how much you will save on your energy bill;
* Smart energy meters have to be installed (possibilities on what sort of smart meters);
* Different facade options;
* Total cost;
* Return on investment and time needed to do so.

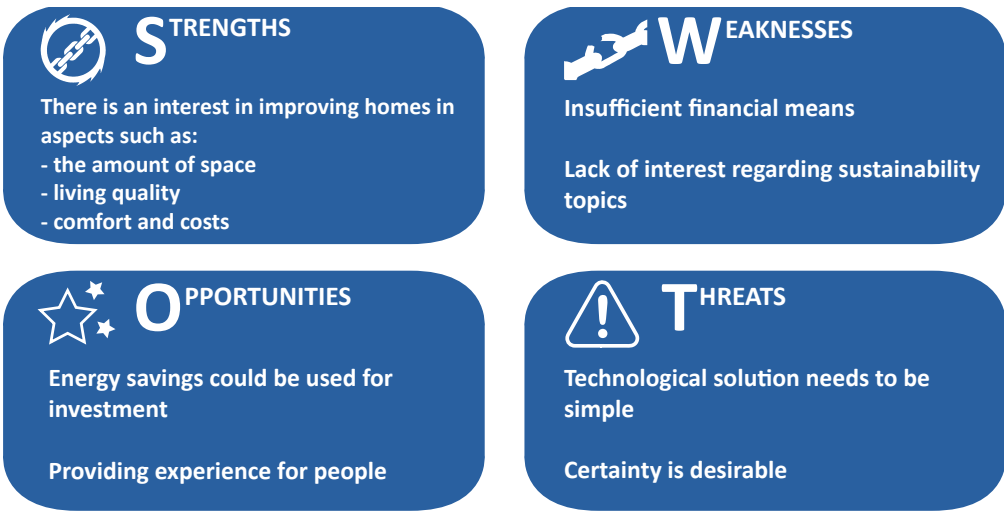


Figure 1.74 — *SWOT inhabitants analysis*

(2) Usage flexibility (inhabitant): *What should be taken in mind?*
(3) Technical flexibility (houses): *In what ways does the technical interfaces play a role?*

Figure 1.75 — *SWOT housing stock analysis*



When summing up the characteristics of both the inhabitants and their homes it becomes clear that Prêt-à-Loger can provide a perfect solution for both the upgrading of the home for the inhabitants and making the house more sustainable in technical terms. The supply of homes consists out of a supply build in a standardised and very similar way. This makes it possible for renovations of these kind of house to be executed by a mass production of pre-fabricated elements. Such an approach would make the renovation much cheaper and faster. The problem with the industrialisation, however, is that the inhabitants in these home are not similar at all. A wide range of different people with an even wider range of demands would have to be satisfied by an industrialised product. At first glance this seems to be a contradiction because different demands are unlikely to be met by just one product. This is why Prêt-à-Loger introduced the concept of a Renovation Toolbox. It would contain a range of standardised and industrialised products which can then be effortlessly implemented in the design. This would allow our renovation to both adapt to the differentiated demand and reap the benefits of an industrialised process at the same time.

Figure 1.76 — *Overview of Prêt-à-Loger's market viability*

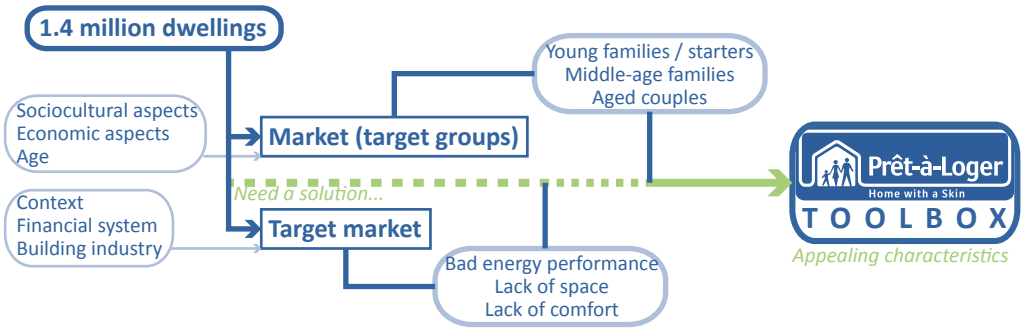


Figure 1.77 — *Project toolbox application and Versailles interpretation*

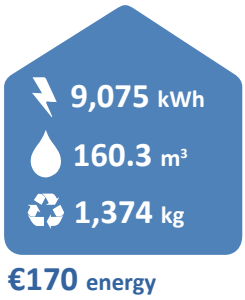


1.2.3 Appealing characteristics

As large parts of the Dutch row housing supply no longer meet the contemporary standards the most obvious appealing characteristic of the Prêt-à-Loger concept is that it makes aging dwellings into highly attractive ones. For stimulating owners to take efficiency measures mandatory policy instruments are increasingly considered to be a real option. In fact, in the Netherlands the requirements for existing buildings were expanded to include dwellings in the obligation to apply cost-optimal measures in large-scale renovations. Nevertheless, to enhance households investments in energy saving measures, the impact on living expenses must be highlighted. Prêt-à-Loger is determined that measures and tools must be provided in order to encourage dwellers to step forward. The proposal is a configurable system that can be taken complete or partially as a way of affordable home-upgrade in accordance to every single household situation. House owners will are not forced to settle elsewhere anymore; instead, they can choose their own way of energy based renovation through the toolbox. The taylormade improvement packages result in different investment prices.

Measurements of a dwelling

Prêt-à-Loger realise that sustainability goes beyond greenhouse gas emissions and that aspects on all three levels, environment, economy, and society have to be addressed in complexity. These aspects extend to the many realms of the living environment. An average Honselersdijk house consumes 3,059 kWh energy yearly as well as 160.3 m3 water while producing 1374 kg waste in a year. In the meanwhile, 170 euro is spent on the energy bill. The project seeks a revolution in household numbers. Figures of energy, water and related finances must be directly addressed by the skin proposal. On the other hand, the concept realises that waste management is a concept system alone and shifts can only flourish out of individual behaviour change that needs to be catalysed, however. All in all, projects targeting household consumption and emission numbers will be viable if they reduce the triggered expenditures.



Environmental advantages and energy efficiency

According to the calculations by enhancing the quality of insulation of the dwelling energy consumption can drop by 80-110%. Due to water collection and storage of rain water 18% drinking water can be saved. Since yearly energy consumption (including heating and cooling) is 568 kwh less than production, many more external appliances can be added to the system, such as the charging of an electric bicycle or respective street lights. For electric cars an additional source is required, e.g. wind turbines. Harvesting a significant amount of rain water does not only reduce drinking water consumption but also put less pressure on the sewage and surface water systems elaborated in the Design

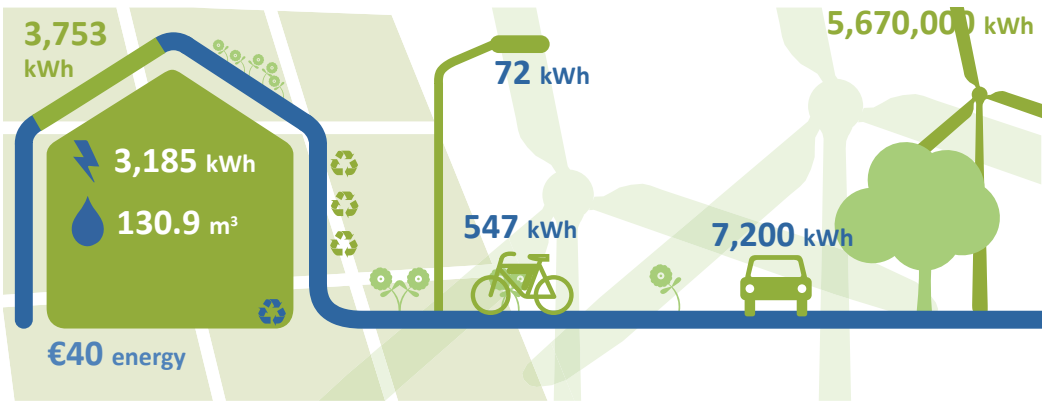


Figure 1.78 — *Environmental advantages and energy efficiency*

Strategy (see Chapter 1.1.4). This progress is also a result of increasing vegetation in the open space.

Typical row houses that consist of prefabricated concrete panels, cladded with clay bricks. Prêt-à-Loger maximises preservation and recycling. The original structure could hold more than twice the load it already carries, therefore ,the preservation of it is fundamental in the renovation story. The newly created items are derived from recycled materials as an attempt to close the material loop. Based on their weight, the three most relevant materials are glass (1,962 kg for the photovoltaic panels), steel (1,036.2 kg for the steel structure), and wood (818.13 kg for floor in the glasshouse). The window frames and the house door are made of 100% recycled material.

Innovative components and flexibility

One of the main innovations of Prêt-à-Loger is to introduce a flexible method into the renovation process. This is defined as the Renovation Toolbox as mentioned in the previous sub-chapter. In the part explaining the buyers conclusion was given that the clients are highly varying socially and by age. Tailoring the renovation packages on the individuals, solutions can be created basically worldwide (depending on the range of tools offered) but especially in the geographic variety of North-Western Europe.

Each part of the new constructed material, the skin can be chosen by individual preference, at the current development phase from 3 levels. The levels define the amount of added qualities by financial terms. These choices certainly have an effect on the energy performance. Through the north and south roofs the levels of performance are shown on Figure 1.79. The currently 3 level of solutions show a variety of prices and energy values. Merging these individual solutions a personally tailor-made Skin is conceptualised, then realised based on the client's needs and possibilities.

Economic benefits of flexible design

The toolbox has been tested on our family models. Even though, level 0 does not change the existing state of elements and could be calculated in the process, we were curious what packages could fulfill the demands of certain family models. Driven by our main value, the scenarios all involve the Skin and Solar harvesting. It is visible that for less than half the price of the high-end version an already compact and fulfilling package can be created. The average Honselersdijk model is also in average price range. This number may seem to be over the possibilities already determined, however as presented in the Affordability chapter various solutions are available to overcome the financial boundaries. For the three families in completely different stage of life three different scenarios are created. The starter couple seeks maximising sustainability and energy efficiency with most affordable way possible. They are keen on investing in technology rather than in-

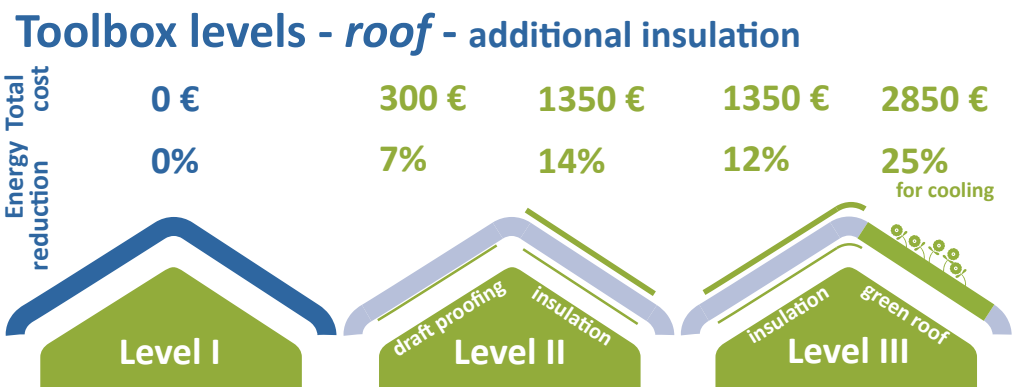


Figure 1.79 — *Economic benefits of flexible design*

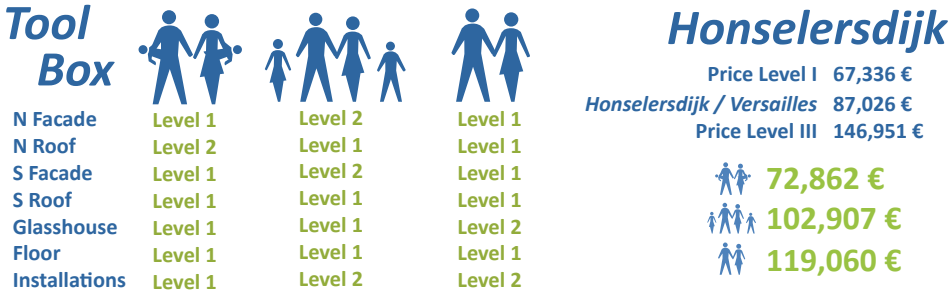


Figure 1.80 — *Toolbox packages applied to certain family models*

sulation. The middle-age family is interested in a more complex solution by maximising insulation and the installations. The grandparents invest in the glasshouse and the installations but keep the rest on minimum. However, this solution is the most expensive. In conclusion, it is drawn from the experiment that specific cost clusters cannot be proposed. Further on in the Affordability chapter various scenarios will be elaborated towards the financial possibilities and subsidies of the product realisation.

Prêt-à-Loger as an innovative solution

(1) Industrialised production and user flexibility

One of the greatest disadvantages of current mass renovation is the lack of flexibility for end-users. In order to resolve this issue but still provide affordable solutions different technical elements are rolled out in a standardised way over row housing. While this is easier for the contractors it often conflicts with the inhabitants' desires and individual situation. Therefore, the developed toolbox regarding incorporates the advantages of the mass production where standardised parts of the product are prefabricated and ensures the adaptability to specific individual demands.

(2) Use of local knowledge

The most typical Dutch dwelling is the row house. At the same time and particularly in the green ports such as the Westland region glasshouses are often used for food production. The merging of glasshouse production technology with products utilised for implementing housing renovation, sustainability has led to a product showcasing an approach which aims to incorporate local technologies embedded in the economy and culture of the location.

(3) The added value of space

Most renovation solutions only deal with climate performance and internal comfort. Prêt-à-Loger also tackles the (un)availability of space. This can make an extra difference between people planning to move.

(4) Adhering to existing developments such as the Energiesprong

There alreafy on-going development concepts in the Netherlands. Contractors, governmental parties, financing bodies and end-users have entered a discussion about future steps. Prêt-à-Loger has already obtained an extensive network with whom experience is constantly exchanged.

(5) PV panels as the motor of design

The integration of PV panels has led to two types of advantages. On the one hand, the PV panels have a relatively short payback time allowing the generation of additional cash flow to finance the rest of the renovation. On the other hand, the PV panels are used as an element of a design providing additional quality and space, which focuses on end-user demands. Thus, the PV panels can be considered as the motor making Prêt-à-Loger

affordable and as elements that enhance the motivation to apply the design.

6) Inhabitant engagement

Due to the close involvement in the process the users are unconsciously involved in sustainable developments. Moreover, the Domotica system will continuously provide feedback, input and interaction further igniting a sustainable awareness. The concept goes beyond the impact of a sustainable dwellings and facilitates a new generation of sustainable society.

Reflection

The Dutch housing market primarily consists of standardised row housing but at the same time the inhabitants of the dwellings are highly diverse. Living can be differentiated into two aspects: house and home. The house is a technical shell, providing shelter and a controlled climate. 'Home' represents a place of emotions, an environment in which memories are born and relationships are formed. An atmosphere for relaxation, love and security.

The housing stock built in the post-war era is no longer up to the contemporary standards. Prêt-à-Loger confronts this problem with a solution that combines industrialised production of construction elements that can be applied to the standardised houses tailored for the specific demands of the inhabitants. The ultimate ambition of Prêt-à-Loger is to have an impact on a larger scale through the Renovation Toolbox and contribute towards the establishment of a sustainable world:
Create energy efficient houses protecting our homes!



Figure 1.81 — *The ambition of Prêt-à-Loger regarding the global impact of the project*

1.3 Individual or collective housing building concept

1.3.1 Spatial organisation

Metropolitan scale

As presented earlier (see Chapter 1.1.2), the sub-urbanisation and sprawl within the territories of the Randstad has been substantial in the second part of 20th and the beginning of 21st centuries. However, according to the recent policies of the province (Structural Vision for Zuid-Holland, 2012), these tendencies are opposed by accepting the rule of permitting new constructions only within the already urbanised areas although the region still accommodate newcomers. In this context the only possibilities for further development seems to be by optimising the transportation networks allowing the densification of smaller towns and rural areas. Therefore, interventions in terms of the existing mobility networks are highly necessary in order to facilitate the commuting flows on everyday basis. The case study of Honselersdijk is indeed a low-density town which is one of the possible target areas for densification. Aiming to create favourable conditions for these development and, meanwhile, to organise a network on sustainable principles a transportation plan including enhanced public transport, electric vehicles e.g. bicycles and cars and shared automobiles is elaborated. Further details are presented in Chapter 1.4.



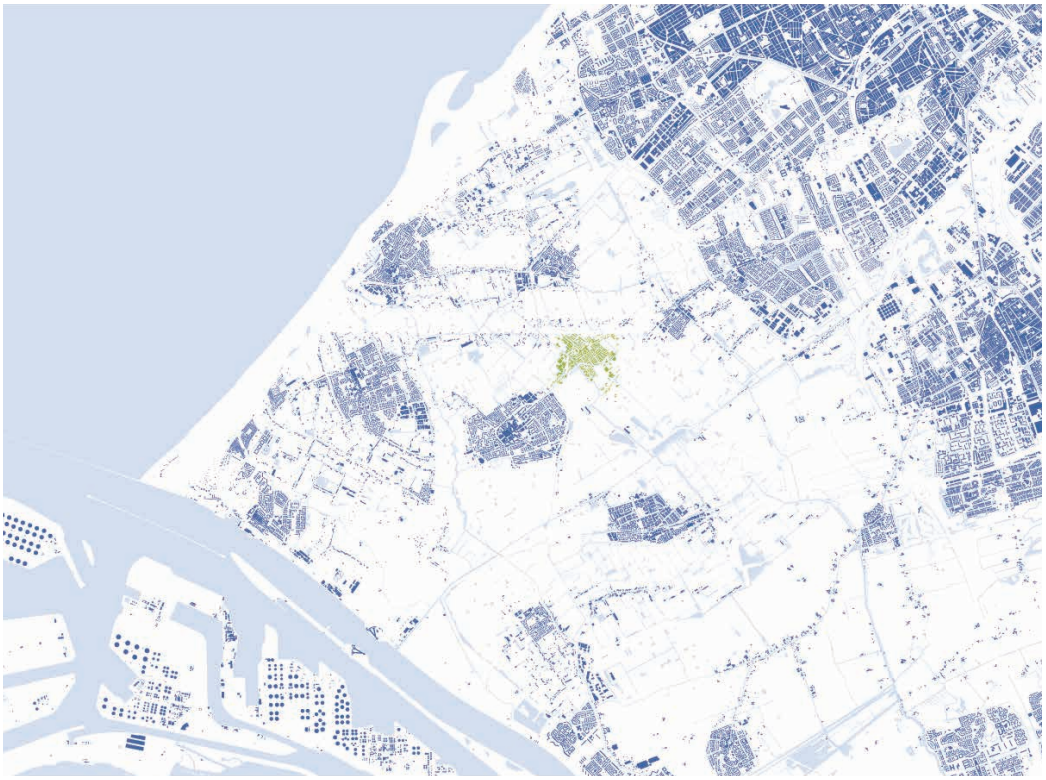


Figure 1.82 — *Metropolitan scale: location of Honselersdijk within the greater metropolitan area of The Hague*



Figure 1.83 — *Conceptual vision regarding the further urban development of Honselersdijk*

"My environment is other people"
- Machiel van Dorst, TU Delft

Urban scale



The case of Honselersdijk is an interesting one because of its location in the surroundings of two major urban centres of Randstad e.g. The Hague and Rotterdam. Considering the existing policies of the province of South Holland it can be imagined that the area can transform substantially in the future. However, our team focuses not on direct densification of building stock but rather on the optimisation of the functional utilisation of the existing public spaces. The proposed planning framework and direction of town's development seek for further benefits from this optimisation by introducing functions that promote sustainable adaptation of the excessive space serving pre-dominantly the automobile networks today. In other words our concept relies on densification of the functions via designing spaces and policies which favour the flexible and adaptive utilisation of the public space e.g. accommodating more than single function.

Figure 1.84 — *Urban design goals*



1.3.2 Community building

The way cities have developed over the last decades has lead people into living mostly separate and isolated life. The global economic restructuring has hampered the cohesion of the former strongly bonded neighbourhood communities gathered around local economies. Relations became more detached from the local neighbourhood areas (Castells, 1997). Furthermore, the rise of World Wide Web and ICT has led to the introduction of various means of communication and virtual social networks such as Facebook, Twitter etc. As a result considerable amount of social relations now take place outside the neighbourhood communities. Cities and local districts seem to gradually become places full of strangers questioning the importance of the neighbourhood in the globalised world.

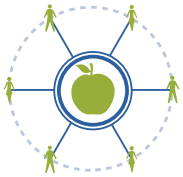
However, in the recent years the social cohesion and community engagement tend to be increasingly recognised as fundamental aspects for the development of sustainable urban areas. The Council of Europe has developed numerous strategies towards enhancing social cohesion within cities. These strategies often emphasise on shared values and commitment in the recognition of a collective goal or good while evaluating social cohesion in the context of sustainable development. Therefore, the definition of common objectives and project initiatives enabling local community-building seems to be crucial for urban development which can successfully raise the neighbourhoods' quality of life (CoE, 2008).

Urban preservation as community-building tool



This whole project outlines the importance of urban fabric's physical preservation and adapted to the future context of energy neutral buildings. However, as it was already mentioned the higher benefit of preserving the existing structures is the fact that by doing so the project manifest a higher consideration of societal and cultural preservation related to the local inhabitants. The approach ensures better chances to keep the social bond and relationships between the urban communities. This enhances the possibilities for implementing sharing of urban assets and their maintenance; what is more, it can assist the promotion of sharing responsibilities and awareness between the people on the basis of which a strong concept of sustainable future can be built.

Food production as community-building tool



In respect to the particular purpose of the project and the context within it has been developed, the importance of the food concept is emphasised in terms of urban design and functionality of the street. In addition, the establishment of local gardens on the street could be utilised as a powerful tool for bringing the community together on neighbourhood scale and also deliver positive impact on higher scale. This vision pictures the street as a central part of a food community, where food is grown, stored and traded. Based on the principle of Square Foot Gardening, about 2 m2 per person is sufficient to supply vegetables all year round. This method works with a grid of 30 x 30cm each containing a different type of vegetable and this grid is divided over boxes of 1,20 x 1,20 m.

Applying this method results in a lot of advantages compared to a common kitchen garden, some major advantages are:
• Only 20% of the area is needed compared to a kitchen garden, because of the economical distribution of the grid;
• In terms of the soil, only additional compost needs to be added to the boxes;
• Weeding is hardly needed. The self-made soil hardly contains seeds of weeds;
• Finally, pests and diseases hardly appear in the SFG, because each square of 30 x 30cm contains a different type of vegetable.

Adding up all these advantages shows that the Square Foot Garden is economically feasible, profitable and easy to use, making it very suitable for growing vegetables locally in a food community. Last but not least, the square metre boxes ensure certain possibilities for occurrence of locally initialised modification of the space. This will provide the local community not only with the possibility of collectively growing food but also re-design the streetscape according to their common needs.



Figure 1.85 — *1,20 x 1,20 meters box urban gardening concept; Photo credit: www.girldriver-girldriverusa.blogspot.nl*

Energy production as community-building tool



As it was already presented (see Chapter 1.1.4) the concept of Max Town incorporates the energy production as a major element. The promotion of a local energy generation where local residents are actively involved in the production and management of the electricity will create certain community awareness among the residential areas where the concept is adopted. What is more, the scale of the interventions outreaches the level of the individual energy self-sustaining unit e.g. house. By creating a decentralised energy generation system which is capable of exchanging energy between different producers , e.g. houses, will be possible to develop an almost independent and resilient energy grid. According to Lovins (2002), this achievement is not a utopian scenario but a realistic and technologically viable concept which can lead to economic as well as social benefits for the participants. The eventual shared values and goals can be recognised as a driving force for a development that can plausibly result in the establishment of an energy self-sustaining community.

Collective mobility as community-building tool

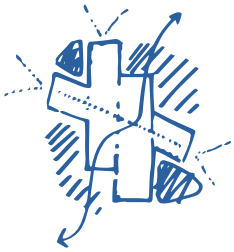


The sub-urban and rural areas experience a common problem in most parts of the world. Due to their lower population density the establishment of viable collective transport system is rather difficult (Hoyle & Knowles, 2001). The lack of transport alternatives results in high dependence on privately owned vehicles in the rural areas as it can also be seen in the examined case study of Honselersdijk (see Chapter 1.4). Without delving into the details regarding the proposed transportation system which is presented in the next chapter it can be revealed that the general mobility concept does not aim simply to improve the energy efficiency and the negative impact on the environment. More importantly, it is employed as community-building tool by the introduction of car-sharing system where local residents can share travels and electric (motorised) vehicles. This approach promotes a transportation concept, based on shared communal benefits, which provides greater possibilities for larger amount of inhabitants to utilise motorised vehicles and reduces the total financial and energy costs that supply the current network because of the collectively organised mobility system (Hulsmann & Fornahl, 2014). Moreover, by creating collective parking locations a substantial number of individual street parking could be re-distributed. This strategy aims to provide more urban space for community activities on the streets that can function mainly as places for social interactions between local residents. Further insights regarding this statement are presented in the following chapter.



Figure 1.86 — *Car-sharing opportunities can really work as community-building tool where individuals are provided with collective advantages without compromising with their individual comfort; Photo credit: www.smartertravelworkplaces.ie/smartmoves/carsharing/*

1.3.3 Urban design concept



Unquestionably the designs and plans for most urban areas comprise honest intentions of facilitating social life within the public space. However, as William H. Whyte famously argues it is fascinating how often this does not seem to be achieved (1980). The latter statement is particularly true while speaking about car-orientated, suburban and rural areas where the dominance of the automobiles within the urban space shunted aside people and social activities. In the past half a century the urban streets have then been transformed into functional spaces which mainly accommodate vehicular flows. This has influenced local inhabitants to spend substantial part of their spare time in private and indoor areas (e.g. house, back yards, urban villas etc.) leading to separate and isolated style of recreation (Svarre, 2014).

Lately, urban design has shifted the perception of the streets from voids of the urban arrangement - dedicated to solely transportation to vibrant shared places of collective life as they were in the past (PPS, 2008). The streets have been increasingly considered as places for people to stroll, look, gaze, meet, play and interact between each other. In the case of row houses the significance of the street tends to be extremely crucial since it represents the shared space in-between all private houses where considerable amount of community activities could take place. The goal of the Prêt-à-Loger team is to utilise this potential and promote a conceptual vision aiming to revitalise the residential streets as an active domain of social interactions between the local inhabitants with a special emphasis on sharing amenities. An approach which correlates with the main assumptions defined by the overall urban design strategy (see Chapter 1.1). Aiming to fulfill the aforementioned objective and based on the well-known works of William H. Whyte (1980) and Jan Gehl (2010) this design concept focuses on three major points in order to transform the existing streetscape (see Figure 1.87):

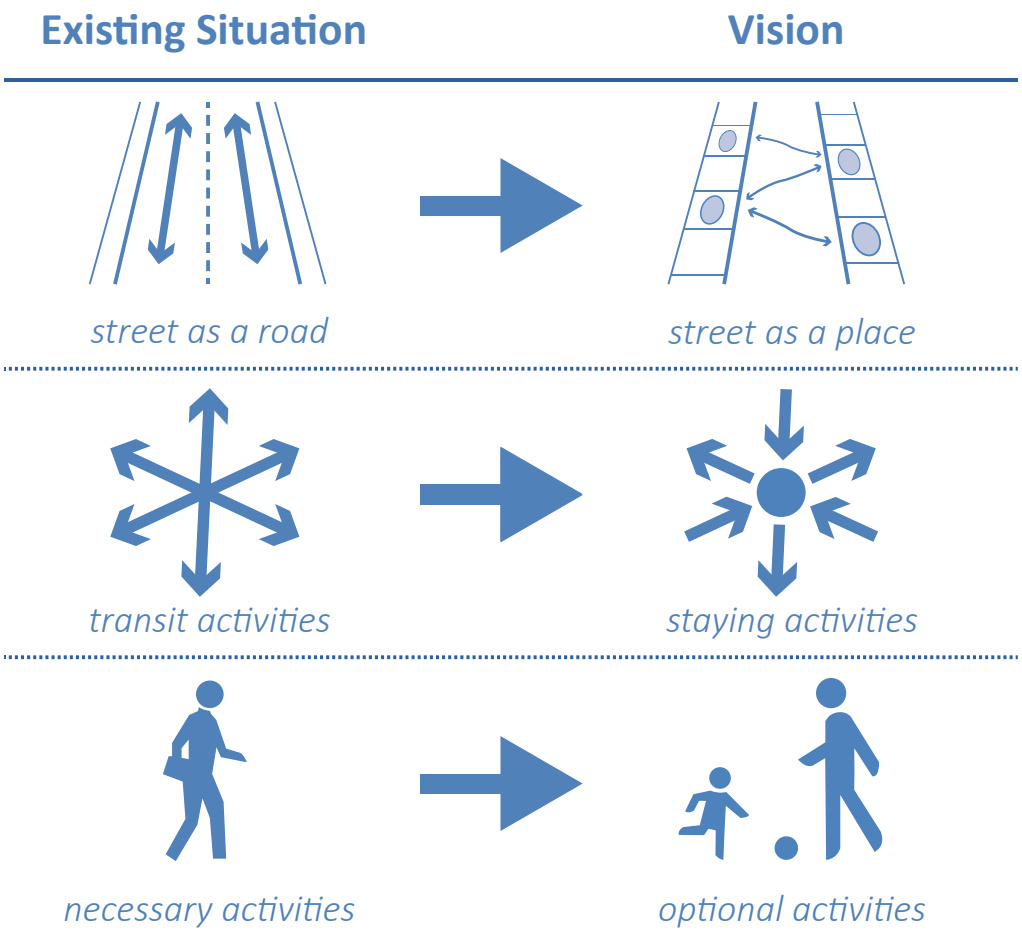


Figure 1.87 — *Design objectives concerning the transformation of the streetscape*

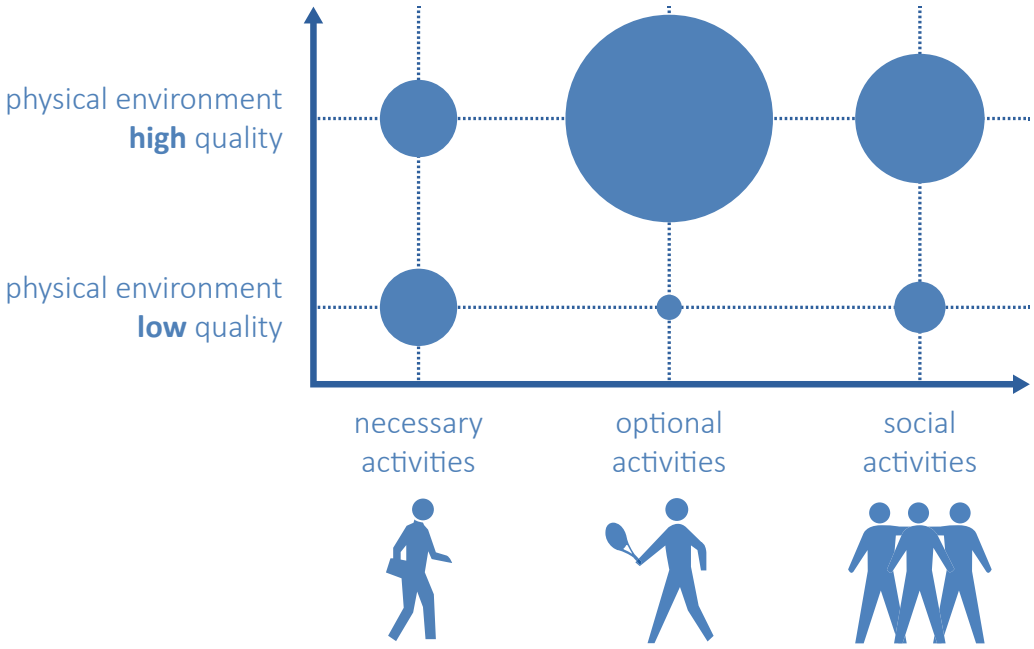


Figure 1.88 — *Jan Gehl's typology of activities within urban space*

(1) Emphasising the importance of the space for facilitating human activities rather than traffic flows including the possible reduction of the street width and regulations regarding the vehicular access etc.

(2) Establishment of amenities which accommodate staying activities instead of simply transit activities where people spend time on the street rather than just pass by. This is based on the Gehl's findings that long outdoor stays mean lively urban space (Gehl, 2010:72).

(3) Creating favourable conditions for emergence of optional activities promoting leisure and recreational activities on the street and not limiting the street to simply facilitating purposeful, necessary types of activities such as going to work or the supermarket or bringing the litter bins out etc.

Interventions regarding these three aspects are incorporated in the urban design toolbox (see Chapter 1.1.5). In order to achieve this vision, improvements concerning the physical environment of the street seem to be necessary. In respect to the aforementioned objective and focus points Jan Gehl (2010) identifies two particular aspects which can be clearly influenced by urban design with a significant impact on the streets' liveliness within residential areas: (1) the edge zone where building and city meets and (2) the transition between private and public space. Thus, a special consideration is paid on these two focal elements within the development of the project's design framework.

Edge zone

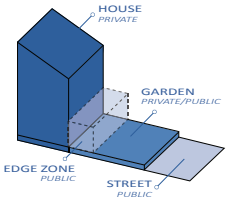


Figure 1.89 — *Visual representation of the edge zone concept*

The importance of the edge zone for the street vitality of the residential area tends to be crucial. This zone ensures sufficient level of private comfort and simultaneously provides good contact possibilities with the public space (Gehl, 2010). Therefore, this area seems to accommodate a substantial amount of the outdoor activities. In principle, in the examined case of Stompersdijk, these zones are present as private yards in front of every house. However, they do not function very successfully because most of these front gardens are rather large and not intensively maintained by their owners who prefer to perform the optional and recreational activities in their private back gardens. This naturally limits the amount of active users and, respectively, the possibilities for social interactions on the street. Indeed, our design concept addresses this issue by the introduction of the ownership pattern concept (see Chapter 1.1.5) where residents with



Figure 1.90 — *The edge zones within residential areas where buildings and city meet are influential for the liveliness of the neighbourhoods; Photo credit: Gehl (2010:103)*

higher motivation to maintain the yards can receive extra space from owners who do not have either desire or time to deal with their gardens. As it was mentioned earlier this provides 'win-win' situation where the general physical quality will be enhanced and local inhabitants will spend more time on the street. These conditions tend to improve the functionality of the edge zones, favouring the occurrence of optional and social activities within the public space (Gehl, 2010).

Public-private transition

The street layout has been developed with a strong consideration of the house skins' execution. As this technological solution itself works as a certain 'membrane', the street needed to become a sort of immediate continuation of the indoor life. In respect to the importance of the front gardens as discussed earlier the development of the skin provides softer transition between the private and public spaces. This creates prerequisites for establishment of areas which represent semi-public and semi-private zones allowing a gradual transition between indoor (private) and outdoor (public) life. In this manner local residents gain the individual opportunity to regulate social contacts in the public space as well as protect private life (Gehl, 2010). In particular, the introduction of a skin in front of the house assists the establishment of well-proportioned transition zone between public and private spaces. This provides essential possibilities for accommodating shared, communal activities initiated by both bottom-up and top-down approaches. Thus, the considerations regarding the different zones and the transition between them should be treated with special attention in terms of design ensuring democratic decision making for a flexible design aiming to promote sustainable environment.

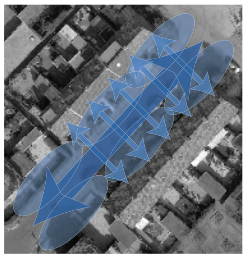


Figure 1.91 — *Street as a communal sharing space*

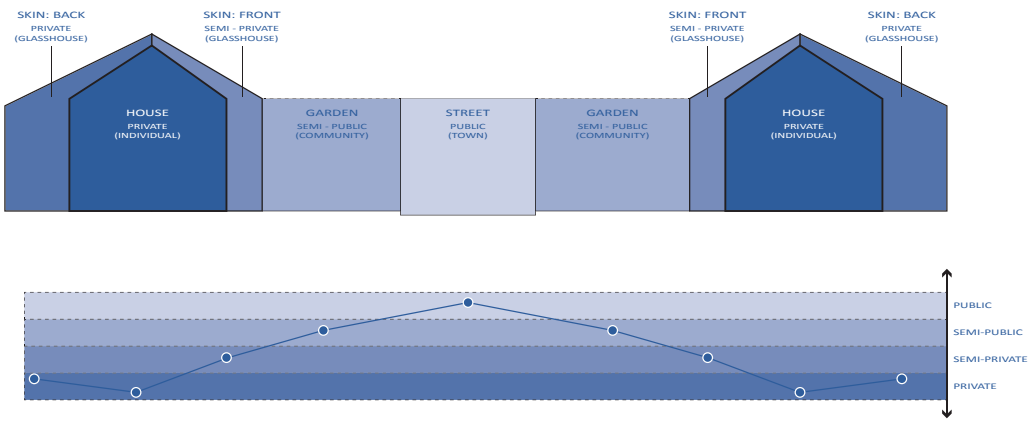
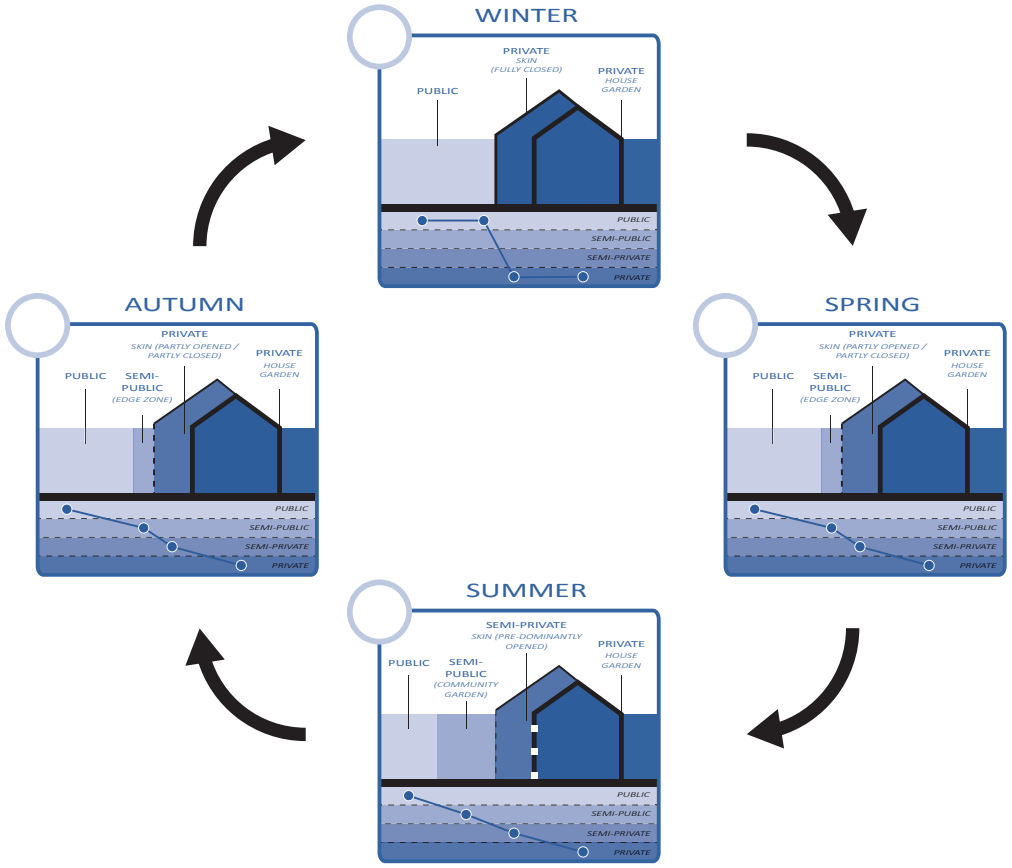


Figure 1.92 — *Transition between private and public*

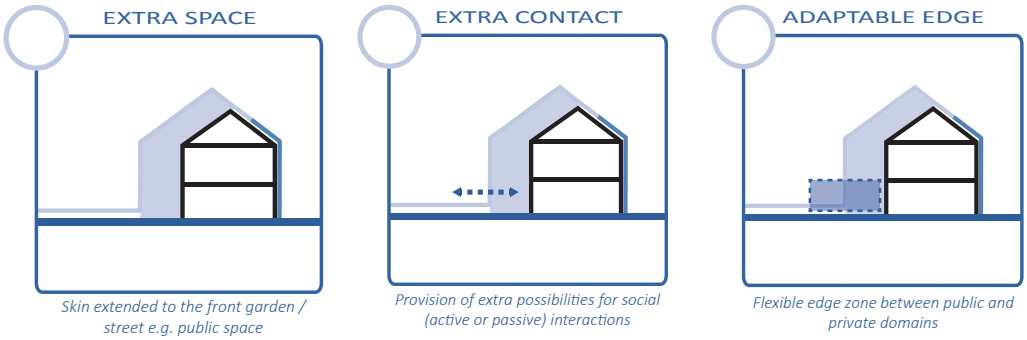
Figure 1.93 — *Variations of private - public transition in respect to the seasonal differences*



Skin as community-building tool

Due to the orientation variety of the row house blocks (discussed in Chapter 1.1.4) the extra space provided by the glasshouse can be added on either front or back of the house; thus resulting in two major transition patterns. When the extra zone is located within the private gardens, it operates as an additional fully private (internal) space providing spatial and functional flexibility to the user while simultaneously enhancing the climate performance of the house. This scenario is discussed in the Architectural Design Narrative chapter (see Chapter 2.1.2). However, when it is on the street side, the skin has a higher external character working as both spatial and social determinative element. It operates as an additional transition zone between the private and public domains as illustrated at Figure 1.93. By the flexibility of the glasshouse structure, depending on the season and weather, it lengthens the use of the garden by its closed nature, meanwhile during the warmer months it can be opened, merging semi-private and semi-public zones reflecting on the transition between private and public spaces (transforming from winter garden to external living room). In this way, the skin operates as a social facilitator by providing an extra space, flexible edge zone between public and private domains that ensures higher individual comfort for the user and extra possibilities for social contacts, either active or passive, with the local neighbours (see Figure 1.94).

Figure 1.94 — *The impact of the skin on the street-side in terms of its social dimension*



Skin extended to the front garden / street e.g. public space

Provision of extra possibilities for social (active or passive) interactions

Flexible edge zone between public and private domains



Figure 1.95 — *Scenario representing the urban environment in a case of limited automobiles' access and local inhabitants maintain the private ownership over their front gardens in different extents (scattered public spaces)*

1.3.4 Urban toolbox application

Planning framework

In respect to implementation of the urban design in practice, the 'Max Town' concept fundamentally relies on the aspect of flexibility in terms of decision-making and spatial interventions. For the purpose of integrating this ingredient into the development strategy for Honselersdijk parametric design toolboxes have been elaborated (see Chapter 1.1.5). We strongly believe that establishing only the appropriate (top-down) framework combined within local (bottom-up) interventions can lead to the creation of urban environments which are highly adaptable to further changes.

Conceptual design

Although the previous paragraph outlines a design process with open-ended results excluding strict developments, the Prêt-à-Loger proposes three visionary variations. The latter have been developed by taking in consideration the design and community-building concepts as well as the different alternatives regarding the architectural interventions (e.g. skin's construction) aiming to demonstrate the capabilities of the parametric design toolbox. These visionary examples address the context study of Stompersdijk which was analysed in detail. The decision regarding the street designs are based on the outcomes of the analytical part of the urban context and propose solutions that apply the defined holistic strategy for sustainable development on local scale. In particular, all of the exemplified street designs have adopted the scenario of a limited vehicular access but they vary in terms of mobility flows, ownership patterns and public space organisation. With a diverse variation, the dwelling' front gardens turn into semi or entirely public spaces. Nonetheless, a certain amount of spaces are left available for further transformation by the inhabitants in respect to their everyday needs in the future.



Figure 1.96 — *Scenario representing the urban environment as a one large collective public space shared by the street's residents with limited automobiles' access and dispersed mobility flows*

Functions & materialisation

Another important aspect incorporated in all designs in the 'Max Town' concept is the local food production either by fixed gardening spaces or flexible farming boxes. Different possibilities are the cultivation of tomato and paprika harvested or small bushes and the salad-types vegetables in the boxes. Meanwhile, the trees can provide with apples or pears and the bushes with different plantations berries. Among the materials we tried to implement as many natural ones as possible or re-use the existing ones. This is how wood or grass-pavement can vary for solid materials we propose 'Zennewijnen Wienerberger' paving and 'Bamboo X-treme' decking; on the other hand, most of the time the informal spaces are covered with grass-concrete ensuring water infiltration and cooling. When is possible alongside the road in narrow rain-garden lines are proposed where smaller herbs can contribute to the seasoning of food and water control on the street. The trees are located on the southern side of the street in order not to shade the gardens and roof-panels. In the street clustering functions there is an attempt to locate small playgrounds, collective bicycle shelters or community gathering places.



Figure 1.97 — *Scenario representing the urban environment in a case of limited automobiles' access, dispersed mobility flows with a highly diversed ownership pattern resulting on the formation of both collective and scatterd (semi-) public spaces*

1.4 Transportation and Mobility Strategies

1.4.1 Urban scale

Existing situation

Since this project strongly addresses the issues of energy production and consumption the essential issue of regional and urban mobility cannot be underestimated. In fact, approximately 20% of the carbon footprint of an average Dutch family is due to the different modes of transportation where almost 18% in total are result of the car usage in the country. As it was already mentioned the town of Honselersdijk similar to other urban and rural areas located in close proximity of larger cities within Randstad tend to be car-dependent. This justifies the case study as a town with relatively high ownership of private motorised vehicles and poor public transport connections.

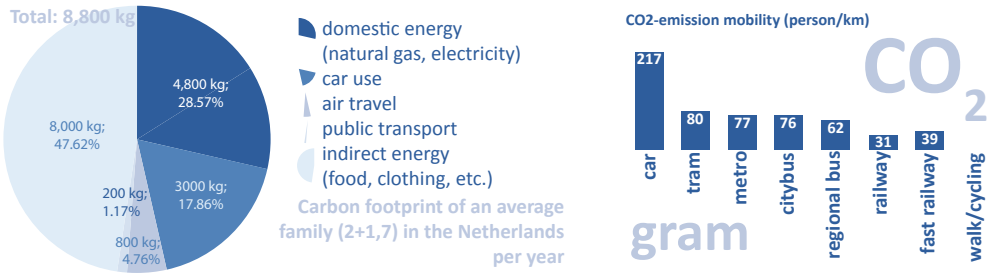


Figure 1.98 — *Graphs illustrating the carbon footprint of an average Dutch family and CO_2 emissions of different mobility modes*

Furthermore, this tendency pre-determines the existing condition where streets are explicitly functioning as car-serving spaces and are being devoid of intensive social activities. In particular, this hampers the quality and vibrancy of the urban environment since the streets are forming a major part of the public space within any town. In order to investigate the demands on the street network of Honserlersdijk a Space Syntax study has been conducted. On the basis of it a sufficient number of roads has been identified as links with minor connectivity frequency serving only few households but still occupying considerable amount of public space.

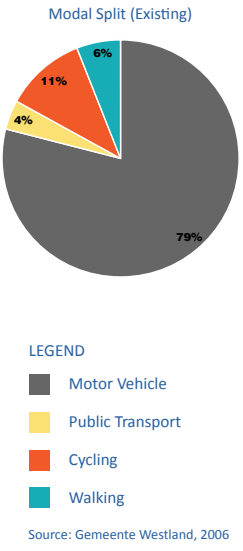


Figure 1.99 — *Existing modal split of Honselersdijk (above)*



Figure 1.100 — *Image of a typical Honselersdijk's street*

Figure 1.101 — *Space syntax study regarding the streets' connectivity within the urban context of Honselersdijk*

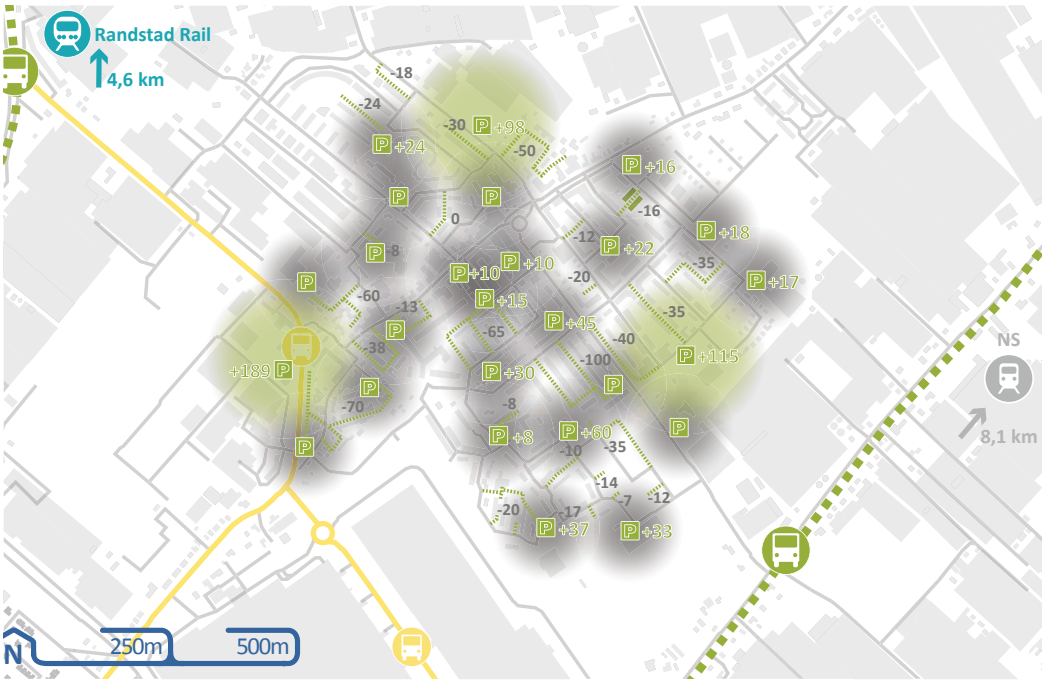


Pedestrianisation

Considering the aforementioned arguments and the size of Honselersdijk on the town level the future transportation strategy promotes green mobility e.g. cycling and walking as major mode of movement circulation. For this purpose, the Prêt-à-Loger team plans to pedestrianize numerous service streets within the urban area on the basis of the Space Syntax analysis. This concept combined with an enhanced public transport network connecting Honselersdijk with the surrounding areas on larger scales is an appropriate approach towards establishing sustainable mobility system. What is more, this urban mobility strategy is developed with strong consideration of the previously elaborated parametric design toolbox and our visionary expressions (see Chapters 1.1 and 1.3) by providing new possibilities for extra utilization of the streetscape developed as a facilitator of social interactions i.e. community gardening and gathering space.

However, this strategy does not aim to promote totally car-free town. We are aware of the fact that residents from satellite towns such as Honselersdijk are mainly commuting workers and students who are impossible to be served on 100% via green mobility modes and public transport system. What we urge for is a smarter and more efficient usage of the private motorised vehicles. Therefore, the concept proposes collective parking areas which are strategically located in order to provide a parking spot for every household within a maximum of 150 meters. The new parking areas compensate in full extents the amount of removed parking spaces previously taking place at the pedestrianized streets.

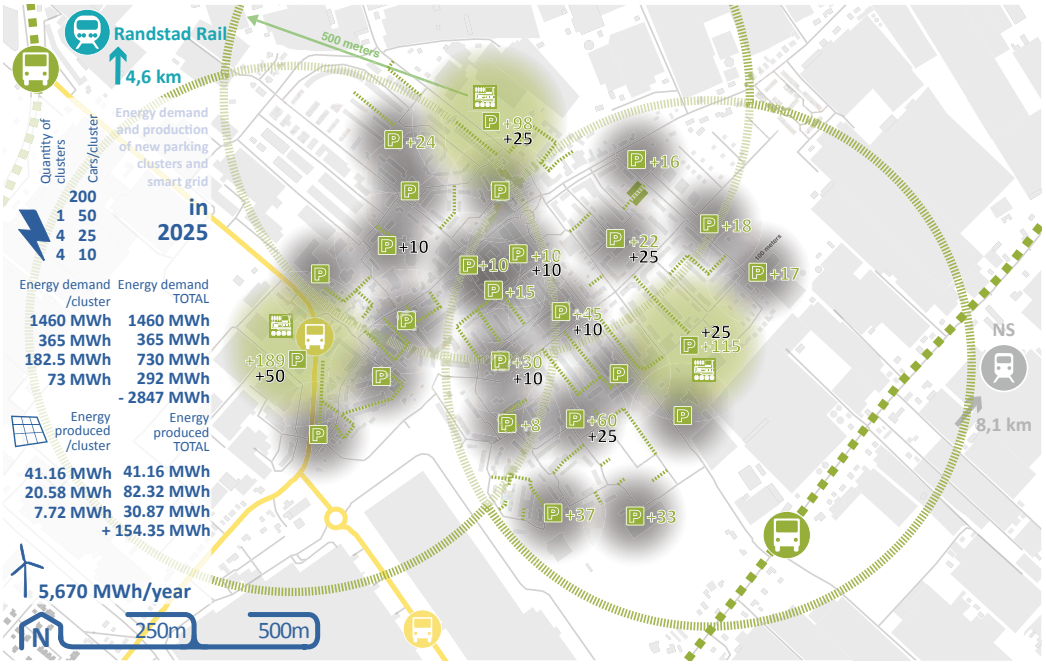
Figure 1.102 — *Energy and parking strategy plan considering the urban area of Honselersdijk*



Electric cars strategy

The previous paragraphs outline the necessity for the creation of a more elaborated strategy regarding the usage of cars in order to organise an environmental-friendly and efficient mobility system on urban as well as on metropolitan scales. Incorporated with the energy and architectural concepts of this project our team proposes the introduction of electric cars usage among the residents of Honserlersdijk. For this purpose, a sharing cars program will be implemented where these automobiles will be electric. The sharing of motorised vehicles between the local inhabitants will reduce the necessity of private ownership of automobiles and respectively lower the impact on the existing infrastructure. As a part of the house skin a car charging station can be optionally established as a place for energy exchange of between the dwelling and the private cars. Moreover, the projected collective parkings would be clustered around the energy micro generators or other electric hubs aiming to incorporate electric, hydrogen and hybrid cars to plug in the town's electric grid. In an idealistic future vision the local residents will be able to supply energy not only for their local needs but also for their transportation demands feeding their private or shared cars.





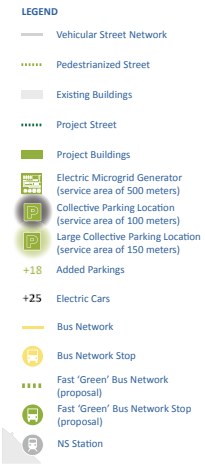


Figure 1.103 — *Energy and parking strategy plan considering the urban area of Honselersdijk*

The implementation of the strategy is planned to be made in three phases. The introduction of the electric cars is synchronised with the development of the distributed energy generation concept for Honselersdijk. This seems to be logical because the capacity of the energy grid is closely related with the provision of available resources for the automobiles and determines their storage / parking possibilities. Taking in consideration the recent trends of electric cars utilisation growth rate in the Netherlands preliminary estimations have been executed for the future of Honselersdijk. The latter calculations projected the rise of electric cars share within the town to:

- 64 (2% of total cars amount) in 2020 – Phase I;
- 390 (11%) in 2025 – Phase II;
- 1038 (28%) in 2030 – Phase III.

Aiming to supply with power the energy cars there are both individually and collectively (clusters of 10, 25, 50 or 100 automobiles) stored. The individual storage is incorporated with the technological improvements of the houses as the cars batteries can be charged by individually produced energyor by the grid. However, with the introduction of more vehicles additional energy production should be ensured. Therefore, at the collective parking locations extra solar panel installations will be established. In order to get a

better idea on the demanded energy and producing capacities we have generated calculations concerning the Phase II of the electric cars introduction where 200 cars are individually and 190 collectively (one cluster of 50 vehicles, four of 25 and four of 10) stored. These estimations illustrated that the total capacity of the collective parking locations is to produce energy through solar panels on 154.35 MWh per year while the number of cars stored within the collective parkings demand 1387 MWh per year (2847 MWh per year including the individually stored ones). This picture clearly illustrates the necessity of adapting additional energy generation facilities. A plausible alternative is the employment of electric windmills which can be also located outside the boundaries of the urban area. The capacity of an electric windmill with rotor diameter 44 metres and hub height 55 metres is to produce 5,670 MWh peek per year considering the wind conditions in this region of the Netherlands. This defines the adaptation of wind energy as powerful alternative that has a sufficient capacity to supply the electric cars' demands.

1.4.2 Regional scale

Existing situation

Honselerdijk in regional perspective is located in close proximity with the cities of The Hague and Rotterdam forming the 'Randstad' South Wing metropolitan area. A primary characteristic of this region is the very high connectivity via railway and highway lines, nevertheless, always congested in the rush hour between the major cities. However, Honselersdijk and the Westland in general is very poorly connected with neighbouring cities despite the minor distances. Thus, the mobility network is highly car-dependent which is pre-condition for favouring urban sprawl and further consumption of energy resources.

Aiming to avoid this negative process we propose strategic improvements of the transport network with providing new alternatives. A fundamental feature for achieving a more sustainable metropolitan future is, indeed, an efficient and transportation network prioritising collective and fuel free mobility modes. In addition, as it was aforementioned in respect to the South-Holland province recent policies of not allowing new construction outside the boundaries of the existing urban areas. Thus, towns such as

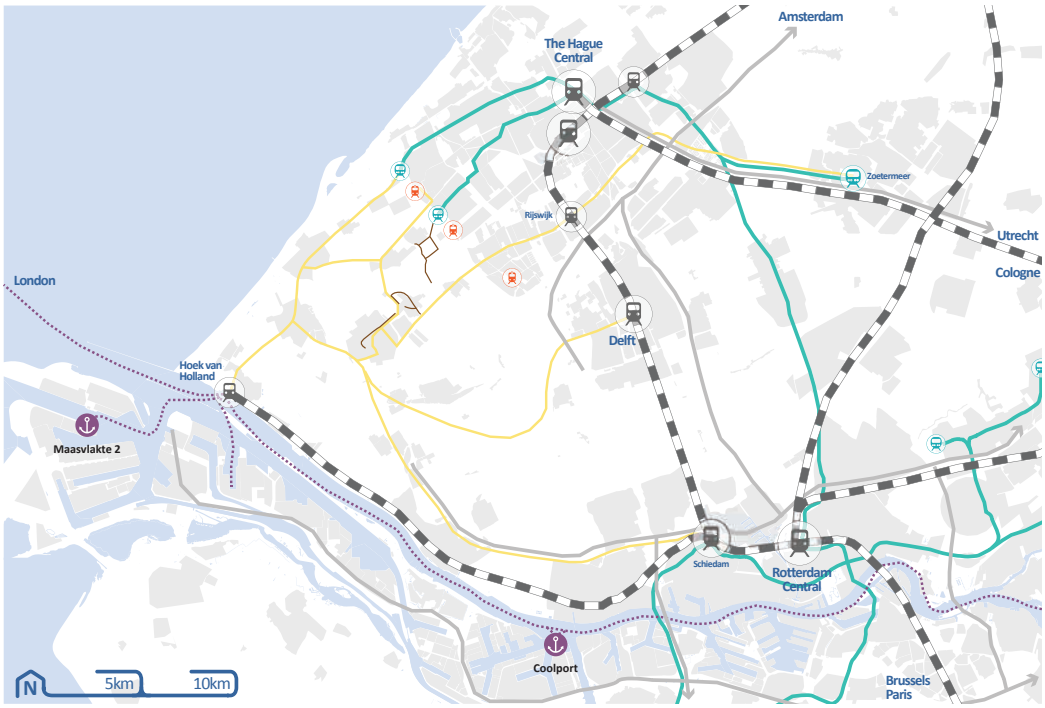


Figure 1.104 — *Transportation network highlighting the connection between Honselersdijk and the Province of South Holland*



Figure 1.105 — *Major mobility network on urban (left) and metropolitan (right) scale*

Honselersdijk are seen as an option for accommodating further population growth by densifying the existing structure. In order to facilitate this growth in a sustainable way, an improvement of the transport network is necessary.

Electric bicycle concept

Until recently an organisation of metropolitan mobility network on the basis of bicycles seemed to be impossible because of the limited distance that the users can commute on daily basis. The concept of the electric bike is that it can be powered by a human strength but an electric motor also delivers extra capacity. Nowadays, the engine has a maximum speed of 25 km per hour without utilising the pedal mechanism, however, the industry already point to increase the comfortably achievable 40 km per hour speed (TREK Bikes, ebikes.ca, 2014). Research (Milieucentraal, 2014) shows that people can easily be transported by this bicycling mode to longer distances up to 20 kilometres e.g. a higher range than the one which can be travelled by a regular bike. Thus, the electric bike is a good competitor of the car on short distances (up to 10 kilometers). Furthermore, it is a cheap mobility mode, which will be detailed further on. Apart from this, it is self-evident that there is a substantial difference between the electric bicycle and motorised vehicles impact on the environment which determines one more benefit of utilising this mode.



Figure 1.106 — *Dutch Electric Bicycle; www.dailydutchinnovation.com*

An employment of an electric bicycle concept in the case of the Netherlands seems to be a reasonable choice. The use of regular bikes in the country has been adopted as a popular mode of transport since few decades. They are utilised by different range of population varying by age and social class as a main means of transport composing a considerable part of the modal split in 2008 (an average of 22.5%, EPOMM). In almost all parts of the Netherlands including the municipality of Westland a sufficient infrastructure such as separate bicycle lanes on both urban and metropolitan scale is already established. Therefore, there is no necessity of further public expenses. In order to popularize the utilization of the electric bikes stations which provide rented and shared vehicles will be established between Naaldwijk through Honselersdijk to Den Haag. The private bicycles can be also charged from the self-produced energy of a single household developed by the implemented technological adaptations.

Public transport

Another key action towards sustainable mobility network for the region is the proposition of three new ‘green’ fast bus lines and re-organisation of two existing bus routes in the region. These express lines are additional to the existing system in order to increase speed and frequency transforming the regional bus system into a competitive rival to cars. The buses connect the main cities of South Holland Province through the Westland on the existing infrastructure. With relatively limited investment compared to completely new infrastructure nodes, the applicability of a light rail system planned in the next decades finishing the Randstad Rail circle can be tested out. In addition to the bus network,



Figure 1.107 — *Electric bike and various mobility modes*

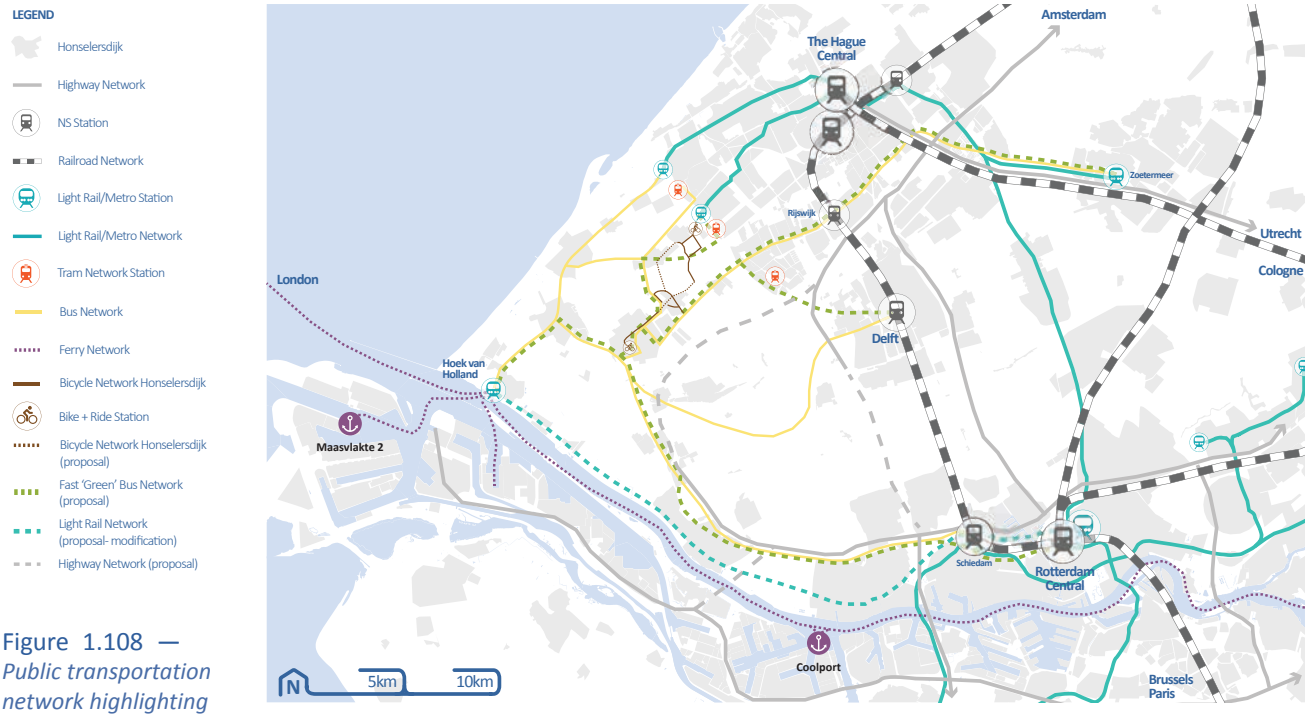


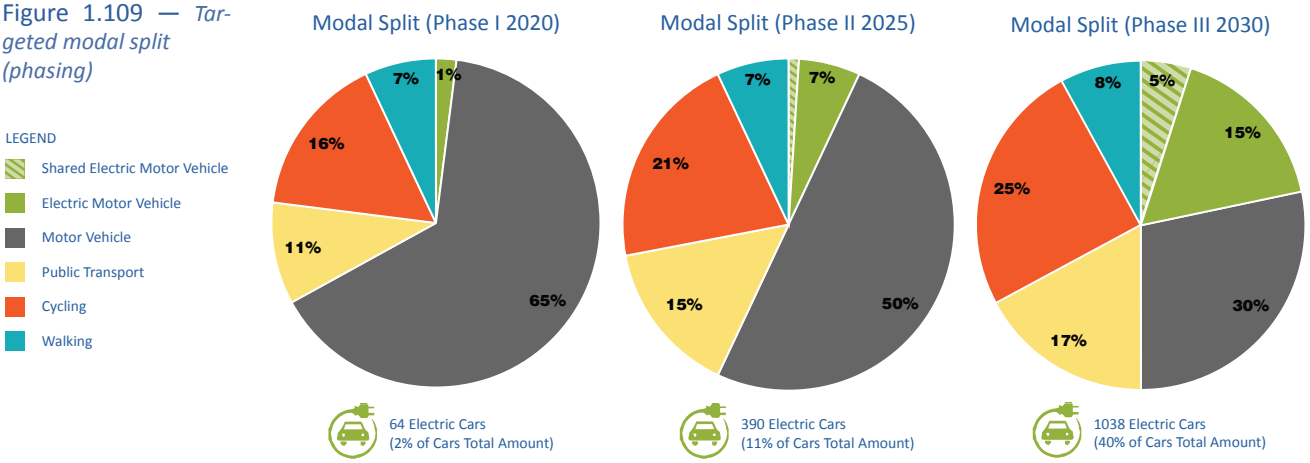
Figure 1.108 — *Public transportation network highlighting the connection between Honselersdijk and the surrounding cities*

the railway route from Rotterdam to Hoek van Holland will be transformed as a part of the successful Randstad Rail network utilizing the existing railway infrastructure. These interventions are necessary since target groups such as elderly and family with children are most unlikely to employ the electric bicycles as a major mode of transportation on metropolitan scale.

As the supporting drawings Figure 1.110-111 indicate it by implementing these minor adjustments the travel time around South Holland is substantially improved as well as different transport modes are incorporated in a multi-modal traffic system. In short, the ambition of this mobility vision is to bring together different towns, e.g. Hoek van Holland and the second Maasvlakte with The Hague or Delft creating a more complex multi-level and faster network promoting lower dependency on private motorised vehicles and urban densification.

As a result of the multiscalar interventions in transportation, by 2030 significant changes are aimed to be visible in the region's modal split. By shifting to (electric) bicycles and giving up private ownership on personal vehicles, a fall of 30% in the total amount of cars in Honselersdijk could be reached. Between 2025 and 2030 the number of electric cars will grow above 1000. Since the quarter of them will be part of the sharing system, the total number of personal vehicles will start decreasing in this period reaching 2600 from 3700. This means the disappearance of 4 individually owned cars for each one shared.

Figure 1.109 — *Targeted modal split (phasing)*



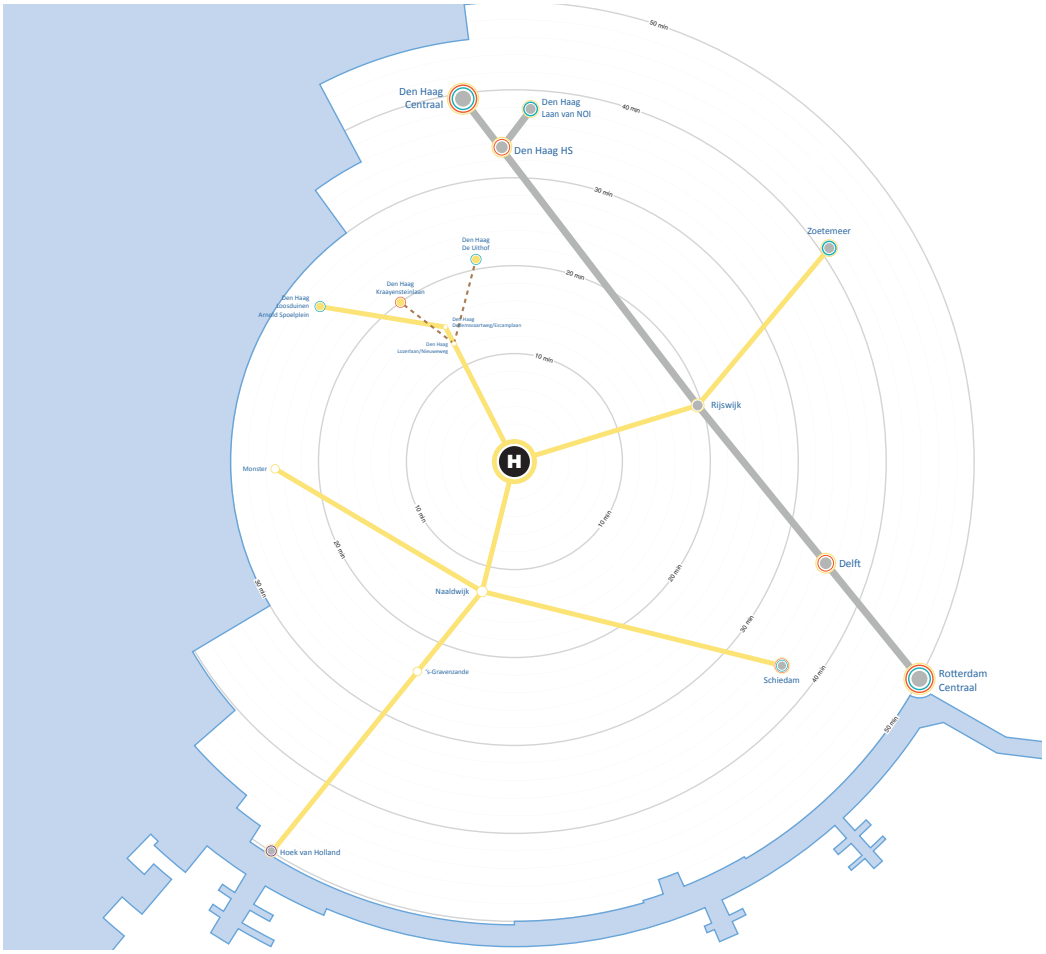
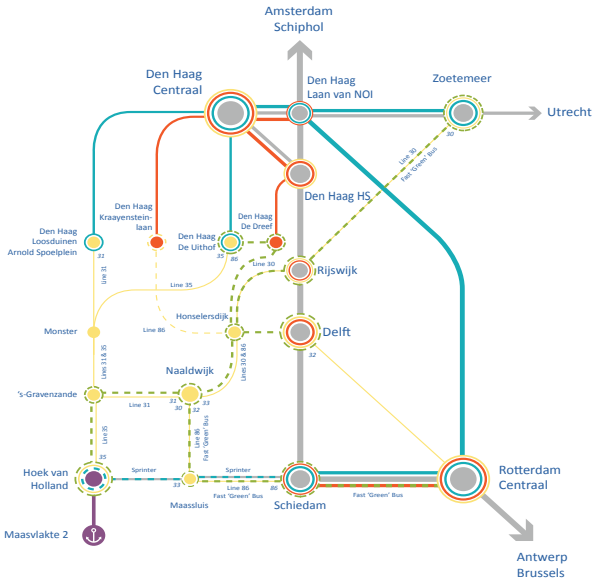


Figure 1.110 — *Spider map representing the fastest public transportation links between Honselersdijk and surrounding cities in respect to the existing public transport netowrk*



Figure 1.111 — *Spider map representing the fastest public transportation links between Honselersdijk and surrounding cities in respect to the proposed public transport netowrk*



Travel Route		Existing Network		Proposed Network	
		Time	Transport	Time	Transport
Honselersdijk	Naaldwijk	13 min		13 min (0)	
Honselersdijk	Rijswijk	19 min		17 min (-2)	
Honselersdijk	DH Kraayensteinlaan	20 min		10 min (-10)	
Honselersdijk	Den Haag De Uithof	21 min		10 min (-11)	
Honselersdijk	's-Gravenzande	24 min		15 min (-9)	
Honselersdijk	Monster	25 min		25 min (0)	
Honselersdijk	DH Arnold Spoelplein	26 min		26 min (0)	
Honselersdijk	Den Haag HS	33 min		31 min (-2)	
Honselersdijk	Delft	35 min		24 min (-11)	
Honselersdijk	Schiedam Centrum	36 min		36 min (0)	
Honselersdijk	DH Laan v NOI	38 min		36 min (-2)	
Honselersdijk	Den Haag Central	39 min		30 min (-9)	
Honselersdijk	Zoetemeer	42 min		32 min (-10)	
Honselersdijk	Rotterdam Central	50 min		40 min (-10)	
Honselersdijk	Hoek van Holland	50 min		22 min (-28)	

LEGEND

- Existing Network
- Proposed Network
- Railway Network
- Randstad Network
- Tram Network
- Fast 'Green' Bus Network
- Bus Network
- Ferry Network

Figure 1.112 — *Connectivity network within the Honselersdijk region including the propositions for public transport network enhancement (above left)*

Figure 1.113 — *Travel time estimation of the existing and proposed networks (above right)*

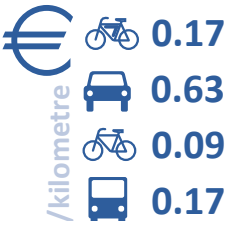


Figure 1.114 — *The expenses of euro cents per kilometre of the different mobility modes (Milieu Centraal, 2014)*

Figure 1.115 — *Financial return of hybrid buses running in the Express network*

1.4.3 Impact of the transportation strategy

Mobility costs

The issue of costs is approached on two levels. On the one hand, the economic feasibility of the proposed interventions is crucial, on the other hand, the cost of facilities for the users is the defining aspect of the success of sustainability. If our envisioned future is financially 'accessible' then the frequently used term of Prêt-à-Loger 'desired sustainability' can truly be applied. As seen on Figure 1.115 a hybrid bus costs 110,000 euro more than a diesel version. Nonetheless, by reducing fuel price by 30% (Hallmark, S., 2012, Volvo, 2012) and with slightly lowered maintenance costs the 'entry-level' sustainable buses in our planned network (running 11-13 times a day an average of 34 km) could return the price difference in 5-5,5 years per bus. In the current practice we experience hybrid buses spreading cities, as it is shown they can be a feasible replacement of their polluting predecessors.

As Figure 1.114 shows, individually cycling is the cheapest alternative per kilometre, 9 cents. In comparison, a small type of car costs about 63 cents per kilometre for an electric scooter nearly 22 cents, and a kilometre on an electric bike costs about 17 cents. This includes the cost of electricity, depreciation, reservation for repair and maintenance and periodic replacement of the battery and these numbers are taken for the same trips in a given period of 5 years. Electric bicycles compete with public transportation in terms of price, however considering the 'registration fee' on buses and trams, for 5-6 kilometres it is a clearly cheaper alternative that is strengthened even further by the flexibility it provides. Private cars are fairly expensive, which in case of sharing possibilities could change the drivers' perceptions regarding ownership.







Figure 1.116 — *'Copenhagen Wheel'; www.i.bnet.com (left)*

Figure 1.117 — *Volvo 7900 Plug-in Hybrid; www.volvobuses.com (right)*

Innovation in Transportation

New technologies are being developped and tested meanwhile this report is being written. From the MIT SENSEable City Lab comes the concept of the 'Copenhagen Wheel' that is a simplified electric bicycle and also smart system controllable by smart phones. In this case the wheel itself can store the energy of pedaling and provide with it in need. In our proposal we have not elaborated the electric buses yet. The reason for this is the incapability of the current batteries to operate as long as this context need them without charging. Nevertheless, Volvo has been testing its 7900 Plug-in Hybrid bus in Gothenburg, which has turned to be a highly successful initiative (Volvo Buses, 2013). The bus saves 81% on fuel consumption and 61% on total energy demand. The bus can run for up to 7 km with charging time of 5-6 minutes. We emphasise that in the Urban Design, Transportation and Affordability chapter Prêt-à-Loger does not suggest exact technological solutions, on the contrary, creates a framework system in which solutions can run in. The presented numbers, facts and assumptions are presented to attract interest in developping detailed measurements.

Population and transportation

In order to highlight the population groups in relation to transportation modes it is vital to conclude the amenities the Province of South Holland offers being as primary targets of mobility. The Region of Westland already offers a range of employment mostly in the agricultural industry, however, the nearby metropolitan areas also provide with a wide range of opportunities. Therefore, many families choose to live in satellite towns in a calm environment from which they commute to the location of daily activities.

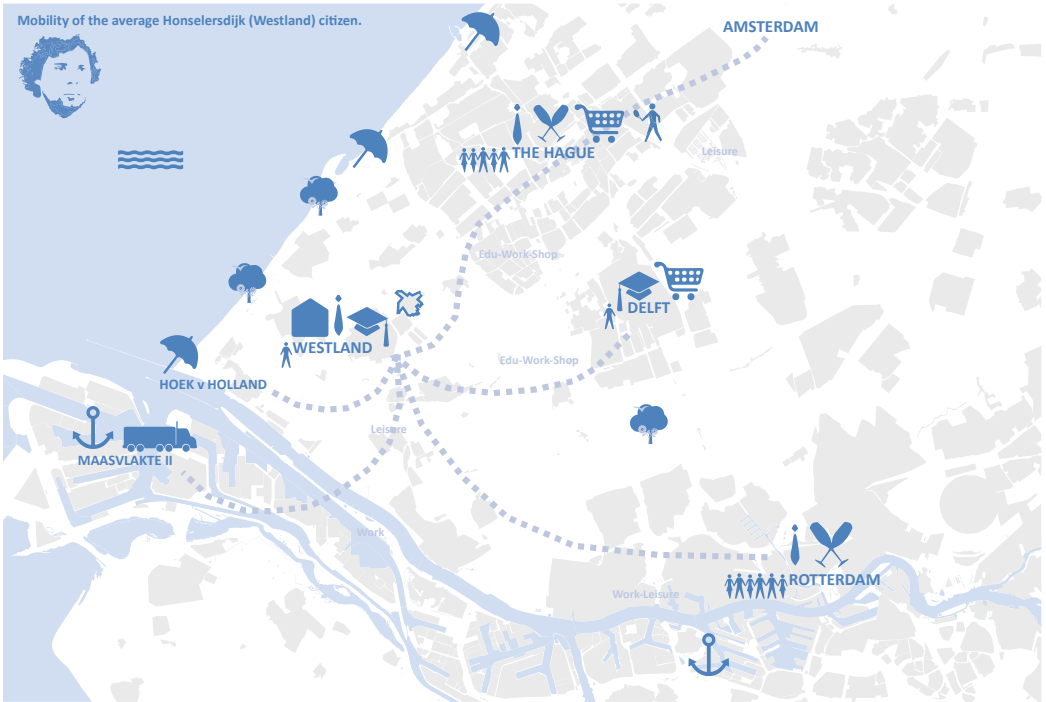
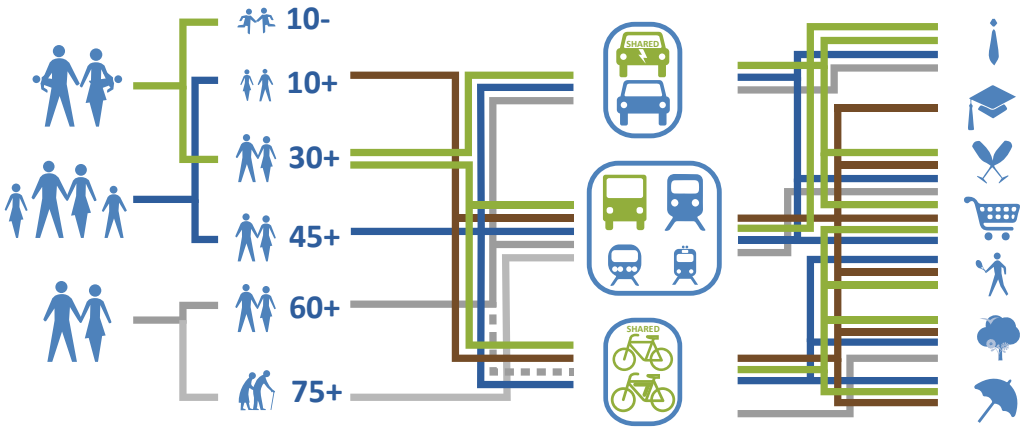


Figure 1.118 — *Activities - Targets of mobility in South Holland*

Figure 1.119 — *Population groups and their choice of transportation modes*



As discussed the large cities offer job opportunities but also education, shopping and leisure activities. In the context of Westland, especially the city of The Hague is in a primary position do to its close proximity (5 kilometres till the Randstad Rail and 10 to city centre). By the proposals we also aimed to bring the Westland closer to the knowledge centre of Delft. The coastline of South Holland Province is mainly a recreation zone.

This brief overview of destinations introduces the modes of transportation of different population groups. As presentation of our family models we divide our 3 examples presented in the Market Viability sub-chapter into the main target groups. A young sustainable minded family (adults in their early thirties, possible small children) takes advantage of all new possibilities. By their limited financial resources and low-footprint mind-set they enjoy the opportunity of sharing electric cars with the community to office or when they take the kids to day-care. These routes are also handled on electric bicycles depending on weather conditions. A new faster public transport is a comfortable, thus viable option for commuting. The nearby primarily recreation activities are reached on bikes due to the easy accessibility and their zero pollution.

A middle aged family with adolescent children is the most versatile in terms of mobility. The parents less concerned about sustainability drive at least one private car but also can take part in the sharing network. The adults use the car for most directions, even so, having a break on recreational routes occasionally. Adolescent youth, on the other hand, prefers to ride the cost efficient public transport and even more feasible bikes. The possible distances of education and entertainment facilities are easily reachable with electric bikes without having to be relied on public transport schedule at any time of the day providing with flexibility to the group that demands it the most. Many elder adults in the Netherlands have the possibility of car ownership, which they use both for work and other activities. However, they continue cycling for shorter distances and health reasons. For those who do not drive anymore the fast and reliable public transport reaching the centres of the region become a handy opportunity.

Housing, Transportation and Energy

Prêt-à-Loger has been driven to combine sustainability with affordable living. Since major unbalance in relation to the future of the planet is connected to the urban sprawl in the Netherlands with high percentage of private vehicles (1,7/household) and low housing energy efficiency due to the post war mass produced stock, for the Solar Decathlon Europe competition we address the rural setting. Families move out to these towns to provide with a calmer living environment and on many occasions cheaper housing opportunities. However, energy and commuting prices are gradually rising. Therefore, in our proposal we want to prove that self sustaining dwellings, community driven neighbourhoods and renewable energy based transportation system can be created in coherence on different scales.

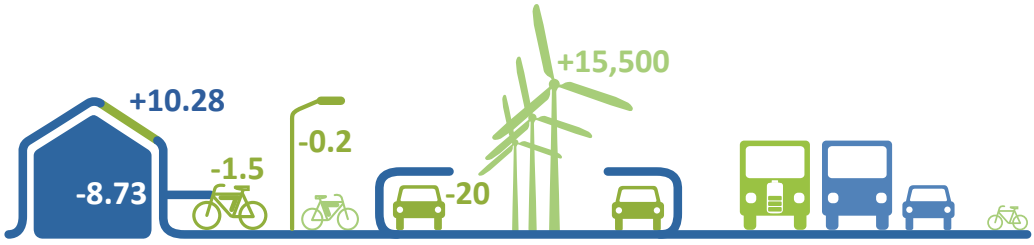


Figure 1.120 — *Energy correlation of housing and transportation*

As presented earlier energy generation through solar PVs on the roofs could produce sufficient amount of energy for housing but also could support the daily full charge of an electric bicycle (or more bikes with less frequency) as well as the street lights in the neighbourhood. Electric cars and hybrid buses are supported by solar energy but predominantly relied on wind energy that can efficiently supply the system of a whole region. As shown in Figure 1.120, based on our estimation one wind turbine could support more than two Honselersdijk-size (7000 inhabitants) towns' energy demands for cars in 2025 and fulfill one town's need in 2030, even so, it is fairly hard to predict the energy demands and technologies 15 years ahead.

Reflection

In particular, the proposed transportation strategy aims to enrich the possibilities for mobility of local inhabitants on both urban and metropolitan scales. The plans pay considerable attention to the contextual conditions within the territories of South-Holland province. However, the concepts of electric automobiles promotion and sharing vehicles e.g. bikes and cars are approaches which seem to be applicable to other regions in the Netherlands in order to tackle the issue of car dependency, the main facilitator of urban and environmental conflicts.

It is vital to address that Prêt-à-Loger does not address urban sprawl and suburbanisation directly. The focus has been placed on the effects and unsustainabilities these created in the Netherlands instead. Regional policies already set the boundaries of new developments, thus keeping them within the existing urban areas. By optimising the transportation networks allowing the densification of smaller towns and rural areas energy efficient housing and transportation can be created. What is more, the currently underdeveloped urban environments can gain a boost as well by the enhanced infrastructure. Although relying strongly on the societal aspects such as desirability of the sharing vehicles and resources the presented strategies possess powerful capacity to transform regions into highly sustainable and environmental-friendly areas.

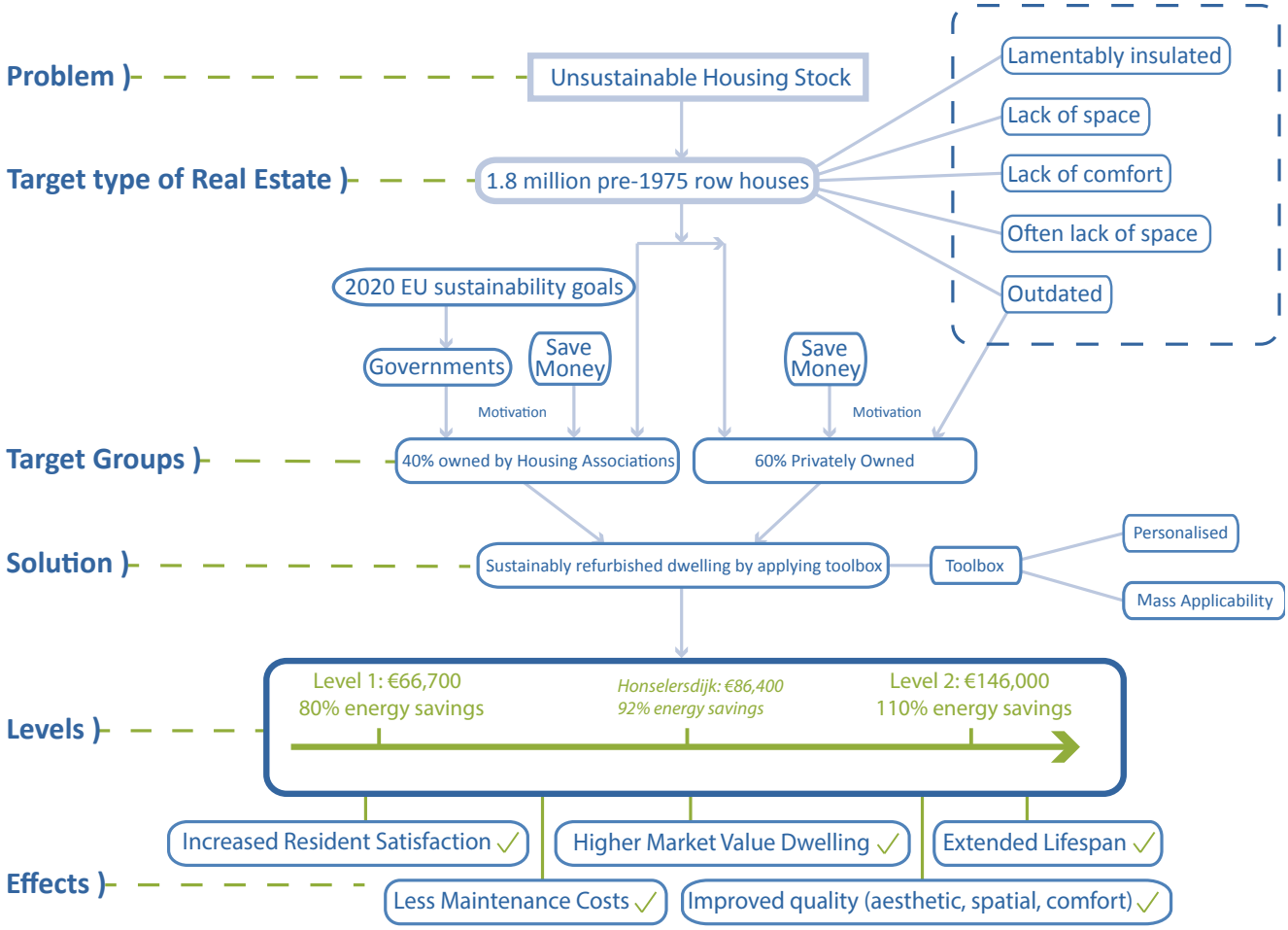
1.5.1 Strategies towards global cost of the project

Prêt-à-Loger

Since humanity has only one planet, one home, we cannot simply construct a new one. On a smaller scale, this same school of thought applies to societies. In order to counteract processes that induce environmental exhaustion, the focus on constructing new buildings shall be rather directed on improving the existing building stock. This approach both reduces the consumption of natural resources and preserves the current urban DNA and the emotions and memories inhabitants have developed out of them. Out of this mindset, Prêt-à-Loger was born; a movement which has the potential to become a nationwide movement or even regional in the North-European perspective.

As stated in the Market Viability Chapter (see 1.2), the poor energy performance is not the only problem of the row-houses, but the quality and comfort are lacking as well. Responding to the individual challenges, the personalised Renovation Toolbox (see Chapter 1.2.2), which enhances energy performance, adds more space to the house and gives a personal dimension to the refurbishment. Furthermore, the comfort level and dwelling value significantly increase. The toolbox ranges in elements and price, but the innovative solutions always enhance the technological performance.

Figure 1.121 — *Prêt-à-Loger in a nutshell*



The product

In particular, the main product of Prêt-à-Loger is the Renovation Toolbox, which always includes a minimum set of elements improving the energy performance of the house. In addition, our main innovation is the Skin, an integrated system of a glasshouse and sustainable technologies covering the existing dwelling. Therefore, the glasshouse is considered as a fundamental part of the product.

Within the renovation toolbox the amount of options would in principle only be limited by products available on the market. For the sake of simplicity the different stakeholders are chosen for a limited set. For example there is a level 1 option to keep the previous garden floor and add only foundation for the glasshouse at the cost of 1,180 Euro. A more luxurious option, level 2, would be to add a new tiling floor, which costs 6,050 Euro. (see Appendix 'Toolbox', pp.1021). If desired a specific tailor made solution could be applied but the competitive prices based on industrialised production will be mitigated.

By offering different packages within a wide range of investment options, a broader target group can be reached. The investment options currently cost between 66,700 and 146,000 Euro but these costs are likely to decrease in the near future. The cheapest package will provide the user with energy savings up to 80%. The most expensive package can reduce energy consumption by 110%. The higher the energy bill, the more attractive higher investment opportunities become. For residents with energy bills lower than 200 euro per month a limited package is feasible. The high-end solutions start to become more attractive to clients paying over 300 euro per month. Residents can certainly choose to invest over their regular energy bill as well.

Investment

The currently available lowest level is already economically feasible to be implemented without a financial gap if taken with a payback period of 50 years. For a twenty-year time, a small financial gap of approximately 7,000 Euro remains. Later this chapter, it will be explained how certain developments such as the increase of energy prices and the reduction of production costs, could make the 20 year version become economically feasible as well.

As illustrated on Figure 1.122 a decline in production costs will aid the price of the solutions driven by innovations in fabrication of materials and mass production. After consultations with (sub)contractors, it is concluded that this decline in production costs is likely to occur during the first ten years, after which it will bottom out and start to grow parallel to inflation. As soon as the different investment levels have bottomed out, the initial investment at that moment will be made up almost entirely out of labour costs and material costs, with a small profit margin for the different (sub)contractors in the

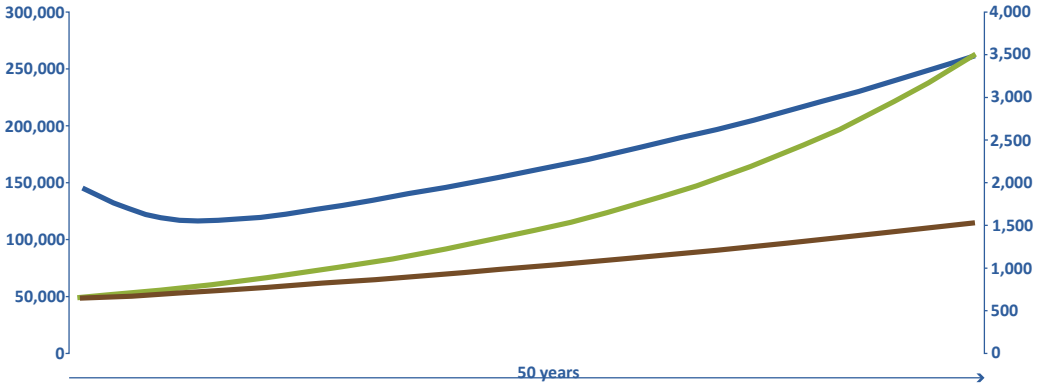


Figure 1.122 — *Initial investment costs and total dwelling costs over time*

Figure 1.123 — *Present value investment and adjusted maintenance costs over time*

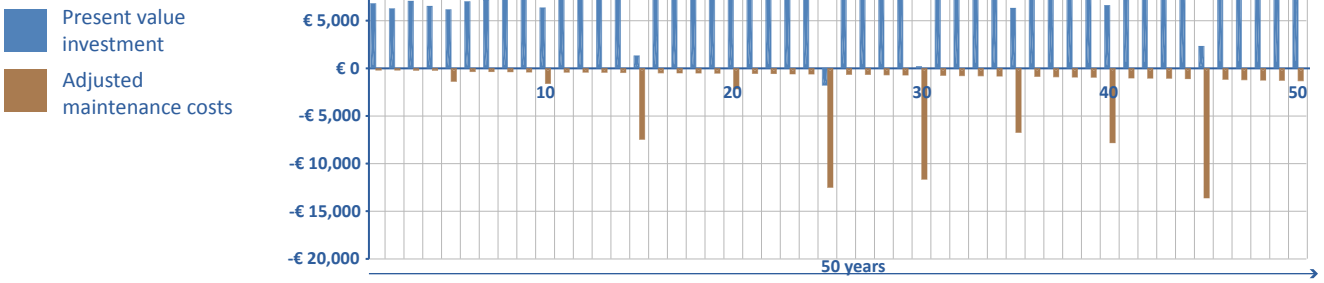
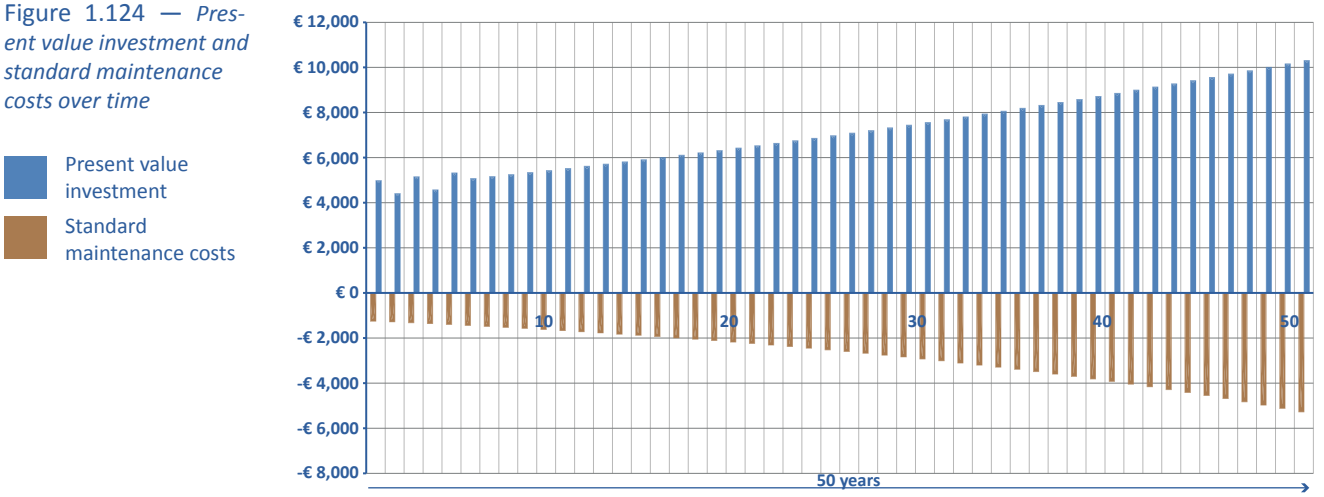


Figure 1.124 — *Present value investment and standard maintenance costs over time*



supply chain. Furthermore, if Prêt-à-Loger successfully enters the market, increased competition between contractors and producers will also have a positive impact on the financial matter which helps to reducing costs during those first ten years.

Variables influencing the investment model

In accordance with housing corporations and contractors, another mode of maintenance has been chosen. This will be comprised of relatively low annual costs, with solely regular check-ups and small reparations annually. However, every 5 years, larger efforts are made to maintain the dwelling. These are also the timeframes in within certain installations need to be replaced, such as the PV Cells after 25 years. The benefits of this strategy is shown on Figure 1.123. The low fixed maintenance costs entail regular check-ups to forecast eventual future problems efficiently. Over a longer period of time maintenance costs are saved.

On the contrary, the standard operational manner of Dutch housing associations has always been to exude a fixed yearly sum for maintenance between 1,200 to 1,500 Euro per year in average. The disadvantage of this approach is that it generates much higher costs over the years then the aforementioned method.

The increase of energy prices (presented on Figure 1.125) is another variable to take into consideration. Over the last 15 years household costs of electricity have risen by 140%, while gas prices have increased by 300% (Tensen, 2011). For the next 10 to 15 years the continuation of the steep increase of energy prices of fossil resources is projected. What will happen afterwards remains uncertain. However, it is assumed that prices of fossil fuels will continue rising at the same pace due to scarcity and a growing global demand. If these conditions will benefit energy neutralising refurbishments such as the 'Home

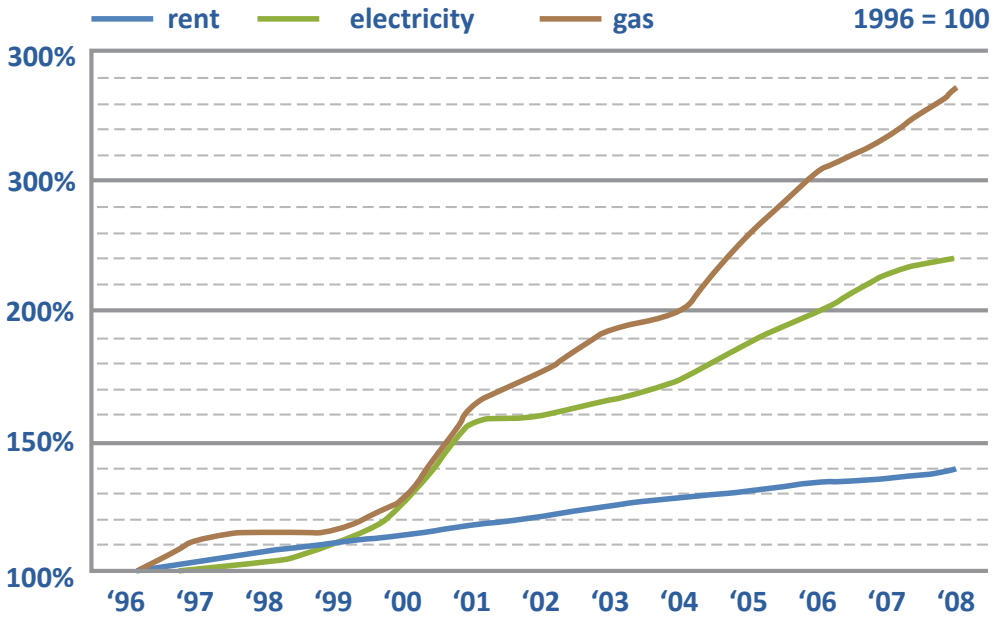


Figure 1.126 — *Rental, electricity and gas prices over for the period 1996-2008*

Figure 1.126 illustrates the correlation between the required level of investment and the total dwelling costs development. This consists of monthly rent or mortgage costs added to the monthly energy expanses. Since the first variable 'rent/mortgage' is rather fixed and stable, gains are to be sought in reducing energy related expeditures. The dashed lines on the graph represent the total dwelling costs development as a result from the refurbishment.

The solid blue line shows the initial investment cost of the cheapest investment level, level 1 (line A1). The green solid line provide with the initial investment required for the Honselersdijk version (line B1) while the solid brown line represents the initial investment costs for the most expensive level (Line C1). The expected rise of energy prices is plotted in the graph as well (line D).

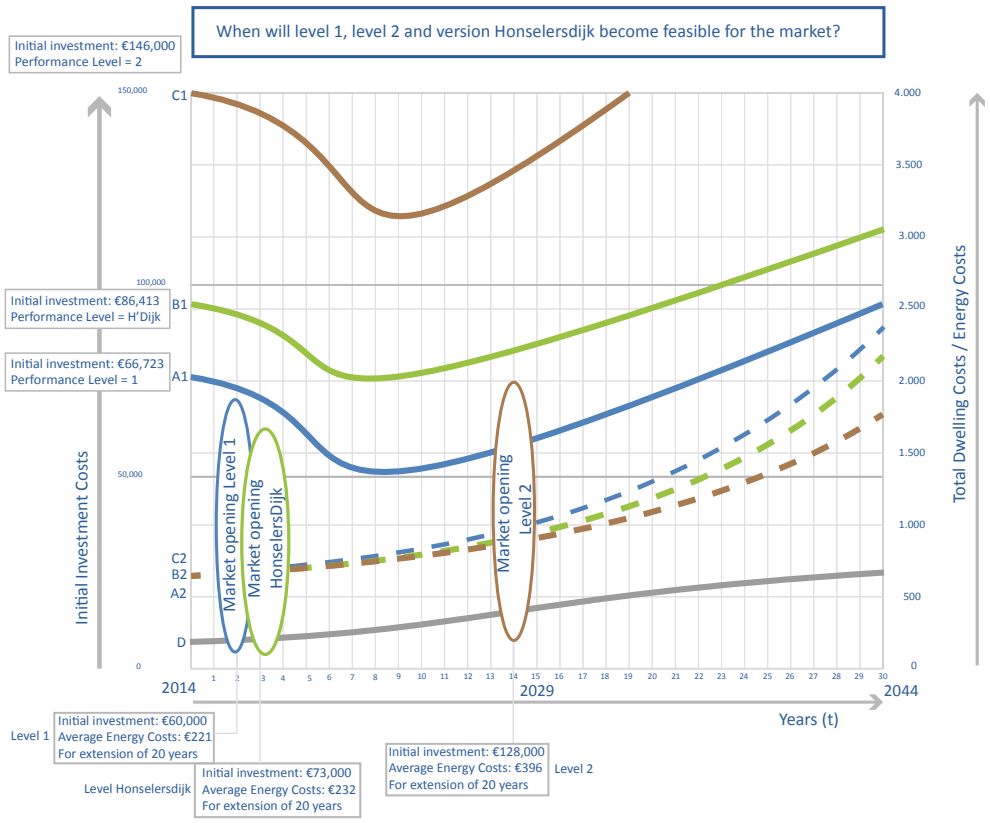


Figure 1.125 — *Feasibility in time of the renovation packages offered by Prêt-à-Loger*

A1 Initial Investment Level 1
A2 Total Dwelling Cost Development

B1 Initial Investment Level Honselersdijk
B2 Total Dwelling Cost Development

C1 Initial Investment Level 2
C2 Total Dwelling Cost Development

D Expected Energy Price Development

As can be read on the figure, the higher the initial investment costs are, the lower the total dwelling expenditures will be during the subsequent years. The solid line and its dashed counterpart are therefore inversely related. More savings are realised on the energy bill by the higher initial investment. Redundant energy can also be exchanged in the grid for financial compensation instead of local use.

Market value, discount rate and mobility effects

A highly important variable not included in the chart is the increased market value of the premises. For the housing associations this is calculated by dividing the rental income of the first year through the Gross Initial Yield (the percentage of the investment that the investor expects to earn back during the first year). Since housing corporations can charge the amount of the pre-refurbishment energy costs this will consequently result in a higher market value after development. For private homeowners the market value of similar dwellings in the direct surroundings is important as well.

In general, as a rule of thumb, it can be said that sustainable refurbishment from energy label F or lower than an energy label A will cause a market value increase of around 5-15% depending on original price class of the dwelling and location. Besides this value can increase even more if extra qualities are added to the dwelling such as extra space, improved aesthetic qualities and extra comfort. Prêt-à-Loger assumes that an extra 5-10% increase can be expected due to these reasons. This advantage can then be used to subtract from the financial gap on the investment.

Another aspect that plays an important role is the discount rate that calculate future revenues to present values. The term includes inflation and the interest on the loan (if applicable). For the calculations a discount rate of 4% has been taken for housing corporations with interest on an eventual loan covered. For individual homeowners a rate from 5% to 6% would be reasonable due to their less appealing bargaining position (higher loaning risks compared to housing firms).

Last but not least, another essential aspect of the financial benefits is transportation in relation to housing. In current trends families move to suburban towns seeking affordable housing options in row house neighbourhoods. However, this considerably raises their expenditures on mobility, especially on fuel. As presented earlier energy generation through solar PVs on the roofs could produce sufficient amount of energy for dwellings but also for transportation. The proposal of Prêt-à-Loger has the capacity to provide with free resource for personal mobility. As Figure 1.114 shows, individually cycling is the cheapest alternative with 9 cents per kilometre. This distance on an electric bike that is capable of returning from 20 kilometres costs about 17 cents (including depreciation, and maintenance) given a period of 5 years. Considering the registration fee on public transportation each ride this mobility mode clearly competes with public transportation in terms of price. What is more, business models can incorporate the inclusion of an electric bike with every ‘skin package’ sold. Private cars remain to be fairly expensive over 60 cents per kilometre, nonetheless, this trend will change due to sharing possibilities and localised sustainable energy generation from the end of this decade.

1.5.2 Business Model

Problem owners - Clients

For the Prêt-à-Loger business model problem owners are sought possessing outdated and (in terms of energy performance) malfunctioning row houses. In the Netherlands housing corporations owning 40% of the row house stock while 60% belong to individuals. The entreprises are searching for ways to sustainably preserve their housing stock, although, they are not able to set-up large scale replacements in most cases. Refurbishment is thus preferred that avoids problems and associated costs with organising temporary accommodations. Housing corporations are an appropriate target group due to
(1) being motivated to extend the lifespan of their stock,
(2) being pressed by governments to cooperate achieving sustainability measurements,
(3) being able to make bigger investments over longer periods and
(4) having large blocks of uniform Real Estate simplifying the refurbishment process. The average payback period housing corporations use for such investments is within the range of 20 to 50 years.

Individual homeowners are also interested in the benefits of a sustainable renovation. However, as stated before extra comfort, more space and improved aesthetic qualities are more important then the energy bill. With inhabitants often being incapable of investing large amounts for long payback times, another type of investment model has to be used. The average individual homeowner stays in the same house for averagely 11 years (CBS, 2013), hence a solution has to be sought in attaching a 20 or 50 year contract to the house rather than its inhabitant. The initial investment could then be done by external investors. Furthermore, lots of individual homeowners have made modifications, which complicate the refurbishment process to to the specific requirements. Private homeowners remain an interesting target group dueto their size. On the other hand, housing associations have imminant characteristics that make them more attractive market in the short term.

A point of discussion for further research would be how the attached contracts will influence the attractiveness of the dwelling when it is for sale. It is a question whether the new tenant will not feel reluctant to purchase a house with monthly extra costs attached. A crucial role is therefore reserved for the marketing of the product.

Stakeholders and the building industry

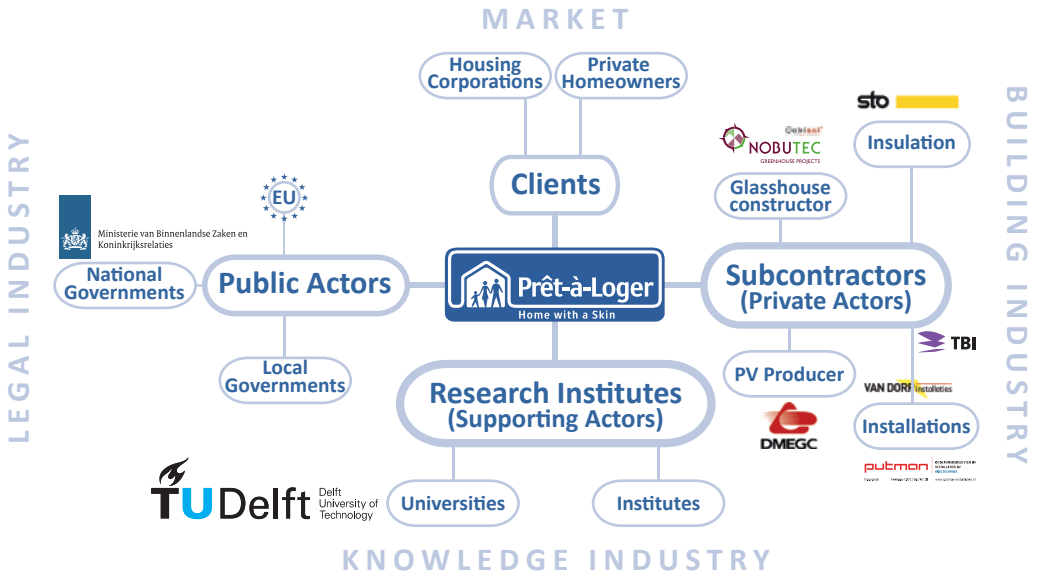
(1) Clients

Housing corporations can set the process in motion by willing to refurbish entire blocks at the same time. Once the Prêt-à-Loger method is successful new blocks will follow. Such a kickstart is needed all the more to also create the awareness among society. A successful start can thus convince doubtful stakeholders and enhance nationwide support. How private owners are reached and involved in the process will be elaborated upon later in the chapter.

(2) Public actors

There is an important role for national and local governments. If the monthly price that tenants save on their energy bill is added on top of the rent, it will cause an increase that will most likely surpass the social payment limit. Without legislative changes tenants would jeopardize their rental subsidies. Governmental interference is currently happening by making exceptions for social rent subsidies for those whose expenses surpass the €650 limit.

Figure 1.127 — *Project stakeholders*



(3) Private actors

Contractors and subcontractors from the construction industry are actively involved from the beginning creating an environment of trust. There are already examples of firms that have been involved during Prêt-à-Loger's conceptualisation and piloting.

(4) Supporting actors

Research institutes such as the TU Delft will remain actively involved in order to ensure that new problems that emerge can be rapidly tackled, so that the process will be smoothened along the way.

(5) Prêt-à-Loger

The role of Prêt-à-Loger in the field of stakeholders is very diverse. In general it is the central hub between all the stakeholders safeguarding the concept, the process and the desired end result without aiming for profit. On the other hand, it cannot be ruled out that a commercial spin-off will emerge out of the team. The team possesses by 60 students and teachers from various disciplines brings together and consults stakeholders as well as aligns the different processes in the scope of the respective body of knowledge.

Explanation of the two different periods: 20 and 50 years

For both level 1 and level 2 and any other option in between, there are two different payback periods in relation to the competition framework as well. Considered over a period of 50 years, the cheapest investment possibility, level 1, seems to be economically feasible. For a period of 20 years, all investment levels remain with a financial gap due to the high initial investment costs. Therefore, it has been estimated when these 20 year payback models would become economically feasible taking into consideration the decline of production costs (due to innovation and upscaling) and the rising energy prices. The investment level 1 and for the average variant of Honselersdijk are extrapolated and estimated to become economically feasible within two to three years. However, extrapolating the current trend of rising energy prices and the expected decline in production costs, the high-end packages are projected to become feasible in 12-15 years.

The business model consists of many variables, such as the energy bill and the increased market value of the dwelling as well as maintenance costs after the refurbishment. This information is summed up in the developed business model (Figure 1.126) that comprises the two main target groups. As adressed before highlighting the advantages, housing associations have the focus in the beginning.

The model shows that the money tenants or homeowners used to pay for the energy bill will be used to repay the debts on the investment for the sustainable refurbishment. For private homeowners, this repayment will be stipulated in a special contract attached to the house in order for it to be inter-changeable among homeowners. For tenants this simply means an extra bill on top of the rent. Instead of paying to the energy company, they now pay this extra bill to the housing association.

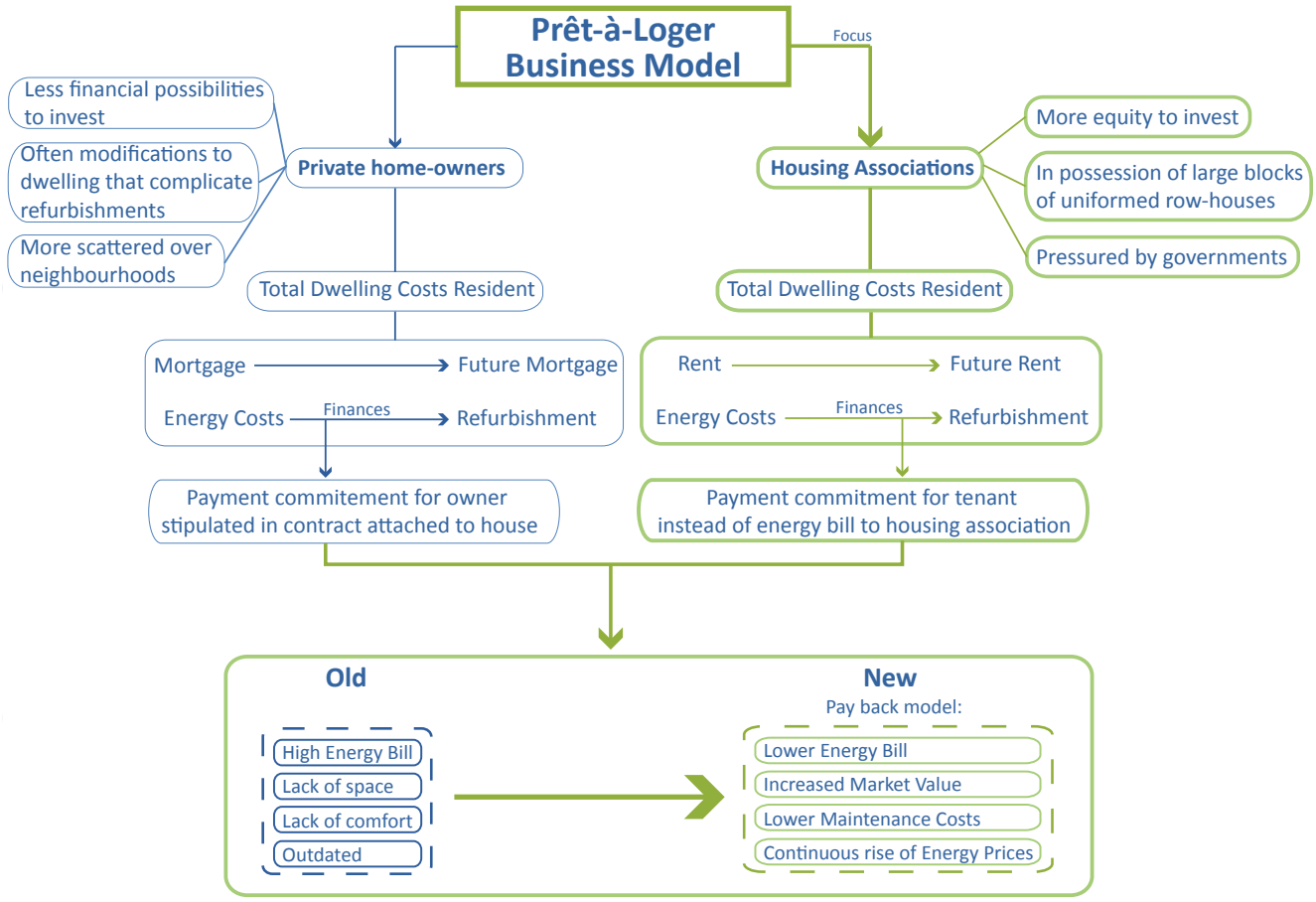
The 80-20 rule towards 2020

As explained before investment costs of sustainable refurbishment are significantly different when targeting 80% or 100%+ energy efficiency. Achieving the last 20% costs more than twice the price. In the light of the 2020 sustainability goals set by the European Commission and adopted by the Dutch government it is obligatory to increase the share of sustainable energy by 14%. The only question is whether '100% energy neutral houses' shall be prefered over 'ones of 80%' for less than half of the development costs.

In accordance of the sustainability goals of the Dutch government, it is wiser to start refurbishing row houses currently up to Level 1 targetting 80% energy neutralisation. If the dwellings are equipped with the Prêt-à-Loger toolbox, the energy performance will have the potential to be improved in the future by the newest technical upgrades and adjustments. New generations of PV cells become more efficient every year. In 20 years these will likely provide with energy neutralisation. Currently, by renovating a mass of row houses to an 80% level, a real leap forward can be made in terms of sustainable energy usage.

In conclusion, aiming for entirely energy neutral dwellings is too costly and assumed not to happen. This is why Prêt-à-Loger facilitates the transition phase targetting larger

Figure 1.128 — *'Home with a Skin' business model*



amount of houses to achieve 80% neutralisation. Keeping an eye on the option of becoming 100% sustainable in the future accomplished by the flexibility of the Renovation Toolbox is vital, though.

Marketing the product

The Prêt-à-Loger team will further develop the Renovation Toolbox and aims to apply it on as many houses as possible. The commercial homeowners will be reached through existing networks and initiatives such as 'de Stroomversnelling' and 'de Energiesprong'. They are elaborated upon in the Market Viability Chapter (see 1.2.2). In summary, these two movements emulate a transition towards a more sustainable housing stock, by refurbishing existing underperforming dwellings. Prêt-à-Loger perfectly fits within these movements and hence can develop these networks' connections.

The private homeowners will be reached through a so called 'renovatiewinkels', which means 'refurbishment shops' where houseowners can get information about sustainable refurbishments and they can immediately purchase a renovation (www.energiesprong.nl, 13.03.2014). Information of Prêt-à-Loger will be available here, so that potential clients can get acquainted with the concept. If the concept is successfully adapted by a few, more individuals from that same street are expected to follow. Thus, it is vital to actively involve early adopters in the strategy for private homeowners.

Post-Versailles Prêt-à-Loger

Prêt-à-Loger goes beyond participating in the Solar Decathlon Europe competition. The project seeks continuation on the foundations that were laid within this framework. Partners of Prêt-à-Loger have provided the necessary funds to develop this product and to test it for a period from 2 to 10 years. Among the various stakeholders a serious base has been laid for future developments surrounding the concept, which has emerged at a time of realising the importance of sustainable renovations in the Netherlands.

In the beginning, Prêt-à-Loger came into existence as a competition entry just as many of the other Delft teams that participate in challenging international competitions. However, during the conceptualisation phase it became clear that the project should look beyond the contest framework. In the long term a deriving team from this student team could take on the central role in the Prêt-à-Loger framework and become a commercial party. As a start, the concepts of the technology will be tested on a 1:1 scale model à la Cité du Soleil in Versailles, France. After the start in July the team will function as first movers, experts of the concept and as consultants towards the other stakeholders in the network. After the competition the house will be placed in the Green Village, a sustainable exhibition site of the university, which accommodates different concepts, projects and other sustainability related features. There will be new possibilities for Prêt-à-Loger to evolve here.



Figure 1.129 — *Green Village at TU Delft, the next home Prêt-à-Loger; Source: www.profadvanwijk.com*

During the first year various tests will be executed to see what direction to develop in terms of technical and emotional aspects. In an experimental study, several inhabitants of a row house will be asked to live (for a short period, such as one or more days) in the Prêt-à-Loger home. They will be monitored and interviewed afterwards about how the climate performance affects 'every day' comfort. However, not only clients will visit the site but also the existing and future stakeholders. What is more, even parties from other countries (especially from North-Western Europe) are expected to be interested in the house, the improved home.

Reflection

From all sides different parties are looking into ways to reduce energy usage. Governments have outspoken ambitious goals to create a more sustainable housing stock. Where most parties focus on demolition followed up by new construction or a purely technical renovation, Prêt-à-Loger realises that the solution for this problem does not reside in demolishment and replacement of the building stock but in preserving and improving it. This is not only provide a more sustainable urban environment but embraces all the emotions and memories inhabitants developed with the current dwellings as well as protecting the existing urban DNA. The potential for sustainable refurbishment of dwellings is immense offering 1.4 million pre-1975 row houses.

The proposal to confront the challenges of such a market is a configurable system that can be taken complete or partially as a way of home-upgrading in an affordable way. The taylormade improvement packages in the form of a toolbox result in varying investment prices, energy saving measures and different increases in market values. Clients, in the form of individual homeowners or housing associations can choose whether they want to earn back the investment within 20 or in 50 years. If they opt for the shorter payback period, all investment options currently still entail a small financial gap. Due to expected energy price rise and decreasing production costs, a substantial part of the toolbox packages between level 1 and 2 will soon become economically feasible. The sustainable refurbishment of all these dwellings will create thousands of new jobs and generate new experience and knowledge. This can also enhance the position of Dutch enterprises in the international housing and renovation sector.

In the Netherlands several large contractors have developed and are developing solutions to create renovations making dwellings energy neutral. What makes 'Home with a Skin' unique is the emphasis on end-user demands. Flexibility in application and the addition of space remain unseen in present context. The design has generated considerable interest of both housing corporations and inhabatants alike not just because of the entry in the Solar Decathlon Europe competition but also due to the development opportunities after the time in Versailles.

2 Architecture design narrative

2.1 Architectural concepts

2.1.1 Introduction

Even though it might sound strange at first, Prêt-à-Loger is not about applying the newest technologies and applications. It is about retrofitting the existing. In current society everything seems to be possible, technology is developing at a tremendous speed and all seems to be labeled as innovative. But what is innovation? We believe that innovation is not just about the 'newest,' the 'brightest' or the 'seemingly impossible.' Innovation is about using the current knowledge for providing an answer to the biggest challenges. This challenge is adding quality to the 'uninspiring' existing building stock and making it future proof for next generations to come.

The first step is to look at this stock, these houses and at the people living in them, with their stories, needs and possibilities. In the existing building stock, houses vary in different shapes and sizes. For example the case study for this project in Honselersdijk; in the street Stompersdijk, multiple houses are inhabited by residents of various ages, backgrounds, financial possibilities and interests (discussed in paragraph 1.1.3).

Prêt-à-Loger's prototype is the answer for that building stock. With its solutions it is possible to face the post-war, mass produced, housing stock, addressing the different families' needs, while developing a sustainable housing stock. The prototype is the realisation of the Toolbox, which is used to cover the differences that can be faced within the whole building stock. It gives the user a broad range of solutions, which can suit their financial possibilities, interest and needs. With "The Skin" comes the solution to the differences in sizes that could be found among the row houses; being fully adaptable in width and height. In fact, the glasshouse technology is capable to fully face the problems that can occur on refurbishing mass produced housing. A technology that is derived from its surrounding in Honselersdijk, an almost endless amount of greenhouses that produces vegetables for all over the world. By combining the advantages of the greenhouse industry and the viability of housing, both existing for centuries and evolved to its most efficient, will create a new, future proof concept.

With this prototype Prêt-à-Loger shows that The Netherlands is ready to face the challenge. It is about making quality achievable for all people, turning the uninspiring and malfunctioning houses into high quality, affordable, energy neutral and, above all, livable homes.



Figure 2.1 — *Family enjoys concept Prêt-à-Loger.*

2.1.2 Where the story starts



Figure 2.2 — *Visualisation time setting of project description. Will be used in the whole document for support.*

Honselersdijk, the story of *Dennis*

The architectural story starts in the Dutch town Honselersdijk, near The Hague. To be more specific, in the street Stompersdijk. In this street the house is located where Dennis grew up and his parents before him. A house that provided three generations a warm home [figure 2.3 - pp. 93].

“The story actually starts before the point my grandparents moved to Honselersdijk. You have to know that in that period, after the Second World War, a big housing shortage had hit the Netherlands. In the 1960’s it was even called public enemy no.1! Families where forced to share their houses with multiple families and so did my grandparents. They lived in a small house in Haarlem with another family. They were really lucky that the occasion occurred to move to the house in Honselersdijk. A just finished rental house in the, back then, outskirts of Honselersdijk. A small town in the Westland area, where the greenhouse industry was already the main economical driver.

The house was not very big, but for a starting family, and seen the fact that there was a general lack of houses, it was perfect. My father was one year old when they moved in. He has spent his whole youth in Honselersdijk. He is still telling me stories about the local football club and the work he did as a teenager in the greenhouses. These greenhouses create the unique characteristic of the neighborhood; typical Westlands (region in the Netherlands between The Hague, Delft and Rotterdam). Until my father married my mother he lived in Honselersdijk [figure 2.4 - pp.93].

A few years later I come in the picture, literally [figure 2.6 - pp.93]. The window you see on the picture was one of the most exciting things of the house, since I could play restaurant with my sister. I remember the neighborhood as a mixture of houses: some were really nice, others looked ugly. By then there were not that many cars around and enough playgrounds for kids [figure 2.7 - pp.93]. Picture 2.6 is taken almost 30 years later than the one were my father is playing pirate [figure 2.5 - pp.93]. You can see that the greenhouses evolved to cheap, efficient production facilities, with the typical white chalk on the windows that -still now- protect the glasshouses from the sun. I remember that there was still enough space to play on the streets and even to use it as construction site [figure 3.8]. My main feeling of the house was that it has been a warm and friendly home to me and my family!”





From left to right:

Figure 2.3 — *House in street Stompersdijk. Grandmother, father and uncle of Dennis.*

Figure 2.4 — *The day Dennis father married.*





Figure 2.5 — *Action Plan for University, City, Country and International scale*

Figure 2.6 — *Same location, 30 years later. Dennis as a little boy.*





Figure 2.7 — *Playground for kids ...and adults... Behind are some terrible houses.*

Figure 2.8 — *Doing construction with my grandfather; on the street*



Figure 2.9 — *Dennis his home: 20 years have passed*

2.1.3 The current state: problem analysis

If we would revisit Dennis his house nowadays, we would consider it to be a clearly outdated post-war dwelling [figure 2.9 - pp. 94] Both spatial and climatic conditions of this dwelling are far from the current living standard. First of all this house consumes massive amounts of energy, around 1800 m^3 of natural gas each year (SenterNovem, 2007a). Secondly, the building physical state of this house results in comfort problems such as moisture [figure 2.10 - p.94]. Finally, however at least equally important, this house lacks space regarding the living standards of common Dutch families [figure 3.11 - pp.94]. This is also one of the reasons why the building standards and regulations change every few year.



Figure 2.10 — *Humidity problems. Attic of Dennis his home.*



Figure 2.11 — *Lack of space: very small living room. Dennis his home*

This case study however is not just about this one specific house: around 60% of the building stock in Holland is a row house typology (Rijksoverheid, 2013a) and around 25% of the building stock is from the post-war period, 1945-1969 (Rijksoverheid, 2013b). It all comes down to roughly 1,4 million dwellings of this post-war row house typology (SenterNovem, 2007b). Dwellings that share the same outdated climate and spatial conditions as Dennis his home. In this existing building stock lies the biggest sustainability challenge of the Netherlands. So what is the future of this typology?

Shouldn't we just demolish these houses?...

2.1.4 Improving your house, preserving your home

Prêt-à-Loger believes that demolishing these houses is not the right solution for the future. If we listen more closely to Dennis his story, it becomes clear that there is also a very positive side to these houses: they have always been providing a warm home. Not only for Dennis, but for at least 1,4 million families in the Netherlands. Really being a typical Dutch dwelling, where people have always been associating with.

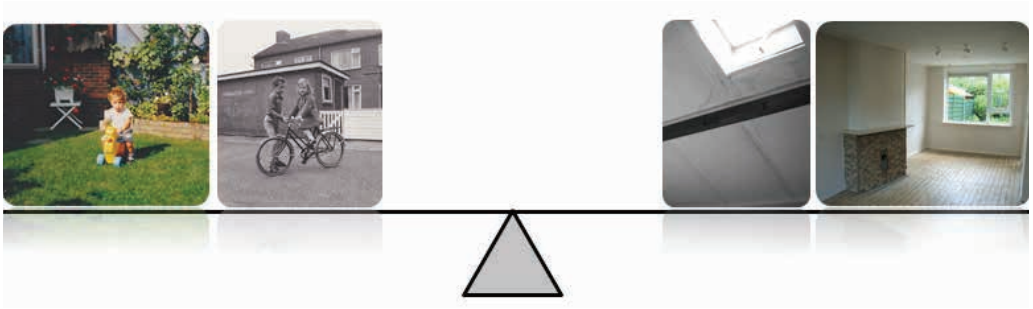


Figure 2.13 — *Finding the balance between what should be improved and what should be preserved.*

We believe that in the end it is all about finding a balance between what should be improved and what should be preserved: ***improving your house, preserving your home***. Improving the climate and spatial performance of the house, while preserving the properties that make these houses into homes.

2.1.5 Home with a Skin

The concept

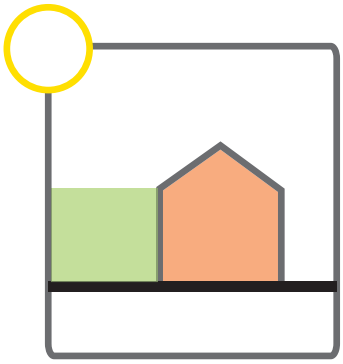


Figure 2.12 — *The house becomes a home by it's spatial identity*

So how can we improve the house, while preserving the home? First we need to define the properties that makes a house into a home. If we look at Dennis his story again, we could say that it is the people living in the house and the aspects of their corresponding identity that are essential to preserve: the living space with it's identity [figure 2.12 - pp.95] So we should renovate without touching the 'living.' This is done in four steps, which are explained on page 96.

Prior to the specific design for the house in Honselersdijk, there is the concept of the toolbox: People can compose their unique renovation, representing their 'home' identity, while making their house energy neutral. The specific house design for 'Home with a Skin' is one specific composition of this toolbox suitable for the context of Dennis and the house in Honselersdijk [figure 2.14 - 95]. In the next paragraph the toolbox will be explained.

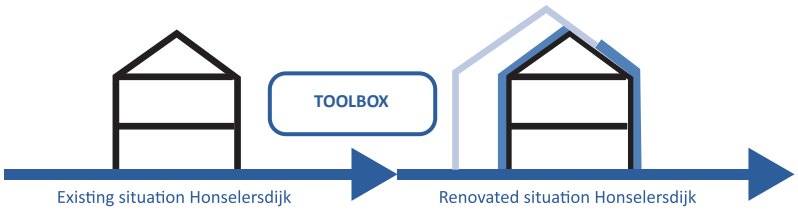
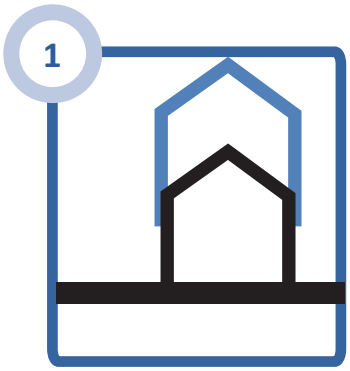


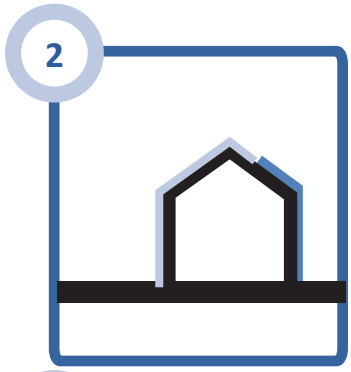
Figure 2.14 — *The skin design explored in this project is one option of the toolbox*



Step one

As mentioned before the 'home' should be preserved. This is achieved by putting something over the house, without really touching the 'living' of the existing. This is called the 'skin.'

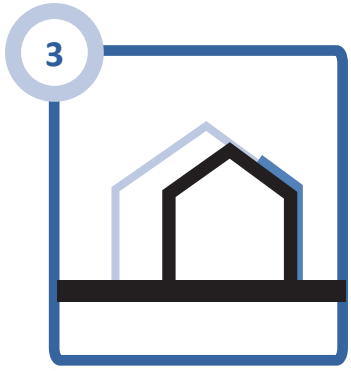
Figure 2.16 — *Step one: putting over a skin without touching the 'home'*



Step two

To improve the climate performance of the existing house, the skin is designed based on orientation. The sun side functions as a harvesting side -harvesting solar energy and heat-, while the cold side is optimized to reduce heat losses. In terms of materialization this results in glass on the sun side and extra insulation on the cold side. By doing this, the heat- and cooling load are reduced, which result in reducing the energy demand.

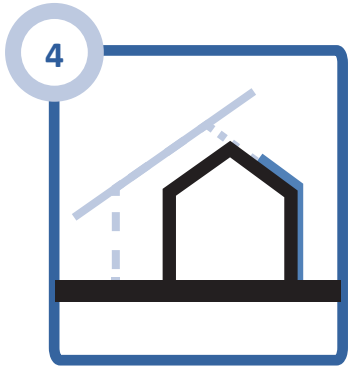
Figure 2.15 — *Step two: improving climate performance by materialization based on orientation*



Step three

Furthermore, and equally important, the spatial performance is improved by creating living space on the harvesting side of the skin. This space, both spatially and climatically, functions like a buffer zone that adds additional quality to the existing and meanwhile improving the climate performance of the house.

Figure 2.17 — *Step three: improving the spatial performance of the house*



Step four

Finally the functioning of the skin and the improvement of the existing house is optimized by making the skin adaptable throughout the year. This way both space use and climate performance are optimized using a passive design approach.

Figure 2.18 — *Step four: optimizing both spatial and climate performance by adaptability*

2.1.6 Adaptability of the Skin

Adaptability of the steel structure

The steel structure of the Skin was designed in order to create a technological system that can be used to cover the renovation of the whole variety of row house blocks.
According to these three different types of anchorage between the glasshouse structure and the existing row house were developed. Those three main categories were chosen in correlation to the differences that can be found in the existing row houses. These are mainly related to: presence of the chimney and structural condition of the row house.
The first main distinction was made among houses that have or not the chimney. Here is possible to find the first two types of anchorage. Then another possibility was created for houses that cannot carry the extra load of the glasshouse.
Where the existing house gives the possibility to anchor the Skin structure to the existing chimney, the two side beams are connected to that, while the two inner beams are anchored to a steel beam placed at the ridge of the existing roof. This case is the one used in the prototype house for the competition [figure 2.19 - pp.97]
Where, the row house doesn't have a chimney to anchor with, all the beams are connected to the ridge beam placed at the top of the roof [figure 2.20 - pp.97].
The last solution was made for the renovation of houses which have a load bearing structure that cannot bear extra load because of the really old structure or other problems that can occur. In this case the solution was found proposition of a Skin structure that goes completely over the house, giving it extra strength and supporting the new glasshouse [figure 2.21 - pp.97].

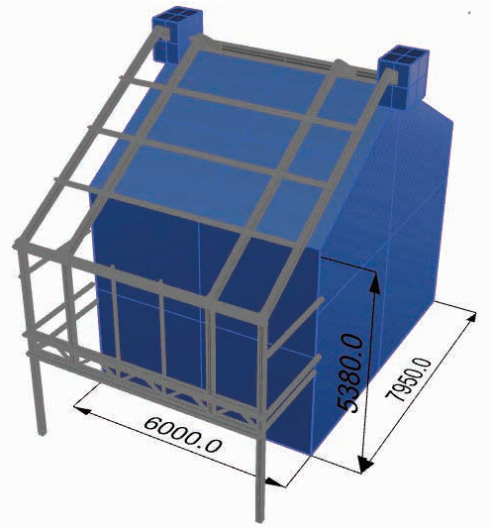


Figure 2.19 — *Structure for a house with chimneys*

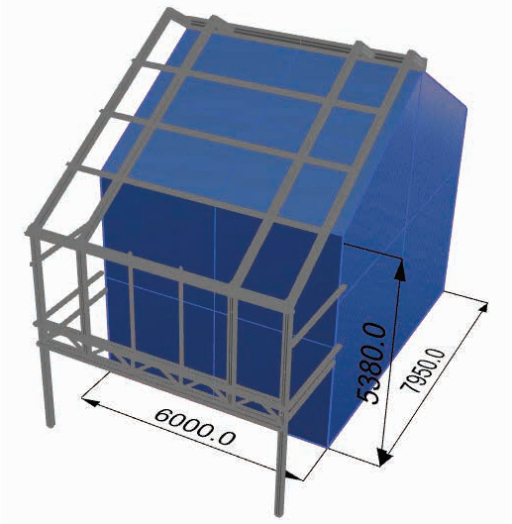
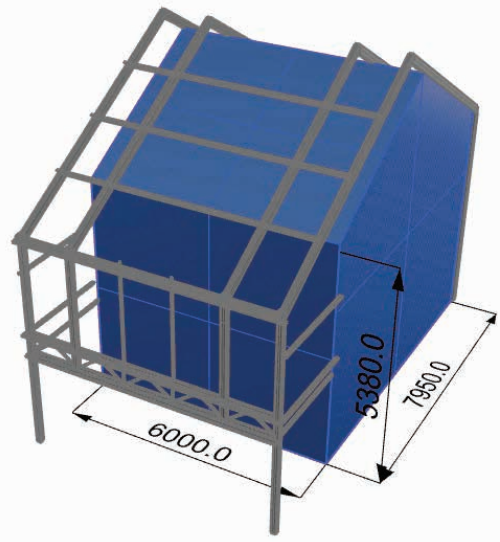


Figure 2.20 — *Structure for a house without chimneys*



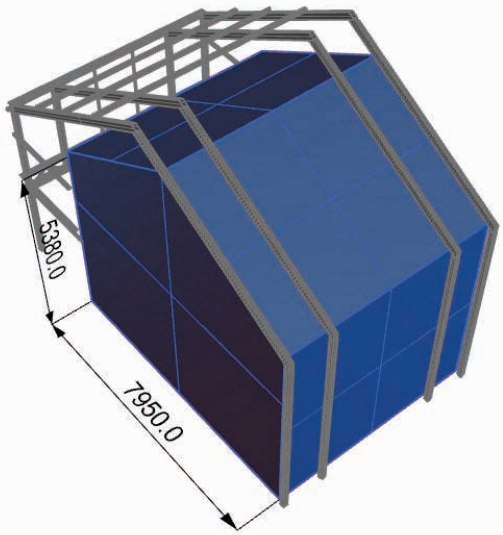
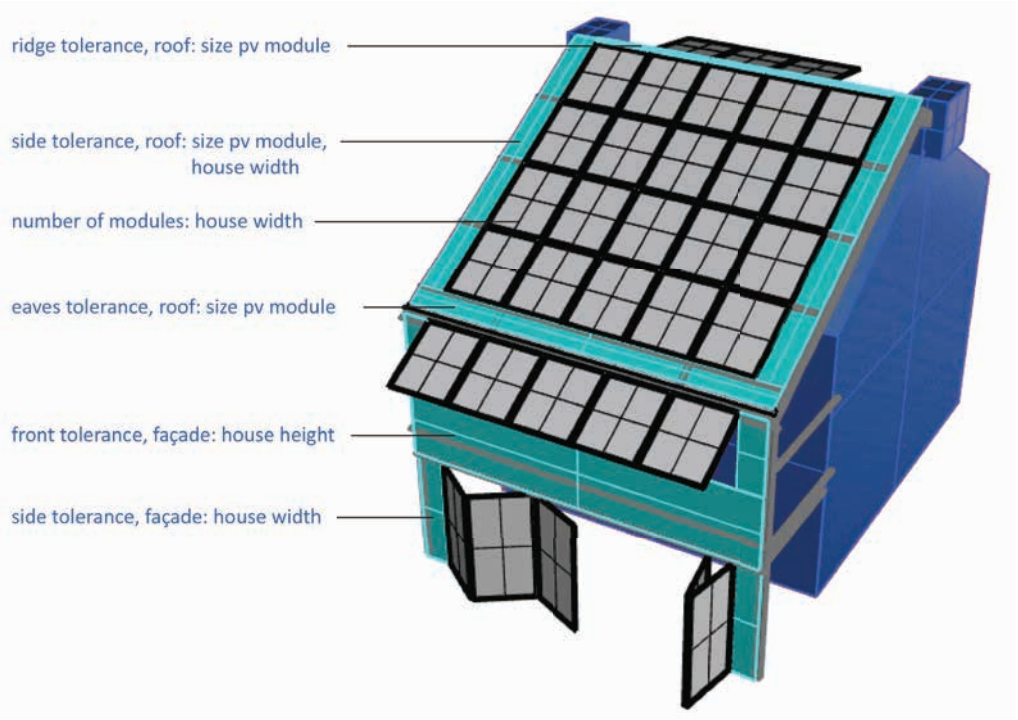


Figure 2.21 — *Structure for a house without chimneys and low load bearing capacities*

Adaptability of the aluminum gable

Thanks to the aluminum gable design, the glasshouse can be easily adapted to better correlate the dimensions of the row house that has to be refurbished and the module used in the glasshouse itself. Changes in width and height are coped with fitted glass panes positioned vertically and horizontally in the Skin. These are shown in figure 2.22 on pp. 98. These fitted glass panes help to cover tolerance problems correlated to both width and height of the existing house, since these will be deviate for different houses.



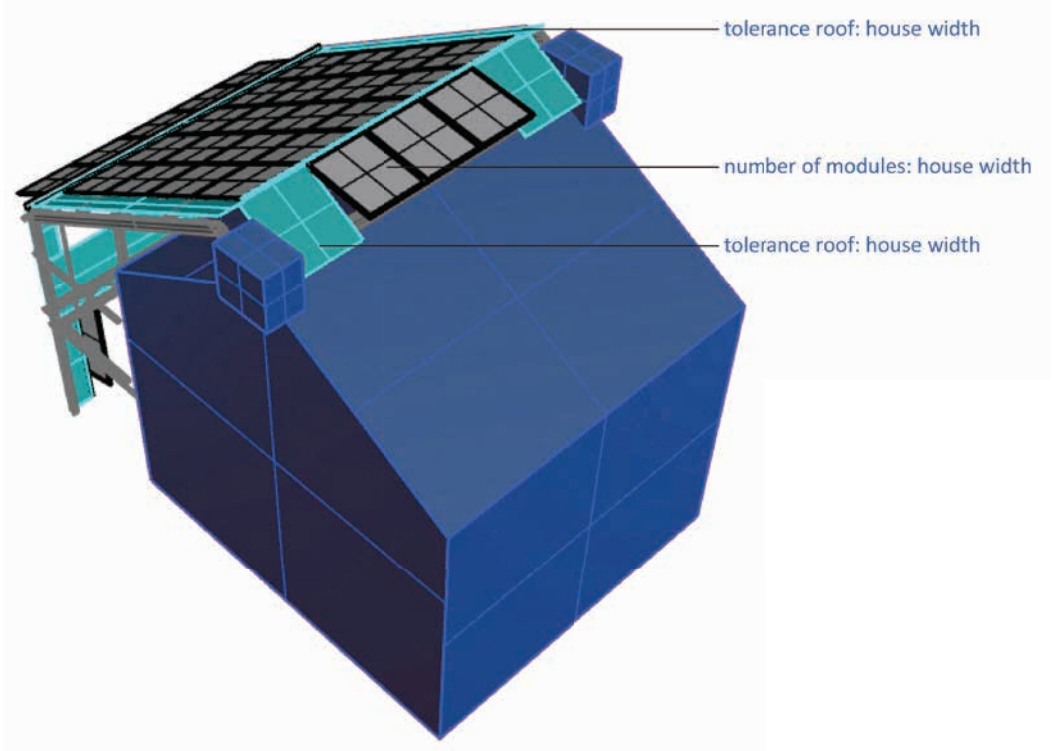


Figure 2.22 — *Glass panes to cope with different sized houses .*

Below a series of examples are presented that show how the glass is totally adaptable to the difference that can occur on existing house dimensions.

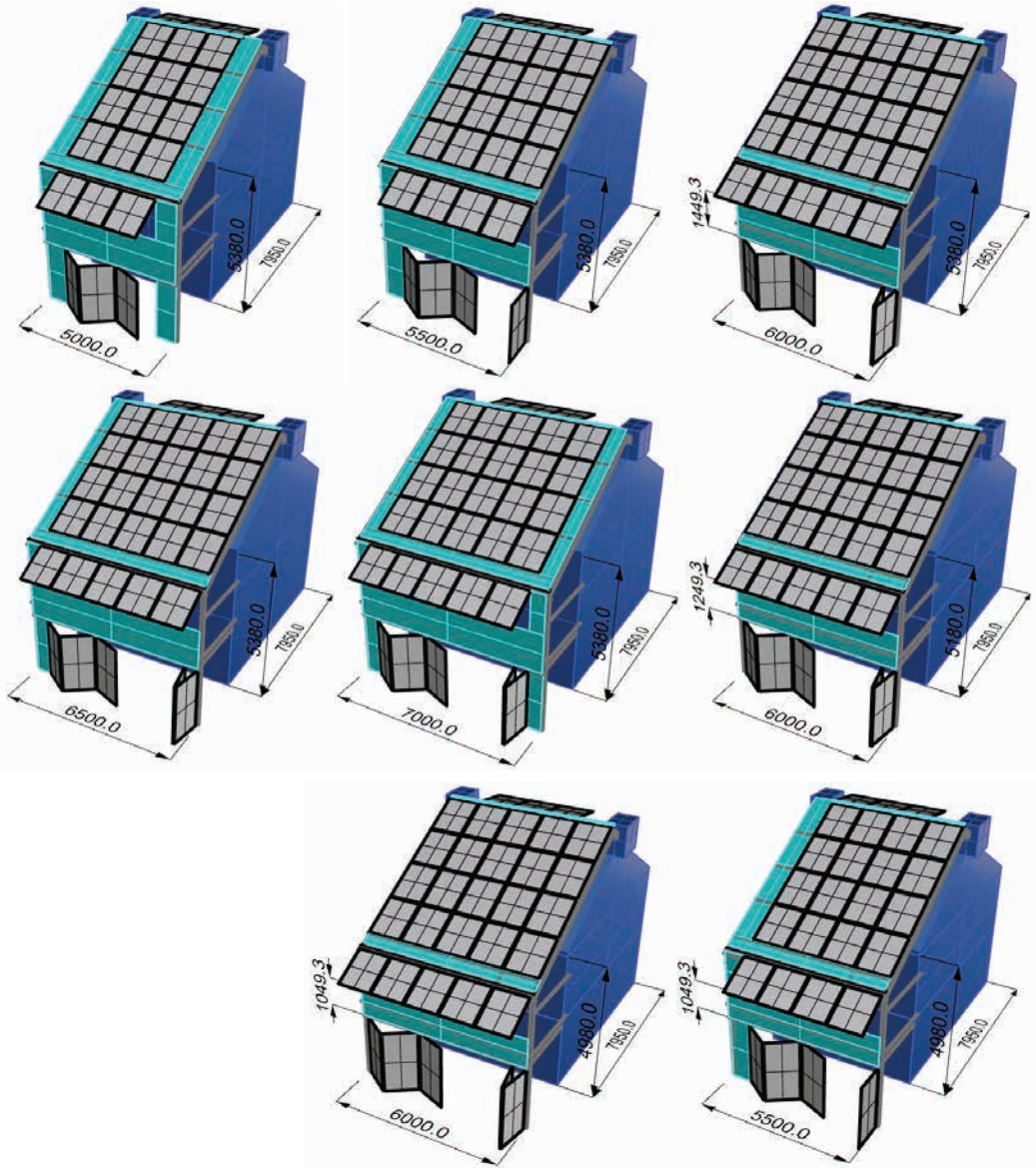


Figure 2.24 — *Adaptability for variety of dimensions.*

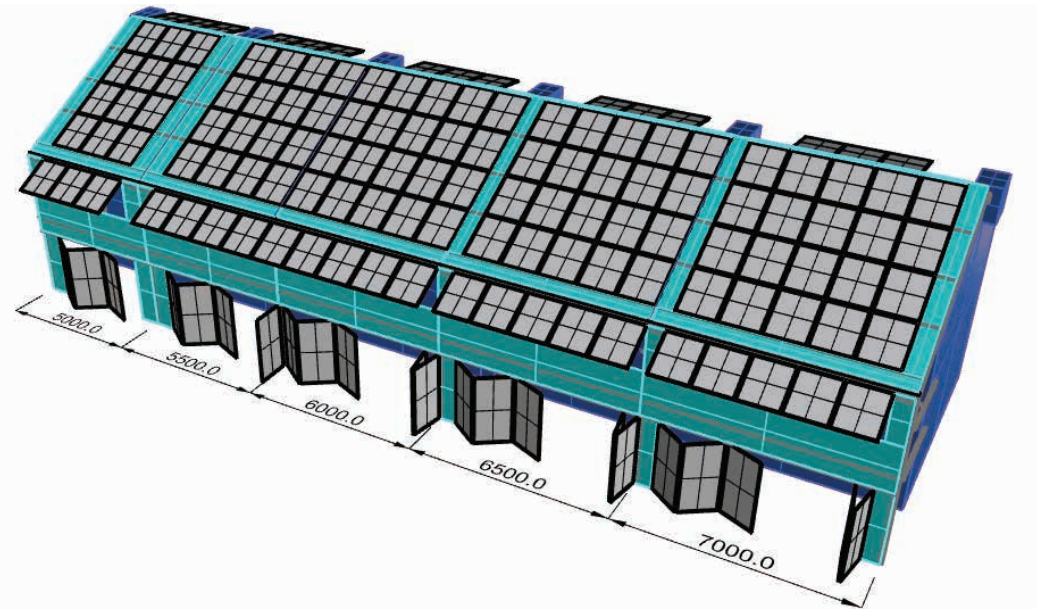


Figure 2.23 — *Different dimensioned houses combined in row.*

Having a toolbox gives the possibility to users to choose among different kind of photovoltaic panels (opaque or semitransparent), the tolerances that the glass panes provide at the roof eaves are used in order to have the possibility to install both system in the same aluminum gables [Figures 2.25 and 2.26 - pp100].

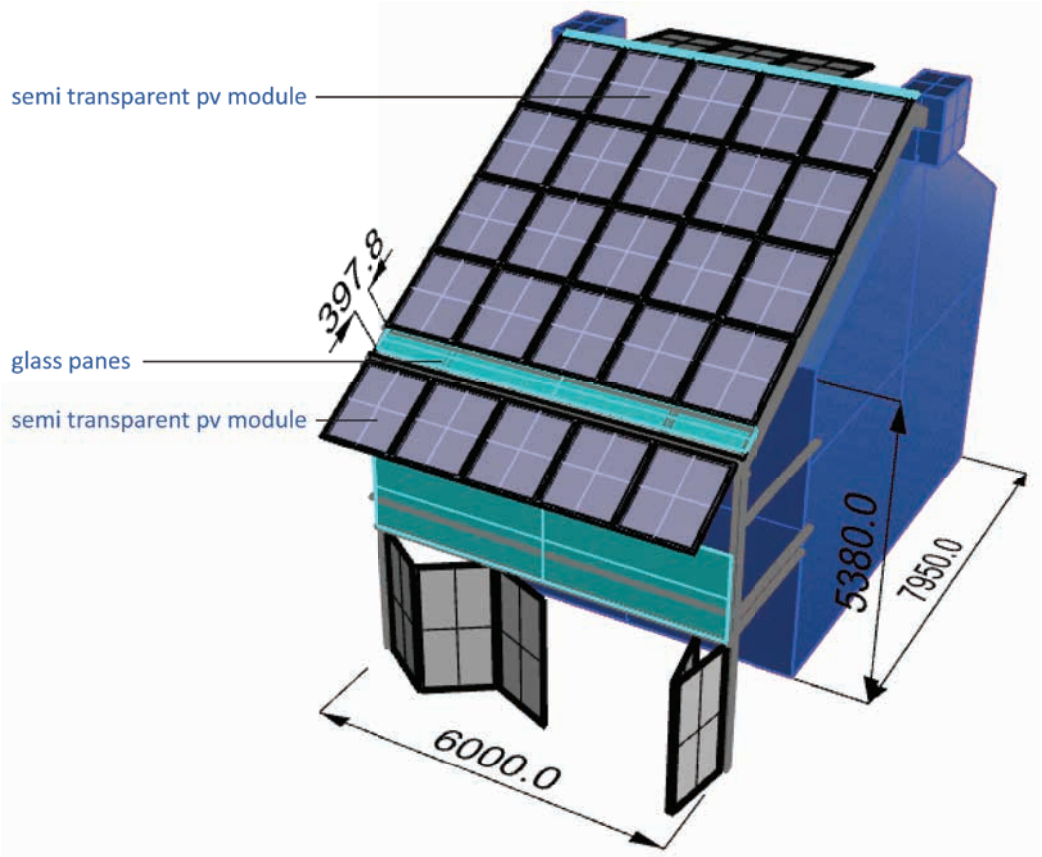


Figure 2.25 — *Maximum transparency vs solar power.*

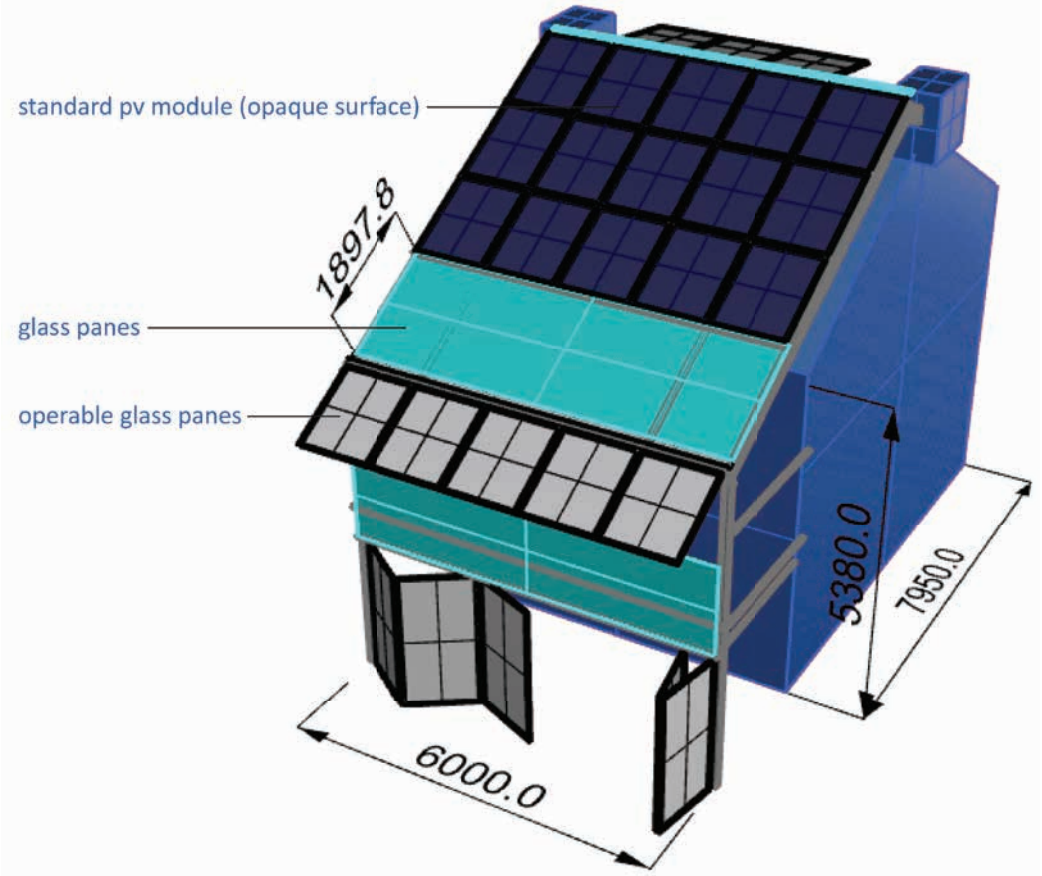


Figure 2.26 — *PV's are opaque, bottom part of roof is transparent. No PV's in operable part.*

The extra space provided by the skin results in the creation of two major transition patterns in dependence of its addition at the front or back garden of the house. Having this extra space as sun space, its application to the variety of the row house blocks is strictly connected with the orientation of the specific block to which it is added. The operability of the glasshouse, in fact, is related to the amount of sun that it receives during the different seasons, affecting its energy performance through the whole year. Moreover, a fundamental feature of the skin is the integration of photovoltaic panels on the roof and their orientation. This directly affects the energy production of the refurbished house.

Figure 3.27 on pp.101 gives insight to understand how the best position of the skin changes from back to front garden, when changing the orientation from south to north. For row house blocks where the single dwelling has an East-West orientation, the position of the glasshouse and PV modules have almost the same performance as if placed on both East and West side. In this case the owners will have the possibility to choose between an additional fully private (internal) space (garden) or an additional transition zone between the private and public domain (street). The easiest application is always on the garden-side, since this is not influencing the street scene and a permission can be achieved more easy.

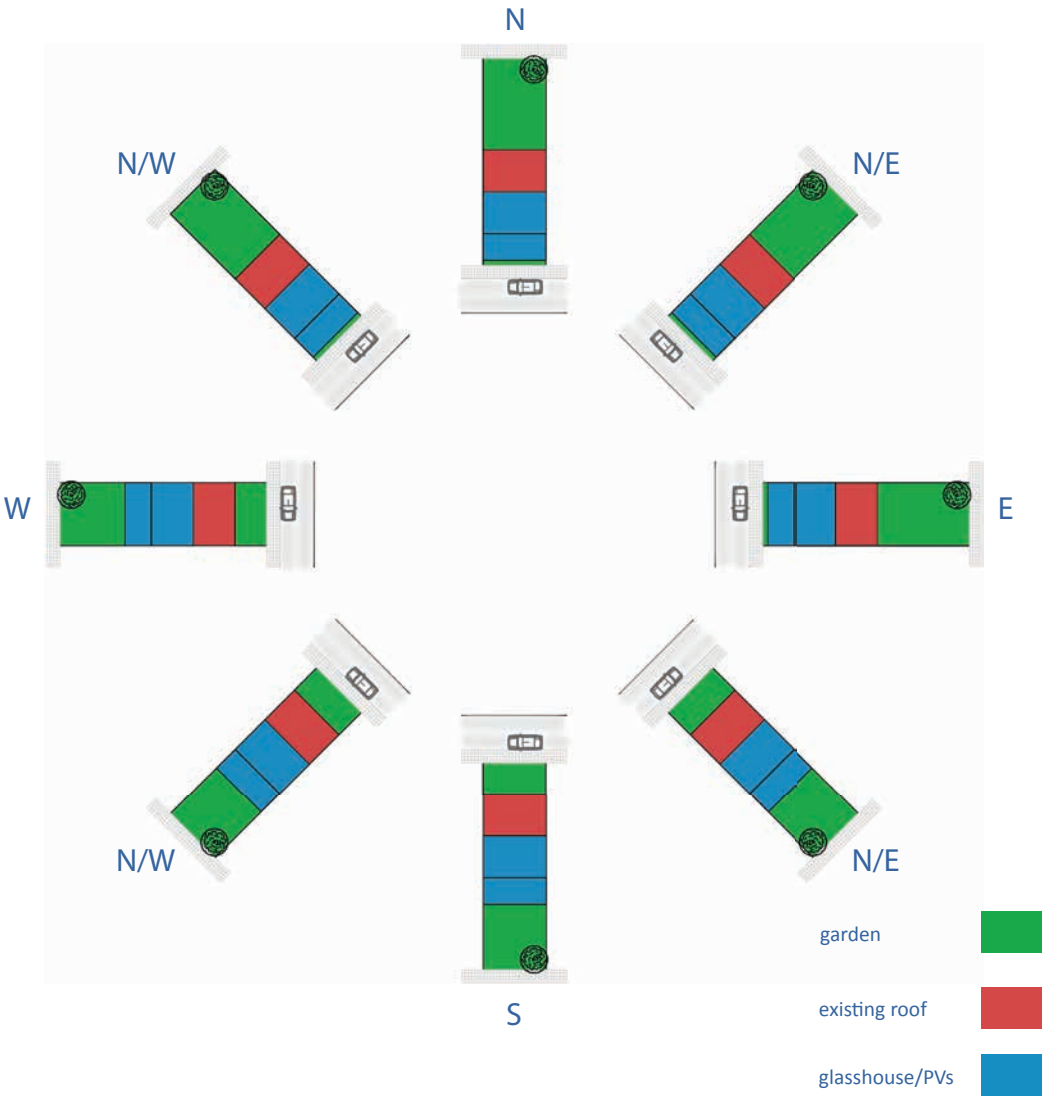


Figure 2.27 — *Different orientations and its corresponding design.*

2.1.7 Improving spatial performance

During the post-war construction period, the houses are designed taking minimal functional dimensions into account. This means that both garden and house are relatively small according current living standards. When trying to make the existing more sustainable, one should always think from the perspective of the user. In this case the common Dutch family. However, for the major part of this target group saving energy is not a sufficient motivation to renovate their house. The two most important aspects of a home according to the Dutch are divined as 'space' and 'garden' (research platform 31). This means that sustainability only becomes feasible if it is attractive for this target group and it becomes attractive when 'garden' and 'space' are improved. This is exactly what the skin provides.

Starting with the existing house, this is not well optimized in terms of use. It consists of a house and a garden throughout the year, but taken into account Dutch weather conditions, the garden can only be used around 50% of the time [figure 2.28 - pp.102].

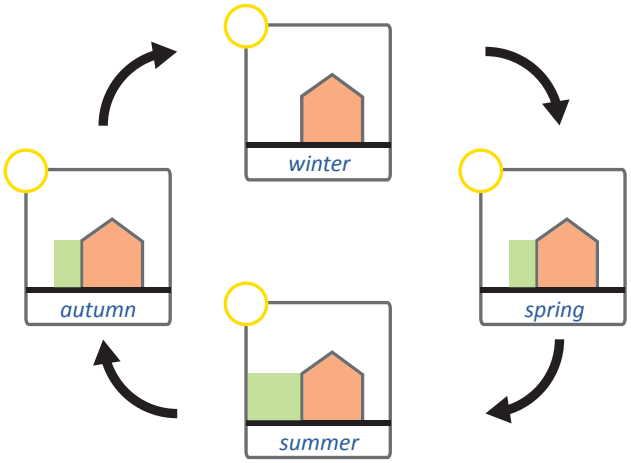


Figure 2.28 — *The existing house is not optimized in terms of use, for the garden can only be used 50% of the time*

By applying the skin, the use of this space is optimized by its adaptability. The 'space' changes throughout the year related to the seasonal activities. In winter the skin will create a buffer zone with temperatures suitable for a winter garden, while the living space remains the 'warm core.' This way people can enjoy green all year around, despite the grey and cold weather [figure 2.29 - pp.102].

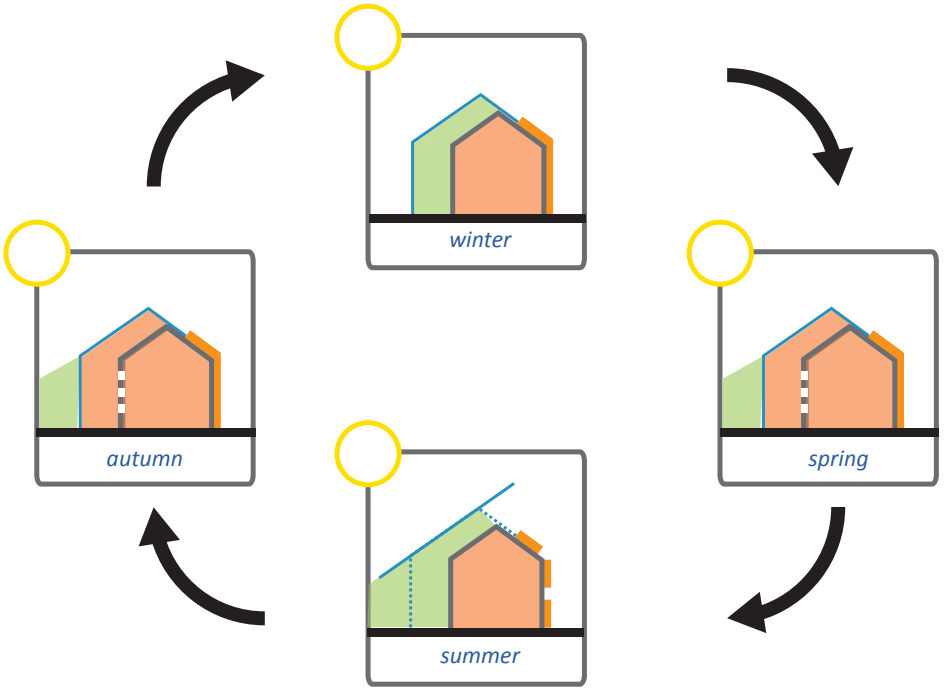


Figure 2.29 — *The skin optimizes the space use related to the seasonal activities*



Figure 2.30 — *In summer the skin becomes garden again*

When spring breaks, the temperatures in the skin become comfortably enough to function as an extension of the living room. The doors between living room and the skin will open: people can fully enjoy the sight of the first leaves and flowers. During summer the focus of activities is mainly on the outside. The skin adapts to this by open up completely, so people can make fully use of their garden [figure 2.30 - pp.103].
Calculations show that around 90 days a year temperature at noon are below 18 degrees Celcius, so the glasshouse can be used as a winter garden. Around 130 days a year the temperature at noon are within the 18 and 24 temperature limits, the glasshouse functions as a extension to the living room. Only 11 days a year the temperatures will drop below 0 degrees at 5 AM (the hour when the temperature is approximately the lowest). The remaining days the glasshouse is above 24 degrees Celcius and can totally be opened to the garden.



Figure 2.31 — *In winter the skin is closed, providing a winter garden*

Because of the skin, people can enjoy their garden and living space all year around for it adapts to the activities throughout the whole year. Cosy and compact during winter, open and bright during spring and autumn and open and airy during summer, when the major part of activities will be in the garden. Because of this adaptation, people can fully enjoy and experience the colors and activities of each season. It is this adaptability of the skin that turns a relatively small house, into a home with a high spatial quality ([figure 2.31 - pp.103].

2.1.8 Improving climate performance

Starting again with the existing situation in Honselersdijk, the climate performance is far from good. The house consumes large amounts of energy and lacks thermal comfort. This house is not designed taking bioclimatic aspects, like orientation and adaptation, into account. This results in having the same house with the same garden throughout the year. The only thing that changes over the year is the energy consumption [figure 2.32 - pp.104].

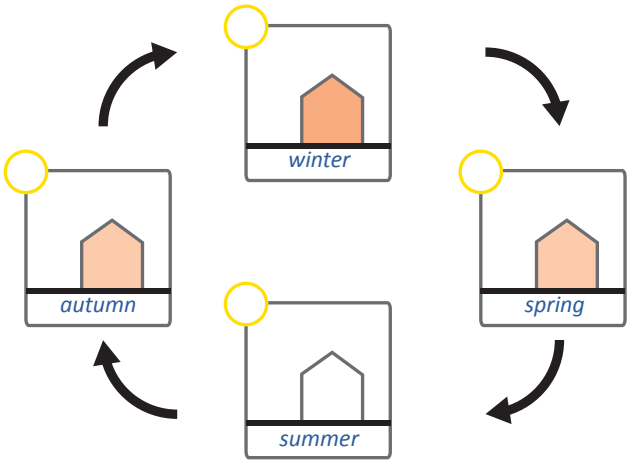


Figure 2.32 — *The existing house is not designed based on orientation*

In the skin design, both orientation and adaptation have been taken into account as bioclimatic strategies to improve the climate performance of the existing house (see Contest Support Documents, Chapter 6.3 - pp.339). The main design approach regarding orientation is having glass and photovoltaic panels on the sun-side, for harvesting heat and energy. On the other hand the cold side of the house contained extra insulation to minimize heat losses. Furthermore the skin is adaptable to maintain air quality and comfortable temperatures all year around. In winter the skin is closed, during spring and autumn the skin provides indirect natural ventilation for the house and in summer the skin is completely open to maximize natural ventilation using the stack effect, maintaining a comfortable temperature [figure 2.33 - page104]. More detailed schemes are shown on page 107.

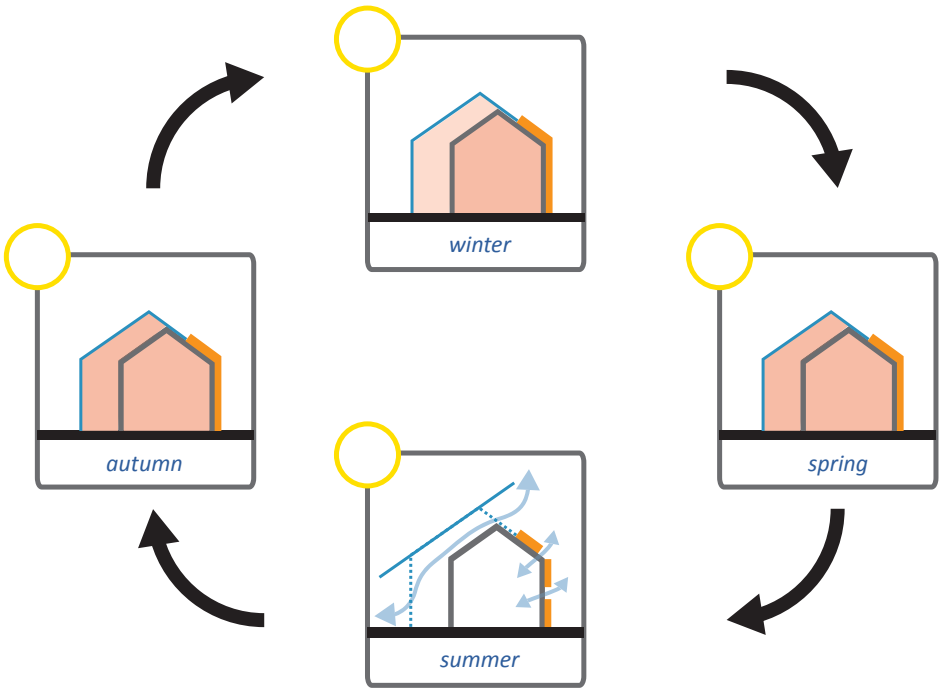
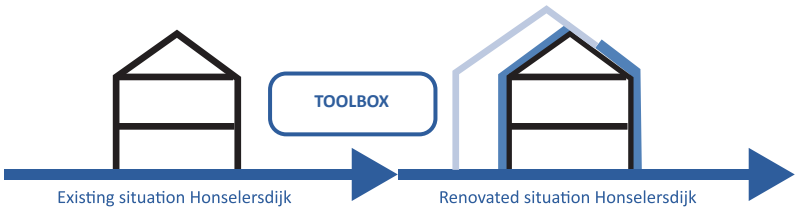


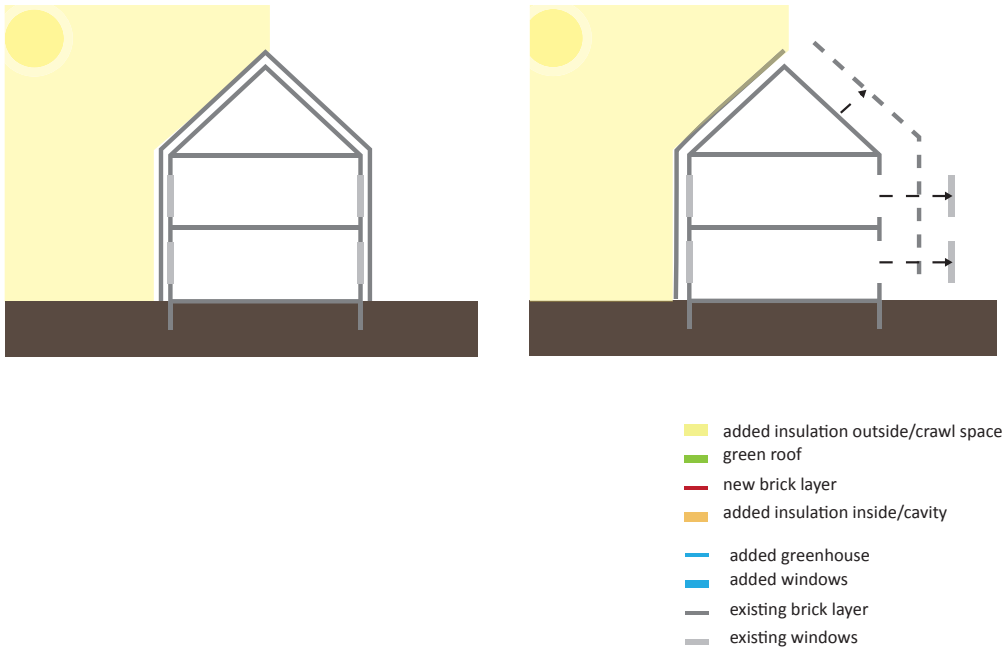
Figure 2.33 — *The skin improves climate performance based on orientation and adaptation throughout the year*

2.1.9 Toolbox composition Honselersdijk



Based on the toolbox a composition has been chosen for the context of Honselersdijk, Dennis his home. As previously mentioned, the composition is based on orientation, house properties and users identity. Dennis' house is North-West orientated, so the glasshouse is positioned on the garden side. The house has the dimensions explained in drawings GE-320 - GE-323 to which all the elements of the Skin are adapted according the toolbox. Finally, the house contains chimneys, resulting in the toolbox option of constructing the greenhouse to these chimneys.

Figure 2.34 — *Existing situation of Dennis his home and elements that are removed from the house.*



Removed elements

The elements that are removed in this context are:
1. The windows and frames on the North-West side
2. The outer layer of brick on the North-West side
3. The roof tiles on the North-West side

The whole South side is remained completely intact. This is possible because of the greenhouse.

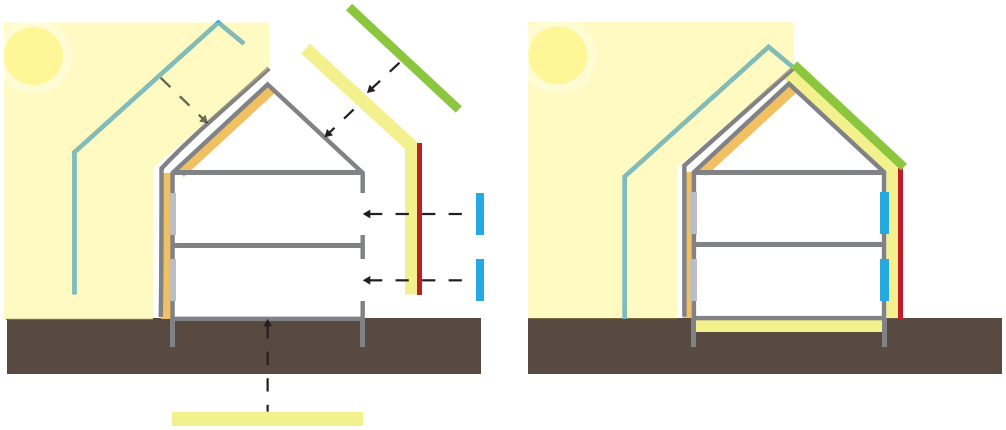


Figure 2.35 — *Toolbox composition for Dennis his home*

Added elements

Based on users identity, in this case the family of Dennis, the skin is composed of the following elements, added to this house (fig...):
1. A thick layer of insulation of the North-West side
2. Brick slips on the North-West wall
3. A green roof on the North-West roof
4. Cavity insulation on the South-East wall
5. Inside roof insulation on the South-East roof
6. Greenhouse on the South-East side attached to the chimneys
7. Integrated PV-panels
8. Folding door integrated in the greenhouse
9. Renovated sustainable garden
10. Smart installations and monitoring
11. A thick layer of insulation added to the crawl space

This composition at the same time improves the overall climate performance of Dennis his home by adaptability of the Skin combined with smart installations [Figure 2.36 - 2.39 - pp. 106 - 107]

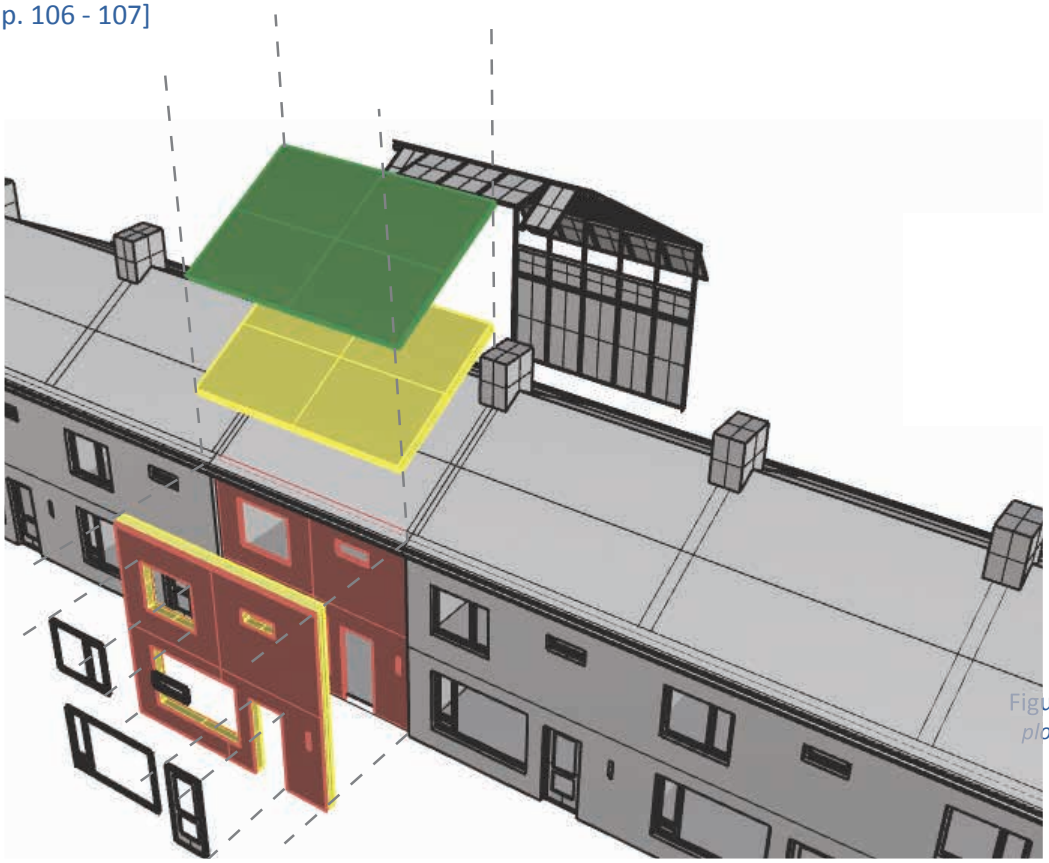


Figure 2.36 — *Exploded view toolbox composition*

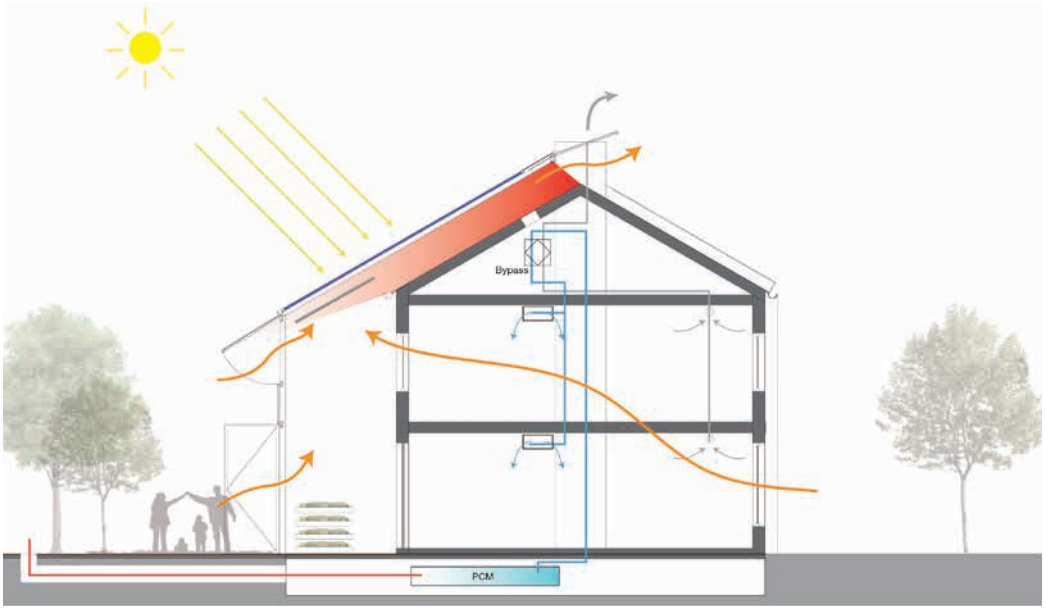


Figure 2.37 — *Functioning of the skin on a summer day (chapter 4.2.1)*

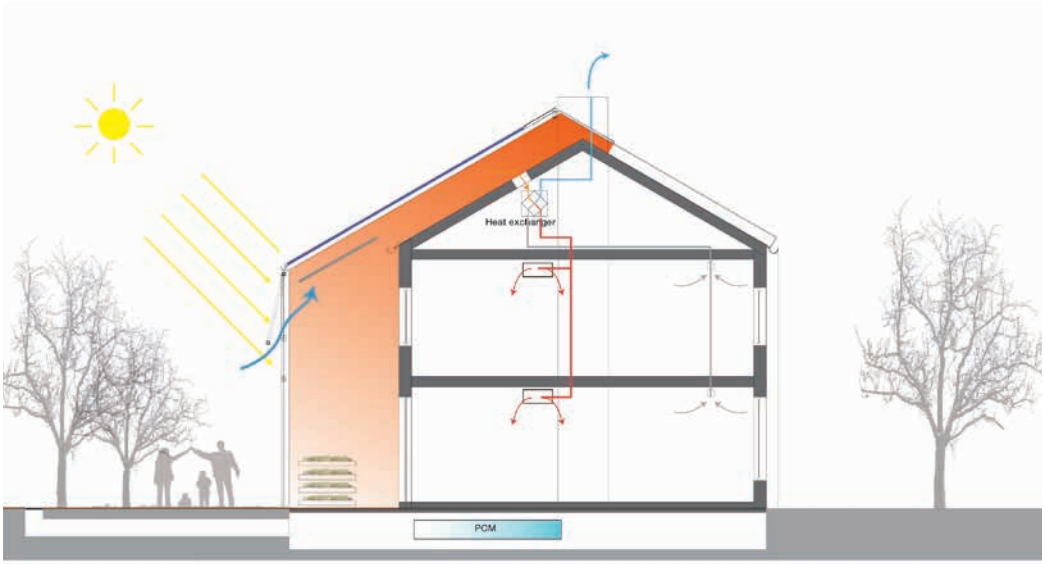


Figure 2.38 — *Functioning of the skin on a winter day (chapter 4.2.1)*

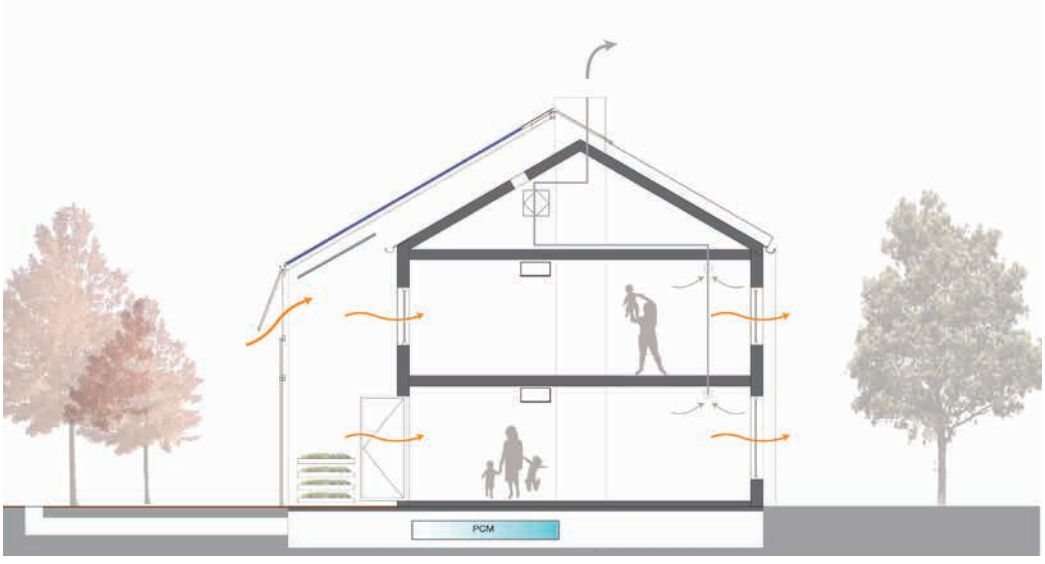


Figure 2.39 — *Functioning of the skin during spring and autumn (chapter 4.2.1)*

2.1.10 Integrating the garden

The garden is an important element in the design. The skin forms an extension of the house, but at the same time an extension of the garden, the design functions as an integrated whole. Revealing the importance of green is key in the considerations. Integrating green in an urban environment has proven to have a positive effect of the wellbeing of inhabitants, but the design of a garden also gives the opportunity to incorporate more advantages:

Water
Rainwater is harvested by a rainwater tanks in the garden and reused in and around the house. Also the water plays an important role in the materialisation of the garden: permeable material is used in both the front and the backside of the house.

Food
Harvesting vegetables and herbs is one of the themes in both the front and the back garden. In both the private garden and the glasshouse the design proposes space for growing herbs and fruits as this both offers food and activity, depending on the selection of green.

Community
In the design of the front garden, the functioning of the street and the sense of community have been given another meaning. Instead of focusing on the small territories in the form of tiny front yards, the street is reconsidered as shared space, belonging to the community: the inhabitants of the street. This scenario offers more efficient use of space and more space for interpretation. In the design of the street and front garden, fruit trees are the main elements, as this offers both shelter and room for social interaction with neighbours and food. In the garden design this is detailed by elements such as the hedge [figure 2.40 - pp.108] This hedge (in Dutch 'Buurjongens', *eng: 'boy next door'*) allows neighbours to share homegrown herbs and plants by moving boxes around in the fence frame. As seen in the picture the fence has an open character, so social interaction is not distributed, but is still enough closed to create privacy.



Figure 2.40 — *Garden fences called 'de Buurjongens'*

One element of this toolbox composition is a renovated sustainable garden. This extension contributes to the overall sustainability of the house based on three aspects, really making house and garden functioning as one: the concept of the Skin extended to the garden



Figure 2.44 — *Garden as an extension of the Skin*

1. Water reuse – Water from the south roof is collected and used for both watering the garden and flushing the toilet. (Further explained in sustainability chapter)

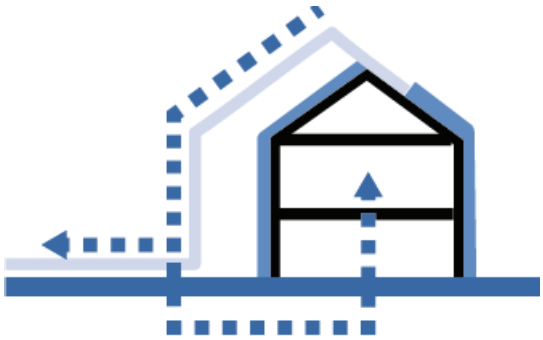


Figure 2.43 — *Garden and water reuse'*

2. Food and waste – Along with the greenhouse, the garden can contribute to food production. Besides that it can close the carbon cycle by reusing bio waste creating compost.



Figure 2.42 — *Garden and food*

3. Biodiversity – By applying local plants, flowers and trees the garden can contribute to local biodiversity, also providing habitat for other organisms than ourselves.



Figure 2.41 — *Garden and biodiversity*

































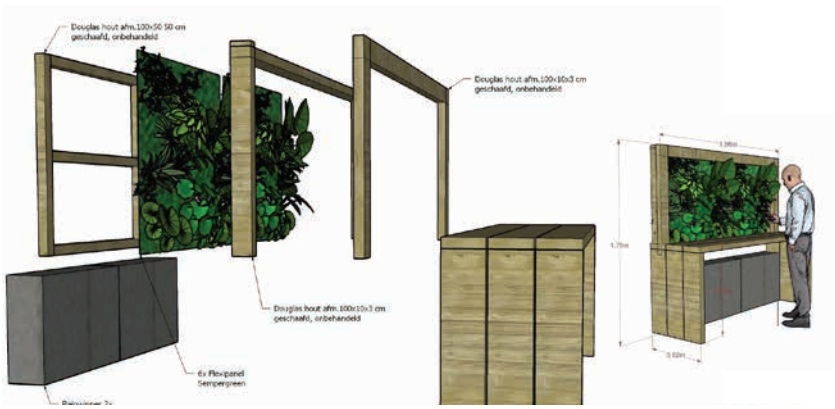


Figure 2.45 — *Garden atmosphere*



Figure 2.46 — *Impression of the competition pavilion*

Balancing sustainability, climate, affordability and quality

Home with a Skin is all about finding the balance between sustainability, climate performance, affordability and quality. It is not just about insulating to the maximum or using the most advanced technology: it is about putting the right amount of insulation and the right combination of passive design strategies and technology. This balance is reflected in every aspect of this project.

2.1.11 Translation to the competition pavilion



Figure 2.47 — *From Honselersdijk to competition pavilion*

The story of the renovation of the house in Honselersdijk is exactly the one that will be presented with the competition pavilion. In all aspects, it is represented as much as possible according the original situation. Two major aspects are different: the materialization and the size. To comply with the rules of the competition the house is down scaled to fit within the solar envelope. This resulted in the removal of one floor level. Furthermore, the sizes and locations of the rooms are changed, to comply to all the rules. Secondly, the existing house is originally made of brick walls. However, for the competition the pavilion needs to be constructed within ten days. The pavilion is therefor made of prefab wood framing panels. Based on these aspects, the following design criterion is the basis of the competition pavilion: The local situation of the house in Honselersdijk should be visually presented as much as possible, readable in the plot design, garden design and pavilion design.

The major downside of changing the structural material from stone to wood is the loss of the thermal capacity of stone. This is partly solved by using phase changing materials [see Contest Support Documents, Section 4 - pp.312]

2.1.12 The plot design

The actual house that will be built on the plot of Versailles is a resemblance of the original house in Honselersdijk. The house is part of a bigger setting, a street of row houses. This has been a key factor in designing the plot for Versailles. We made a 'cut-out' of the street, building one house, but showing there are more (two neighbours). This will be shown in different parts of the plot design.

The house, including the garden, is lifted by 850 mm from the level of the plot and rotated in the actual orientation of the reverence street in Honselersdijk. By spraying the 'blueprint' (floor plan) of the neighbours houses in the extensions of the pavilion, we show how the street of houses normally would continue.
The ramps, that are used as our waiting lines, are placed along the 'cut out' sections of the house. The guests will be led along the section and will walk over the blueprints, where they can notice the neighbours floor plan.

The cut out space of the neighbours will be used to show how the first floor of the pavilion will look. First of all, because the first floor will not be accessible for public. But also to create an interesting effect to show how the houses of that explicit building period were constructed. The next paragraph will explain this in more detail.

2.1.13 The existing row house

The existing row house of Honselersdijk is represented by the competition pavilion by the aspects explained below. Figure 2.48 and drawing GE-332 show where the different points are located on the house.

1. The main difference between the pavilion for the Solar Decathlon competition and the original renovation in Honselersdijk is the materialisation. The original house is constructed of brick walls, while the pavilion is constructed of prefab wood frame panels. This is done to have it built in ten days and save on weight during transportation. In spite of this difference the pavilion visually represents the original building as much as possible, by applying brick slips to the wood frame panels.



Figure 2.48 — *Representing the existing row house*

2. To show that the pavilion represents the row house of Honselersdijk, on both sides a part of the neighbours house is presented. In this way a real slice of a street is demonstrated. On the inside of these walls, one can see the interior finishing and furniture of the neighbours in a typical Dutch interior style. Also the interior of the pavilion itself is designed in the style of a 'common' Dutch family (see also Contest Support Documents, Paragraph 2.1.15 - pp.115). After all, we present a sustainable solution that is affordable for the average Dutch family.

3. In the cut sections on the side of the pavilion even the original detailing of the flooring is represented. For example the wooden floors with wooden beams and the wooden roof with also wooden beams. The cut also shows the way the walls are constructed. As in the case of Honselersdijk, often a cavity wall with on the inside a brickwork or concrete layer and for the outside brickwork.

4. The original house in Honselersdijk contains a crawl space, which also plays an important role in the climate design. In the competition pavilion the crawl space is also presented by lifting the complete building, including the garden, 850mm. This space can normally be reached by a hole in the floor. Since the soil in most of the Netherlands is swampy, a lot of houses have moist problems here.

5. The original house of Honselersdijk is down scaled in total tot comply with the competition rules and fit within the solar envelope [drawing AR-011]. This resulted in removing one level. However the original facade design is respected as much as possible, so windows and doors are positioned on the same position, with same appearance and almost the same sizes as the house in Honselersdijk. We improved the quality of the windows and frames [see Technical Project Summary - pp.275]. Also the glasshouse is smaller than it would be in Honselersdijk, because of this scaling.

6. One of the typical features of the post-war Dutch row house typology are the chimneys. In the renovation proposal these are essential elements for the climate design. These elements are also presented in the competition pavilion and function in the same way [see Contest Support Documents, Chapter 4.2 - pp. 296].

2.1.14 The Skin (drawing GE-332)

As mentioned before, the part of the pavilion that represents the existing row house, consists of prefab wood framing panels covered with brick slips. However, the design of these panels is done in such a way, that it visually represents the renovation of the house in Honselersdijk.



Figure 2.49 — *Representing the skin in the competition pavilion*

When applying the skin in the original situation, a thick layer of insulation in applied. This results in an overall increase in thickness of the wall of a renovated house compared to a house that is not renovated. In the competition pavilion this is made visual by showing a difference in wall thickness between the renovated house in the middle and the neighbour parts on the sides.

In the existing situation in Honselersdijk, the walls are non-insulated cavity walls with a thickness of 270 mm [figure 2.50 - pp.114]. In the renovation in Honselersdijk the outer layer of brickwork is removed and a layer of insulation is added to improve the climate performance of the house. On the sun side, also a layer of single glazing is added to create a buffer zone and to provide extra space, the so called glasshouse [figure 2.51 - pp.114]. In the competition pavilion this is visually represented in the detailing of the wall using brick slips and showing a difference in thickness between both walls, even though the materials are different, namely wood frame panels [figure 2.52 - pp.114].

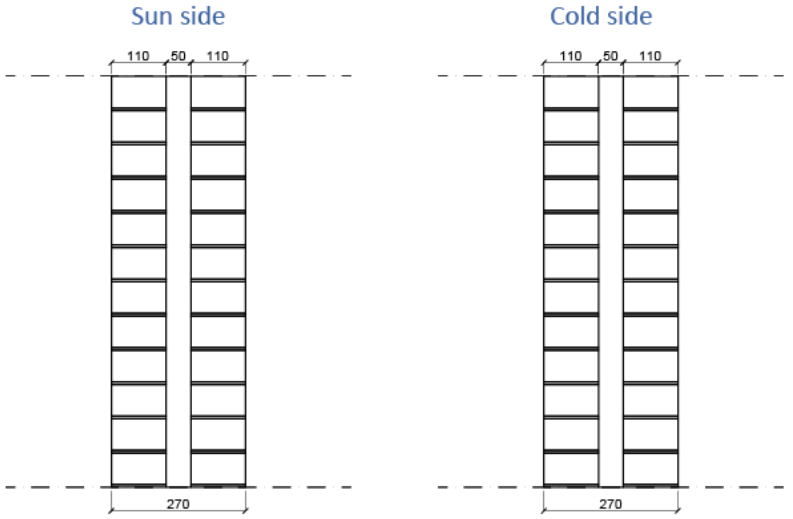


Figure 2.50 — *The wall of the original row house in Honselersdijk*

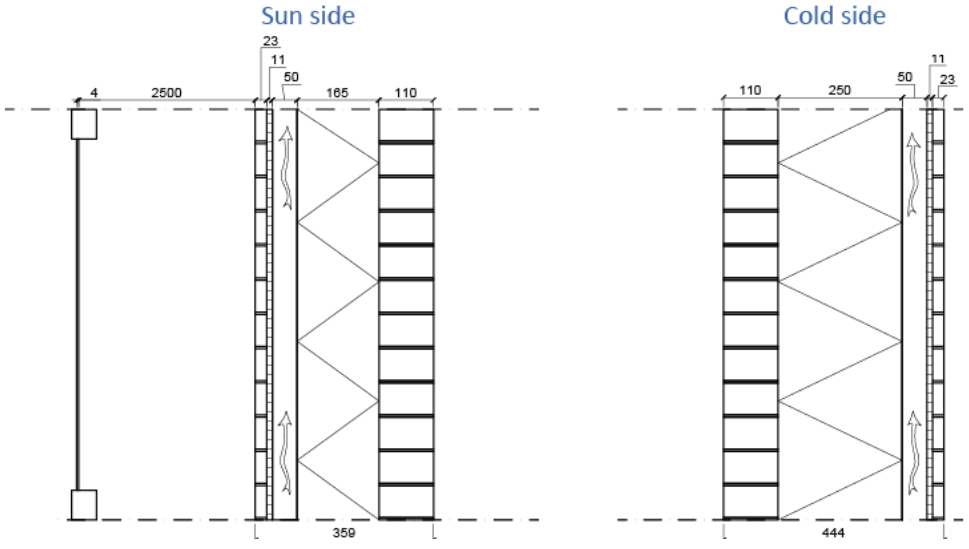


Figure 2.51 — *The wall of the renovated row house in Honselersdijk*

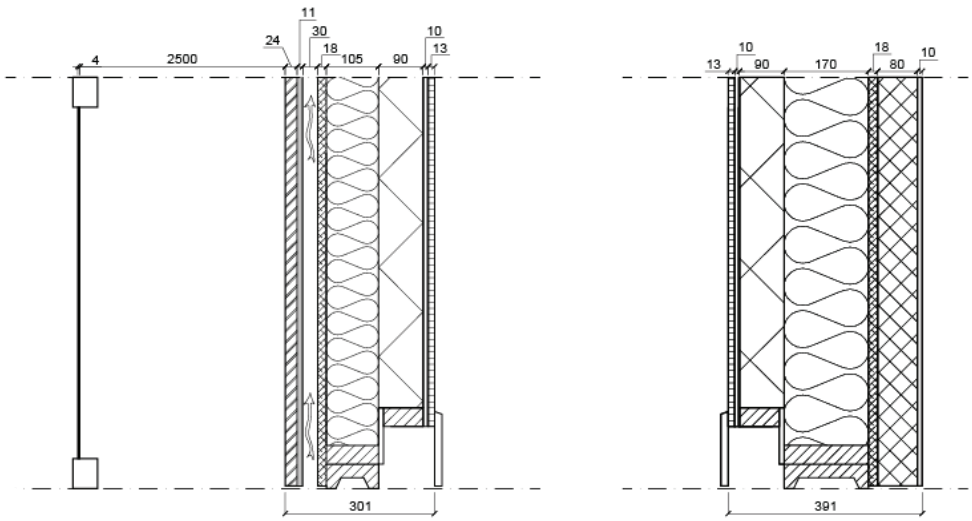


Figure 2.52 — *Wall detailing of the competition pavilion, representing the row house with Skin in Honselersdijk*

2.1.15 The interior narrative

The final approach to the interior design aims to recreate a real Dutch living environment [figure 2.53 - pp.115]. The main idea behind the interior concept is to conveyance a sense of a real life household, far form an aesthetics proper to a new and modern home environment. Our goal is to recreate a sensation of coziness and intimacy in order to give to every visitor a feeling that can be reported to the sensation of entering a known and familiar house. To carry on the idea of "a piece of Holland in Versailles", the interior design exploits the different possibilities given by the different aspects ascribable to the typical Dutch design. Clarity, simplicity, high visibility related to a strong connection with the road are the three main elements that guided the project design and the interior organization of the different spaces.

A fundamental characteristic that defines the typical Dutch environment is the mixture between old, familiar and meaningful elements and new, modern and efficient elements. In order to reach this feeling of a patchwork we tried to find a balance between the different kind of furniture, looking both to the sponsors for the new main parts and to borrowed smaller furniture or different kind of decorative objects to conceive the sense of a warm homely and domestic environment. This expedient enabled us to design next to interior proposal a strong story following the different spaces of the house, that through the borrowed items and various tools, such as pictures showing the real owners of the furniture, will create a brief but solid connection between the visitors and the fictional household.



Figure 2.53 — *Representing an interior of a 'common' Dutch family in the competition pavilion*

During the process one of the main focuses of the team was the recreation of this fictional household. This was not delivered just through the sense of cosiness or intimacy, but also by the recreation of a genuine domestic experience. Who enters the house has to understand and feel that "piece of Holland" that the whole project aims to show. This atmosphere is recreated by faking a real lived domestic space, taking in consideration all the different aspects of a family daily life: from the puckered cover on the couch to the used can of laundry soap over the washing machine, up to the smell of toasted bread from the breakfast. In order to not alter this sensation, all the elements of the exposition inside the house are meant to be hided and concealed inside those same elements of furniture related to the daily usage of the house. Posters will be printed in the newspapers left on the coffee table in the living room and blueprints can be shown on the back of the cereals boxes over the kitchen table.

As the glasshouse will be an expansion of the interior, the furniture is pulled into the glasshouse as well. A nice bench to sit on and plant boxes were vegetables can be grow. This idea is even further elaborated on in the garden. The skin will not form a barrier between in- and outside, it will create a nice extra level of comfort to the existing house. As the exhibition will show in the summer situation, the relation between the interior, glasshouse and garden will be empowered by using the space as one whole and not as single separate spaces.

In the first floor of the house, next to the bedroom, the interior design arranged a model room. This space is fundamental to show the connection between the projects proposal and the existing neighbourhood. Furthermore it will demonstrate the possibility of a future expansion of this redesign to multiple and different households in the area.

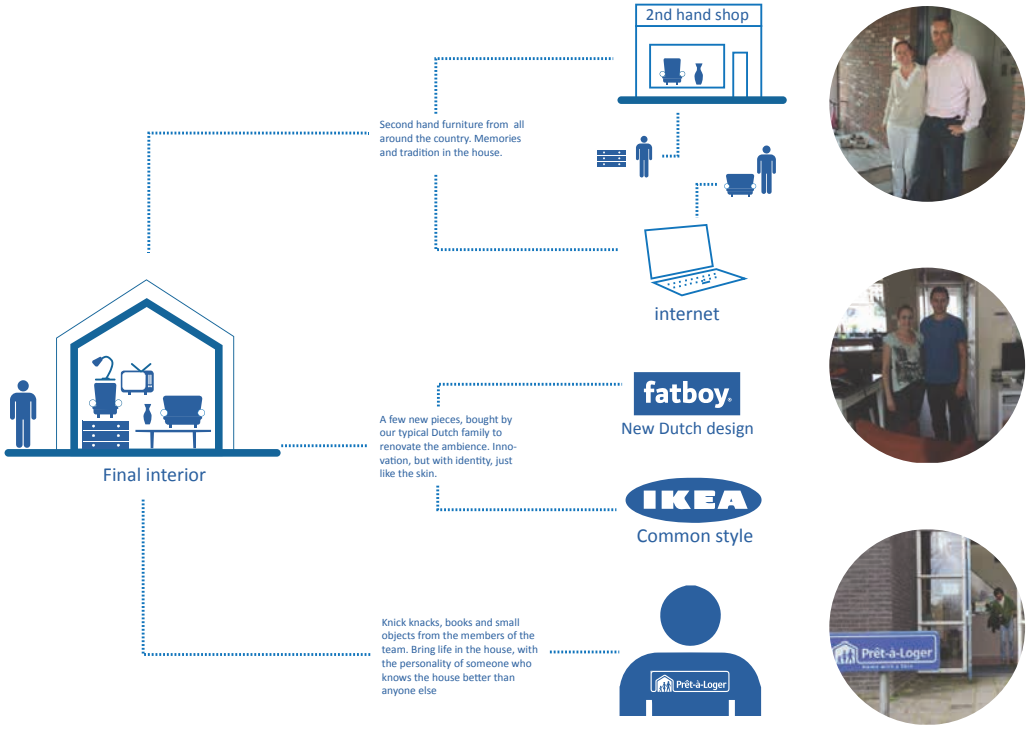


Figure 2.54 — *Process of gaining furniture for prototype house.*



Figure 2.55 — *2nd hand furniture from different cities throughout the Netherlands.*



Figure 2.56 —
Colour setting for the home.



Figure 2.57 —
Pursued atmosphere for home.

2.2 Summary of reconfigurable features

The reconfigurable features of ‘Homes with a Skin’ are the folding doors and the operable windows of the glasshouse, the sunshading panels placed under the glasshouse roof and the windows and doors of the house. When these are opened the house still fits within the solar envelope [Circles in figure 2.58 -pp.118]. The drawings with exact measurements are shown in the Project Drawing AR-041. For more details on the sunshading panels in the glasshouse see drawings AR-362 and AR-363.

All the reconfigurable features are hinged, so can only move within the radius from the hinge. The house itself also has operable windows and doors. The opereable windows are used for natural ventilation in the house.

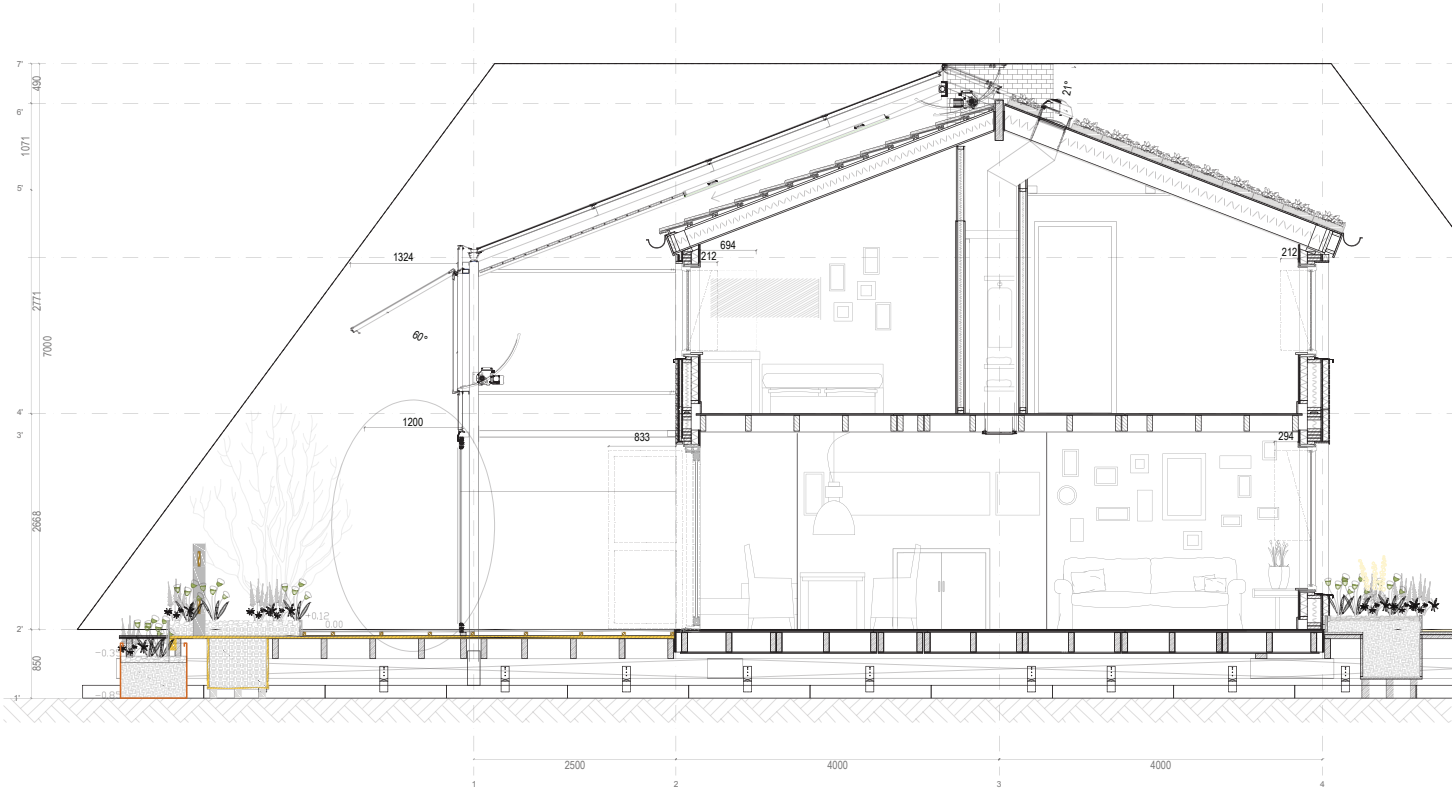


Figure 2.58 — *Reconfigurable features drawing. Complies with SD rule 6.2. See drawing AR-041.*

2.3 Lighting design narrative

2.3.1 Natural light design

The daylight design of this project is to use the glasshouse as extension of the living room and make the external part of the house more livable, even when the temperature or the weather do not allow it. The glasshouse itself will work as an extension of the living room, creating a really well illuminated environment.
On the other side, the measurements will not take place in this part because it can not be officially considered properly part of the living room. This means also, that the natural illumination of the rooms will get worse due to the obstruction of the glasshouse.

To maintain the same amount of natural illumination, this factor is solved in two different ways for the house in Honselersdijk and the one in Versailles:

- The house in Honselersdijk is re-adapted according to the Dutch law NEN2057, especially the section where you deal with the renovation of an existing construction, by verifying the amount of transparent surfaces of the room.

- To improve the natural illumination in the room, three solar tubes that bring natural light, were used to bring daylight inside the central part of the living room.

The calculations for the daylight factor were performed for three different models: the current house in Honselersdijk, the same house with attached the glass skin and the one that is going to be built in Versailles in June. For the cases in the Netherlands, the daylight factor has to meet the Dutch regulations while, for the house in France the requirements to reach are written on the competition manual.

To obtain the daylight factor, the following formula is used for the different calculation points:

$D_F = (E_i / E_o) \times 100$ [%]

where

E_i = illuminance due to daylight at a point on the indoors working plane
E_o = simultaneous outdoor illuminance on a horizontal plane from an unobstructed hemisphere of overcast sky

Now the types of verifications to be reached are listed below.

2.3.2 Dutch law - Main verification

For the law NEN 2057, contained in the chapter 3.11 taking care of the daylight, the most important thing when we analyze and design a renovation of an existing situation is that the current situation of the natural light does not get worse. This is done by calculating the amount of transparent surfaces and improve them, if needed.

This means that if with the glasshouse it is worse, some improvements to take an higher amount of natural lights inside the room must be taken.
According to the Dutch law, the main parameters to consider for the NEN 2057 for the equivalent daylight surfaces, are contained in this formula:

$Ae = Ad * Cb * Cu$

where

Ae = Equivalent daylight area [m2]
Ad = Transparent area of an opening [m2]
Cb = Obstruction factor (determine α, table)
Cu = Exterior reduction factor

The Exterior reduction factor, it has to be considered in case that if there is an external obstruction. It is also important to consider that openings below 0,6 meters shall not be considered, when calculating the Ad of every opening. The following formula has to be applied, in case the percentage is lower than 80 %:

$Cu = 0,8 * (A_{netto} / A_{bruto})$

where

A_{bruto} = portion of construction part located among the four specific external areas [m2]
A_{netto} = portion of transparent part located among the four specific external areas [m2]

As long as the glass structure is composed by more than 80% of transparent material, we consider a value of Cu = 0,8 when calculating the house with the glasshouse. The shading systems are not taken in consideration for the Dutch law. For the obstruction factor, the law says that if there are no obstructions, we have to consider the minimum value. Otherwise we have to look the table for the angles α and β, at section 3.11 “Daylight”, article 3.75 for the existing houses.

The equivalent daylight area is applied for each window and to find out the result for the whole room, this formula has to be applied:

$Ae;t = \Sigma Ae$

Some additional parameters needs to be explained to have a complete understatement of the formula.

This images and/or tables are an implementation to the Dutch code and are used for the calculation of the Daylight surface area. All of the following images are useful for the calculation of the Cu, the Exterior reduction factor.

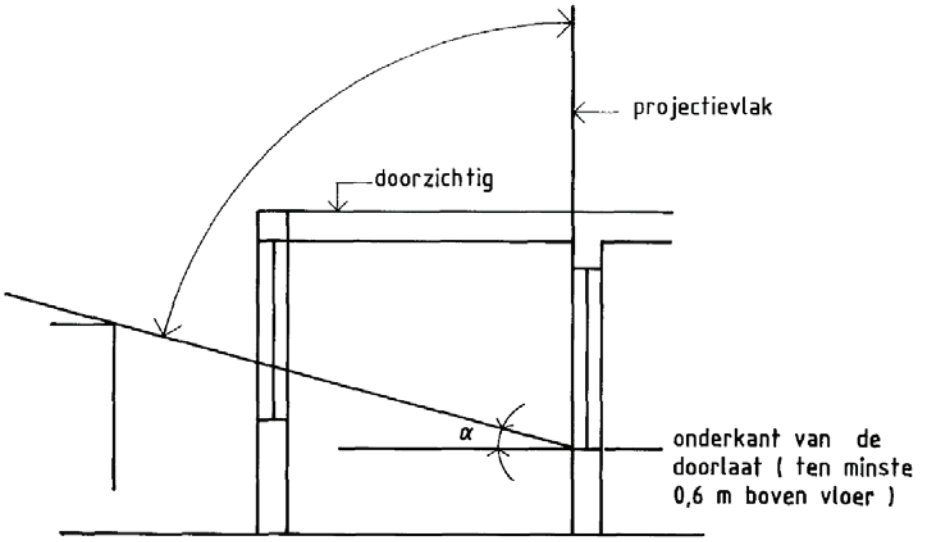


Figure 2.59 — *Image with listed the external factor reduction, when there is a transparent top.*

Determination external factor reduction in external partition with transparent top: bounding surfaces in vertical section.

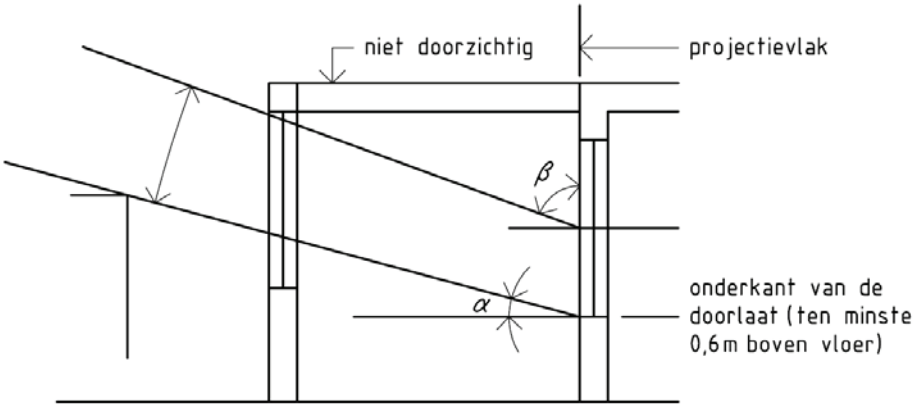


Figure 2.61 — *Image with listed the external factor reduction, when the top is not made of a transparent material..*

Determination external factor reduction in external partition with opaque top: bounding surfaces in vertical section.

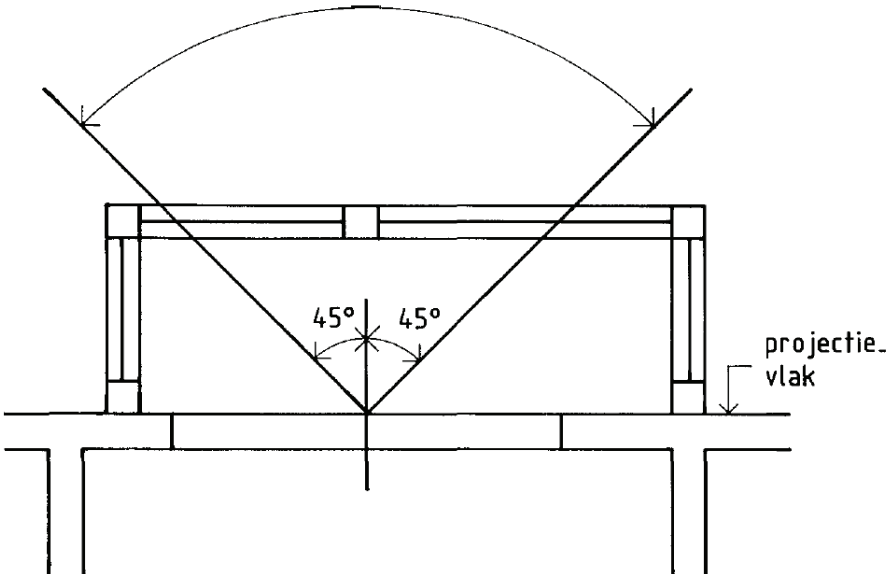


Figure 2.60 — *Reduction factor according to the vertical section, when we are dealing with a transparent surface.*

Determination external factor reduction: bounding surfaces in the horizontal section.
Now we show the table used to calculate Cb, the Obstruction factor.

β in °		α in °							
Van	t.m.	25	26-27	28-29	30-31	32-33	34-35	36-37	38-39
-	0	0,86	0,83	0,80	0,76	0,74	0,71	0,69	0,67
1	2	0,85	0,82	0,79	0,76	0,73	0,71	0,69	0,66
3	4	0,84	0,81	0,78	0,75	0,73	0,70	0,68	0,66
5	6	0,83	0,81	0,77	0,74	0,72	0,69	0,68	0,66
7	8	0,82	0,79	0,76	0,74	0,71	0,69	0,67	0,65
9	10	0,81	0,78	0,75	0,72	0,71	0,68	0,66	0,64
11	12	0,79	0,76	0,74	0,71	0,69	0,67	0,65	0,64
13	14	0,77	0,74	0,72	0,70	0,68	0,66	0,64	0,64
15	16	0,76	0,73	0,71	0,69	0,67	0,65	0,64	0,61
17	18	0,74	0,71	0,69	0,68	0,66	0,64	0,63	0,61
19	20	0,72	0,70	0,68	0,66	0,65	0,64	0,61	0,60
21	22	0,71	0,69	0,67	0,65	0,64	0,61	0,60	0,59
23	24	0,69	0,68	0,66	0,64	0,59	0,61	0,59	0,58
25	26	0,68	0,66	0,65	0,64	0,58	0,60	0,58	0,57
27	28	0,67	0,75	0,64	0,62	0,57	0,59	0,58	0,56
29	30	0,66	0,64	0,64	0,61	0,56	0,58	0,57	0,56
31	32	0,65	0,64	0,61	0,60	0,59	0,57	0,56	0,55
33	34	0,64	0,62	0,61	0,59	0,58	0,56	0,55	0,54
35	36	0,64	0,61	0,60	0,58	0,57	0,56	0,55	0,54
37	38	0,61	0,60	0,59	0,57	0,56	0,55	0,54	0,53
39	40	0,61	0,59	0,58	0,56	0,55	0,54	0,53	0,52
41	42	0,60	0,58	0,57	0,56	0,54	0,54	0,52	0,52
43	44	0,58	0,57	0,56	0,55	0,54	0,53	0,52	0,47
45	46	0,57	0,56	0,55	0,54	0,53	0,52	0,49	0,42
47	48	0,56	0,56	0,54	0,53	0,52	0,49	0,44	0,39
49	50	0,56	0,54	0,54	0,52	0,52	0,47	0,39	0,35
51	52	0,55	0,54	0,53	0,52	0,47	0,42	0,37	0,32
53	54	0,54	0,53	0,52	0,47	0,42	0,37	0,32	0,27
55	56	0,53	0,52	0,49	0,44	0,37	0,32	0,30	0,25
57	58	0,52	0,49	0,44	0,39	0,35	0,30	0,25	0,22
59	60	0,49	0,44	0,39	0,35	0,30	0,25	0,22	0,20
61	62	0,44	0,39	0,35	0,30	0,27	0,22	0,20	0,17
63	64	0,39	0,35	0,32	0,27	0,22	0,20	0,17	0,15
65	66	0,37	0,32	0,27	0,22	0,20	0,17	0,15	0
67	68	0,32	0,27	0,25	0,20	0,17	0,15	0,15	0
69	70	0,27	0,25	0,22	0,20	0,17	0,15	0	0
71	72	0,25	0,22	0,20	0,17	0,15	0,15	0	0
73	-	0	0	0	0	0	0	0	0

Zie vervolg

Figure 2.62 — *Angles to determine the reduction factors in the building.*

With all the listed in the above mentioned part, now we are able to perform the calculations in the next paragraphs to see if the Dutch law is verified.

2.3.4 SDE - Sub-contest 5.5: Natural Lighting

For the Solar Decathlon Competition, the natural lighting level measurements will take place at the scored period in the Competition Calendar.
Photometer(s) will be located in the living room. Light intensity of the area will be measured according to the spectral levels defined by the organization. All available points are earned by keeping the Daylight Factor, ratio lighting level / exterior (direct and indirect) lighting above 4% during measurement periods (cloudy sky). See the Competition Calendar for the schedule of scored periods.

a) Reduced points are earned if the ratio is between 2,5% and 4%.
Reduced points values are scaled linearly.

b) The measurement point height is 0.8 m and the minimum distance to a window is 2m. Direct light-emitting devices and direct sun rays are not permitted on the sensor.

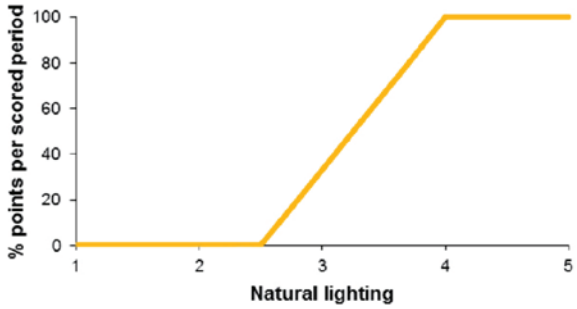


Figure 2.63 — *Graph explaining how the points are acquired during the Solar Decathlon competition.*

Full Points:			Daylight factor	≥	4 %
Reduced Points:	2,5 %	<	Daylight factor	<	4 %
No Points:			Daylight factor	≤	2,5 %

2.3.5 Software used

The calculations were performed with two different programs: Dialux and Ecotect. The choice to use two softwares was done due to the possibility that each of them offer but also due to their limitations.

Dialux is good to calculate the Daylight factor inside a room, but contains limitations in terms of design possibilities and insertion of external obstructions. This factor inflicts the results of the computation. Ecotect instead, was also used to calculate the impact of the roof and of the glasshouse in the living room and especially inside the bedrooms. It has a lower precision of Dialux but the problem is that is possible to insert in the mod-elements like double facades and/or external obstructions.

From the comparison of the results, we can also observe if the outputs are similar.

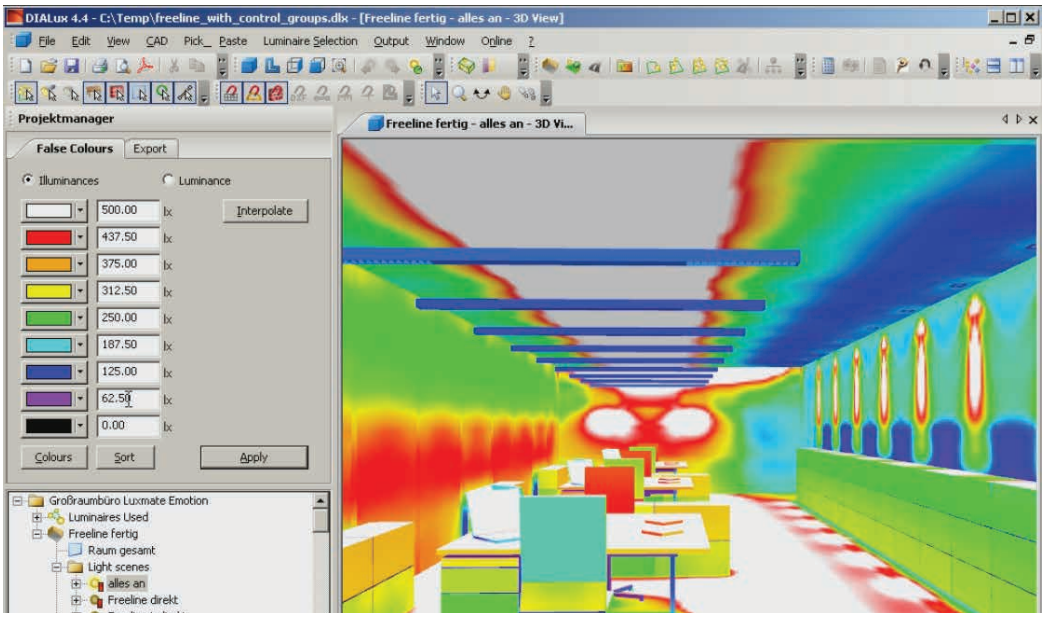


Figure 2.64 — *View of the program input windows with the results of a computation of a light analysis in Dialux.*

Analysis - Living room

First an analysis on the existing situation is run over the model of the original house in Honselersdijk. This is done to understand the starting point of the house that we want to improve with the glasshouse. In the living room of the house in Honselersdijk the walls are disposed in the following way:

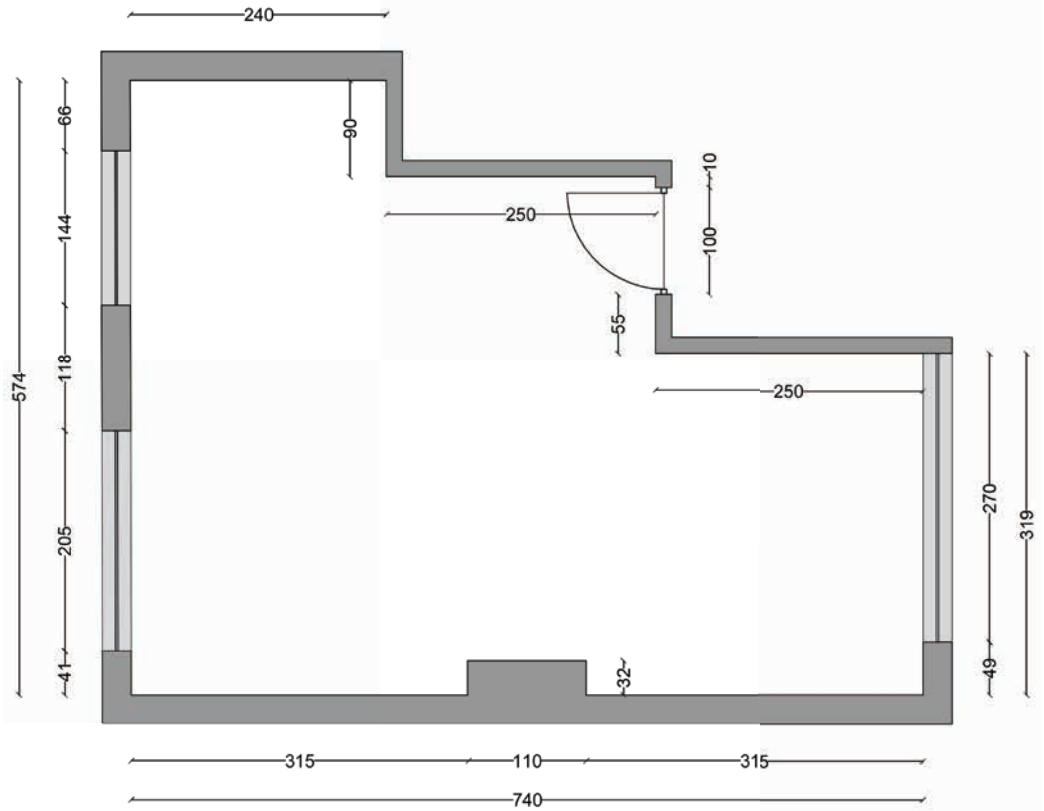


Figure 2.65 — *Plan with the measures of the living room of the existing house in Honselersdijk.*

The further calculation details are according the parameters inserted in the program. The windows show the following parameters:

Position	Glazing	Transmission	Reflection effect	Reflection coeff.
North / South	Single	90 %	80 %	10 %

In the following part the types of material used for the partitions are listed:

Element	Material	Color	Reflection coeff.
Walls	Plaster	White	80 %
Ceiling	Plaster	White	80 %
Floor	Light wood	Light Brown	52 %
Wall	Light wood	Light Brown	52 %
External wall	Brick	Dark Brown	20 %

The analysis was performed considering Amsterdam as the location value, as long as it was the nearest value to the location of the analysis. To calculate in Dialux the Daylight factor, an average value for the external illumination with clear sky conditions, has to be considered to perform the calculations.

The following parameters are considered as input:

- Date: 21/03/2014

- Time: 12:30

- Location: Amsterdam

- Sky condition: Clear

- Eo: 10806 lx

The choice to calculate the DF during spring was taken as default value and to verify that the light was sufficient even in a period, where the external illumination has an average value through the whole year. We consider that if the values are met in this period, they will be more likely to be fine for the analysis in Versailles.

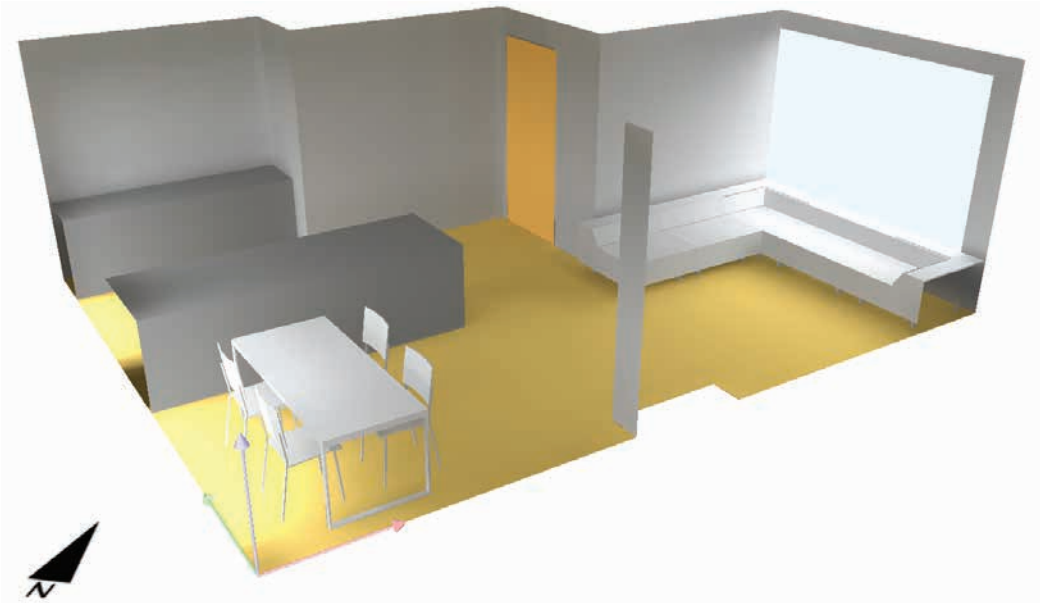


Figure 2.66 — *3D model of the illumination inside the living room.*

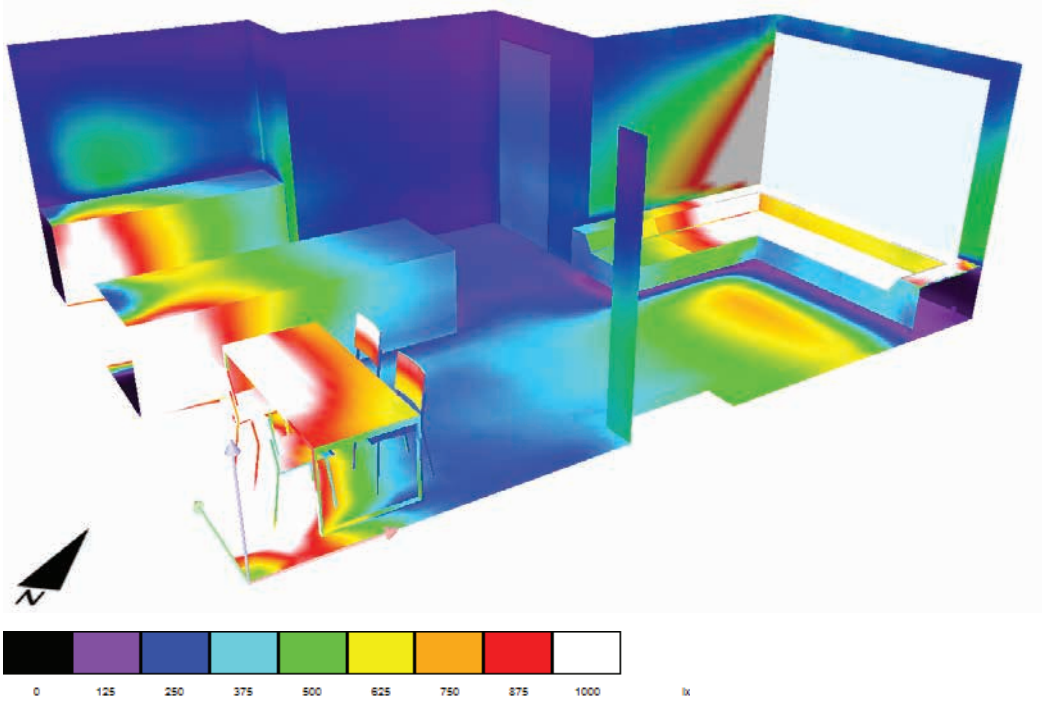


Figure 2.67 — *3D model of the diagram of the natural illumination of the room (in lux).*

All of them are placed at a height of 0.75 meters, listed by the program as useful height, as listed from the project manual. Now we consider both the luminance graphs and the daylight factor points, considering that for the area we consider a Eo of 10806 lux.

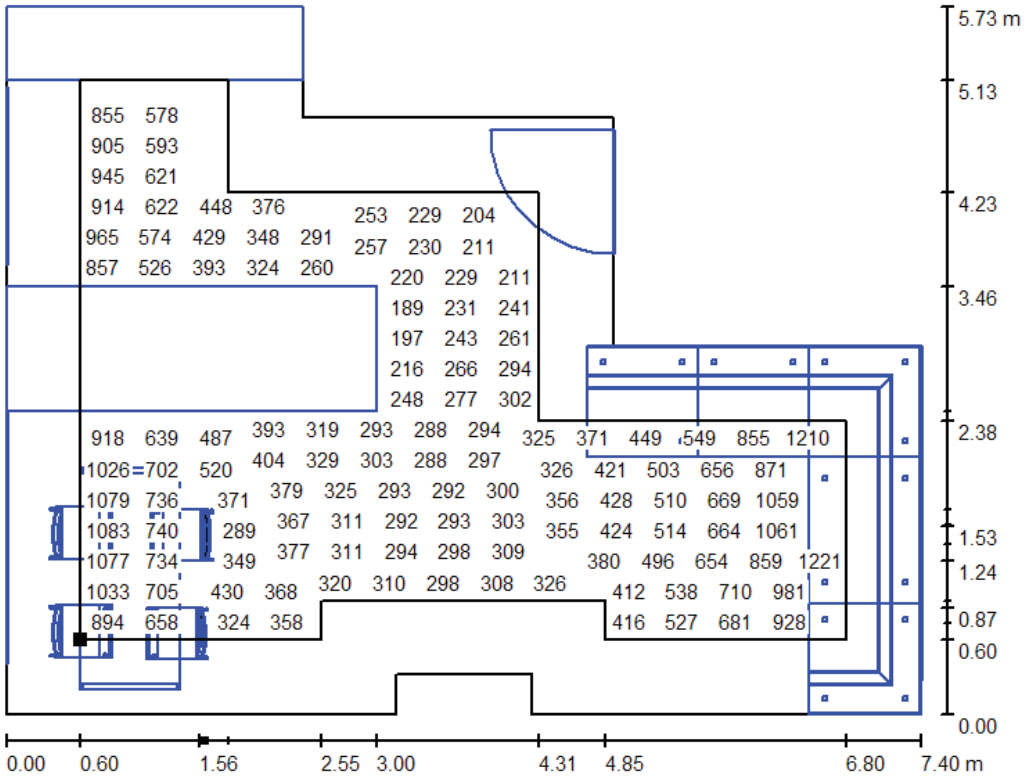


Figure 2.68 — *Results of the lux levels inside the living room.*

In the graphs the lux are shown and now they are compared with the current daylight factor percentages.

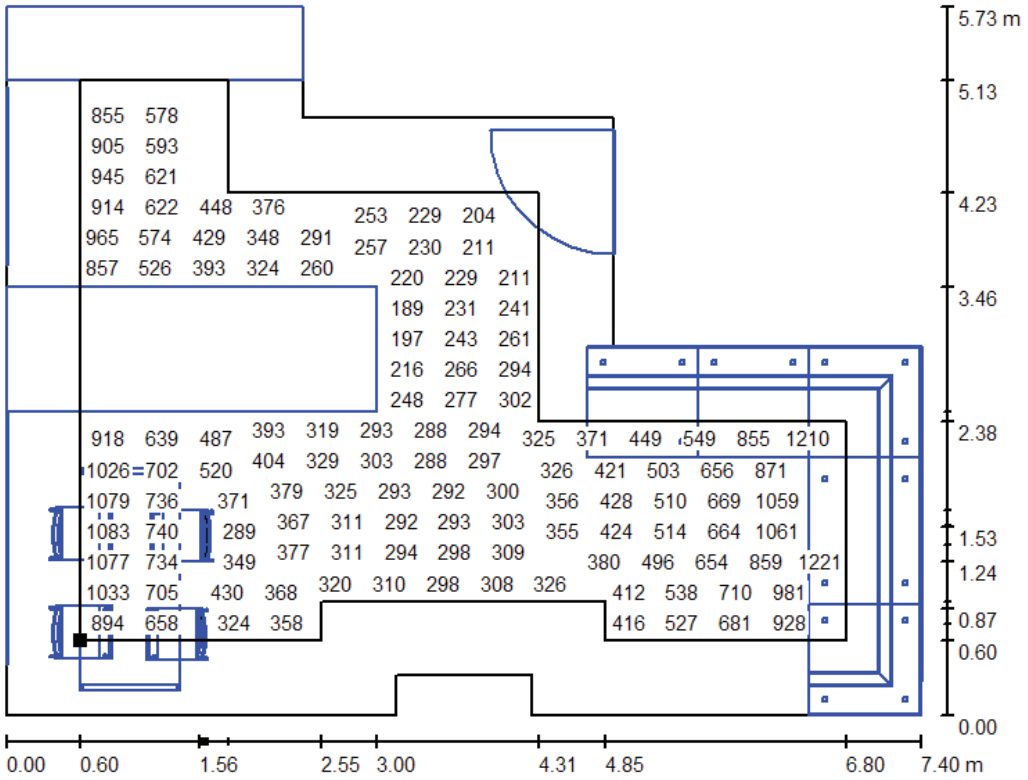


Figure 2.69 — *Results of the Daylight Factor inside the living room.*

We can see that a distance of 2 meters from the window we have generally a daylight factor less than 4 %, while in the middle part we get a factor going from a minimum of

1.88 % to 2.82 %. Starting from this situation we can observe how much the situation can improve.

Analysis - Bedrooms

Another analysis is run in the upper floor, because also this part is going to be a part of the renovation and of the consequent calculations. The model is analyzed without furniture as long as during the analysis on the site, it was unfurnished. This images represent the bigger room:

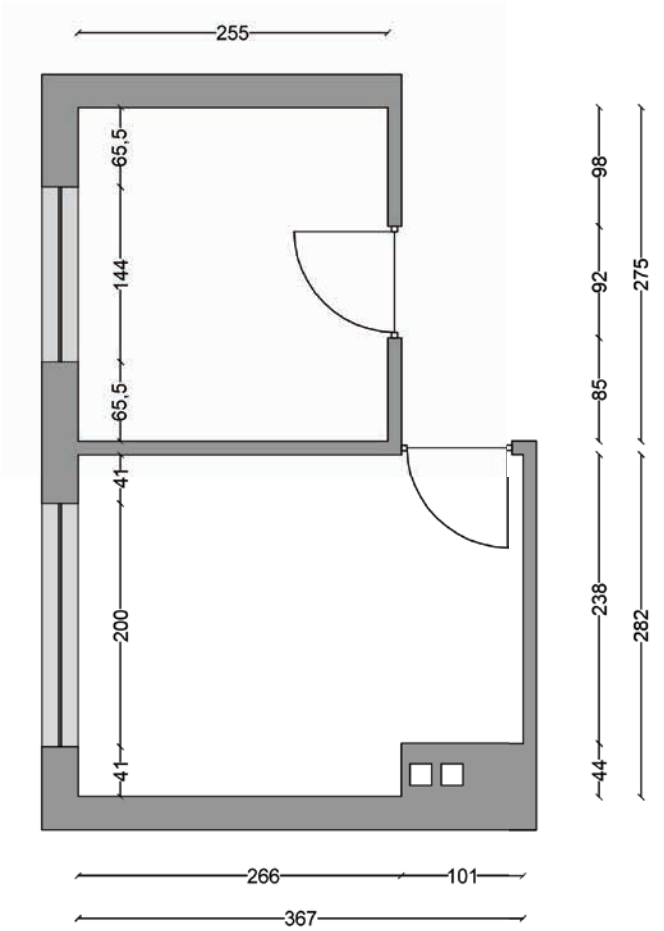


Figure 2.70 — *Plan with the measures of the bedrooms of the existing house in Honselersdijk.*

The further calculation details are according the parameters inserted in the program. The windows show the following parameters:

Position	Glazing	Transmission	Reflection effect	Reflection coeff.
North / South	Single	90 %	80 %	10 %

In the following part the types of material used for the partitions are listed:

Element	Material	Color	Reflection coeff.
Walls	Plaster	White	80 %
Ceiling	Plaster	White	80 %
Floor	Light wood	Light Brown	52 %
Wall	Light wood	Light Brown	52 %

And in the following part, the amount of natural illumination was analyzed. First a 3D view of the big bedroom is shown followed by an analysis of the daylight luminance (in lux).

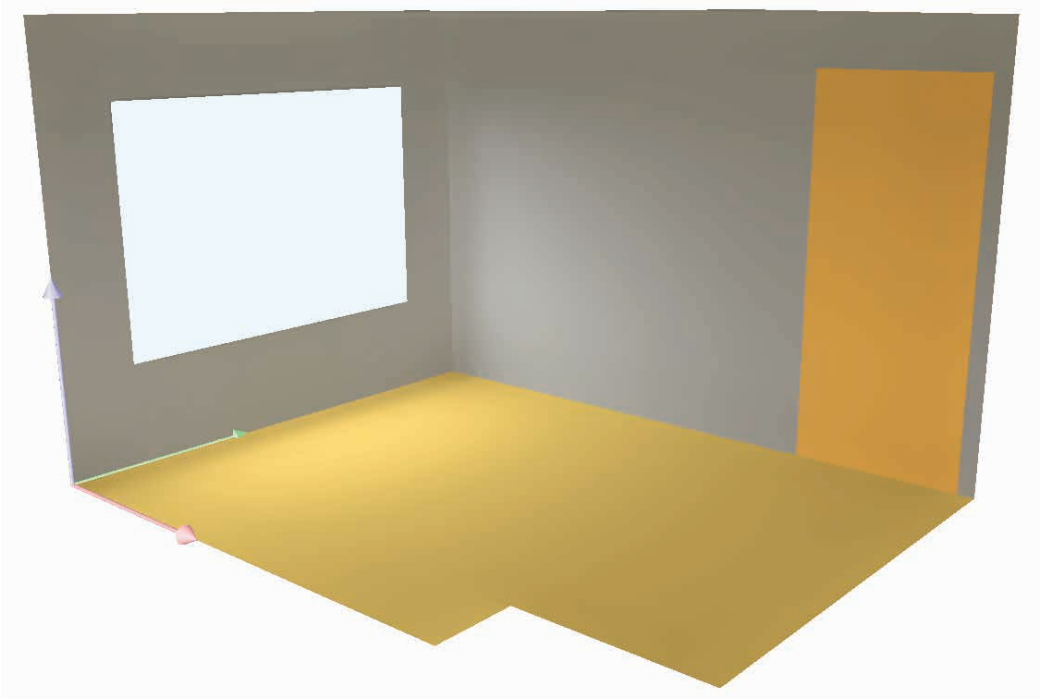


Figure 2.71 — *3D model of the illumination inside the bigger living room.*

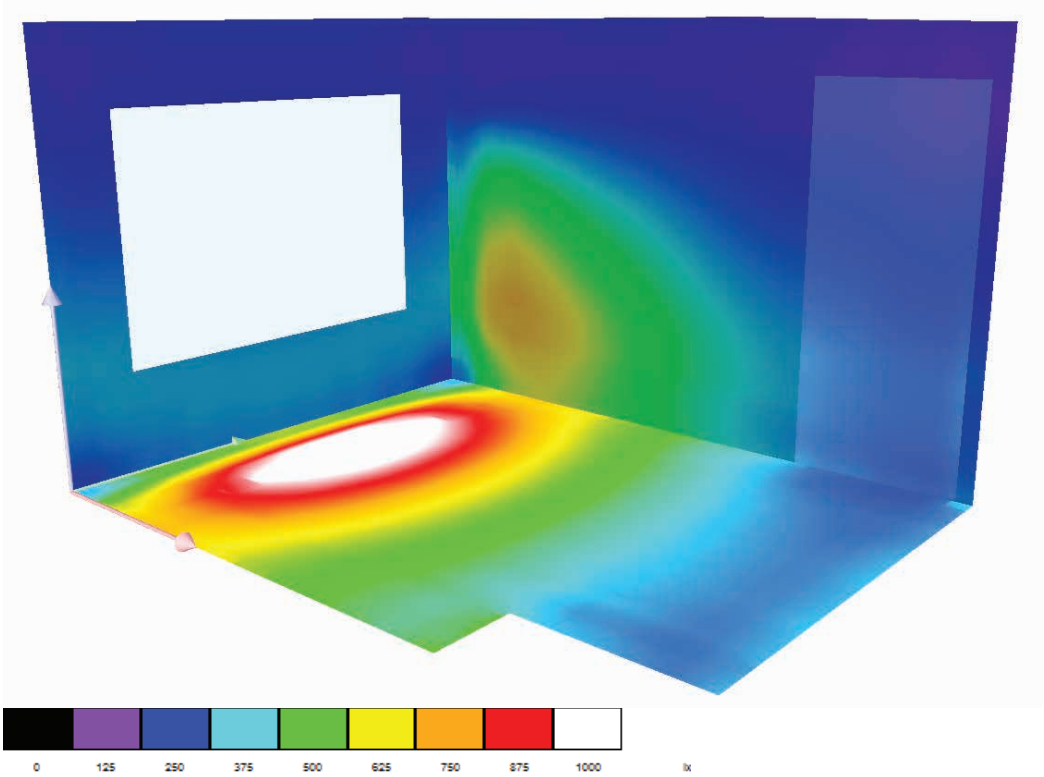


Figure 2.72 — *3D model of the diagram of the natural illumination of the room (in lux).*

Now we show the lux values inside the room after considering the natural external illumination of 10806 lux in the bigger bedroom.

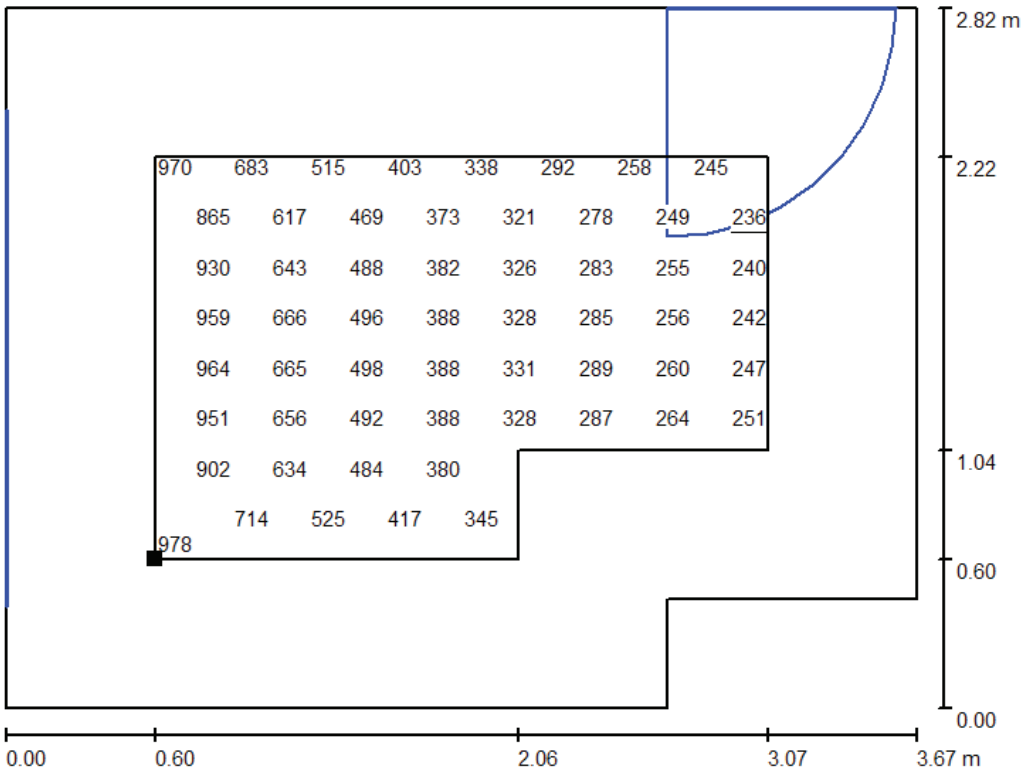


Figure 2.73 — *Results of the lux levels inside the bigger bedroom.*

Then we consider the Daylight Factor insider the room.

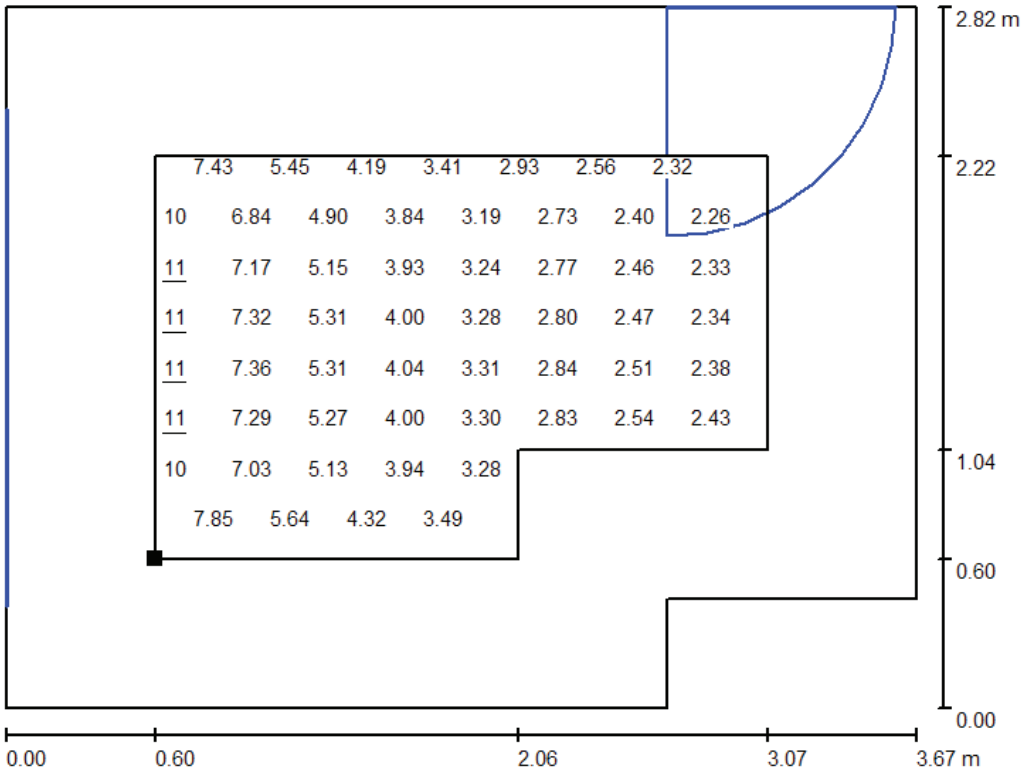


Figure 2.74 — *Results of the Daylight Factor inside the bigger bedroom.*

And in the following part, the amount of natural illumination was analyzed in the smaller bedroom. First a 3D view is shown and then a diagram with the amount of lux in the room.

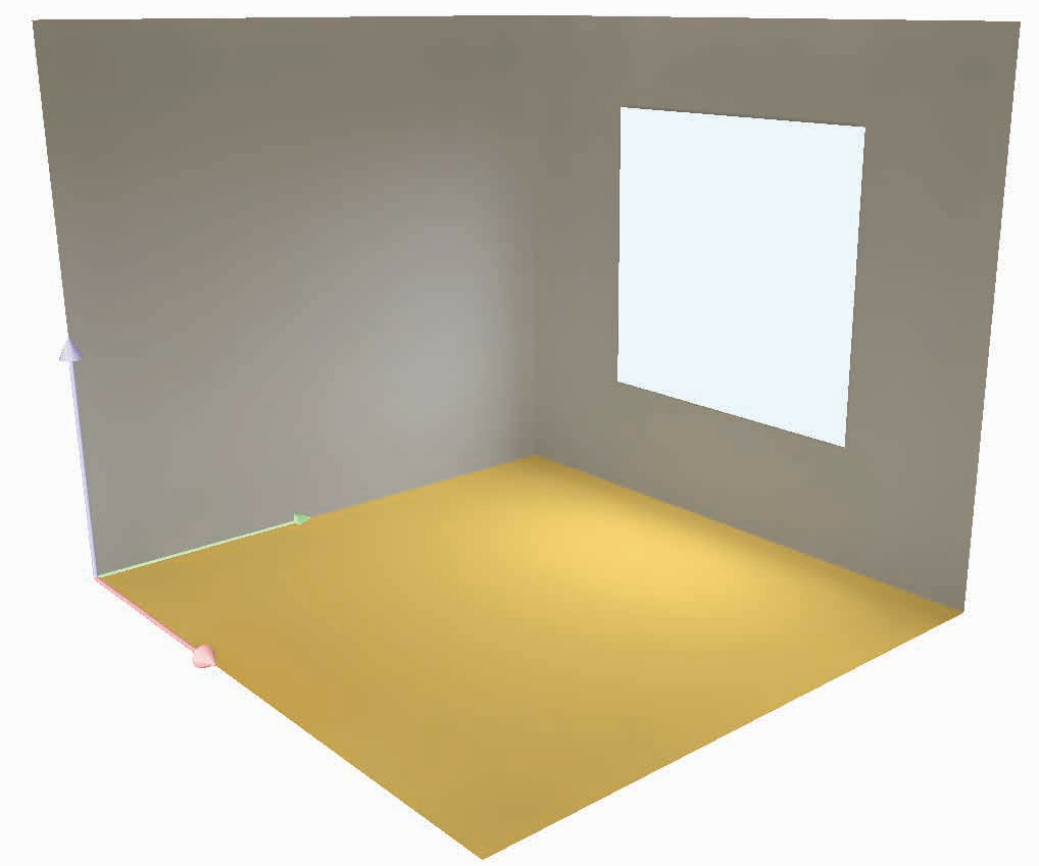


Figure 2.75 — *3D model of the illumination inside the smaller living room.*

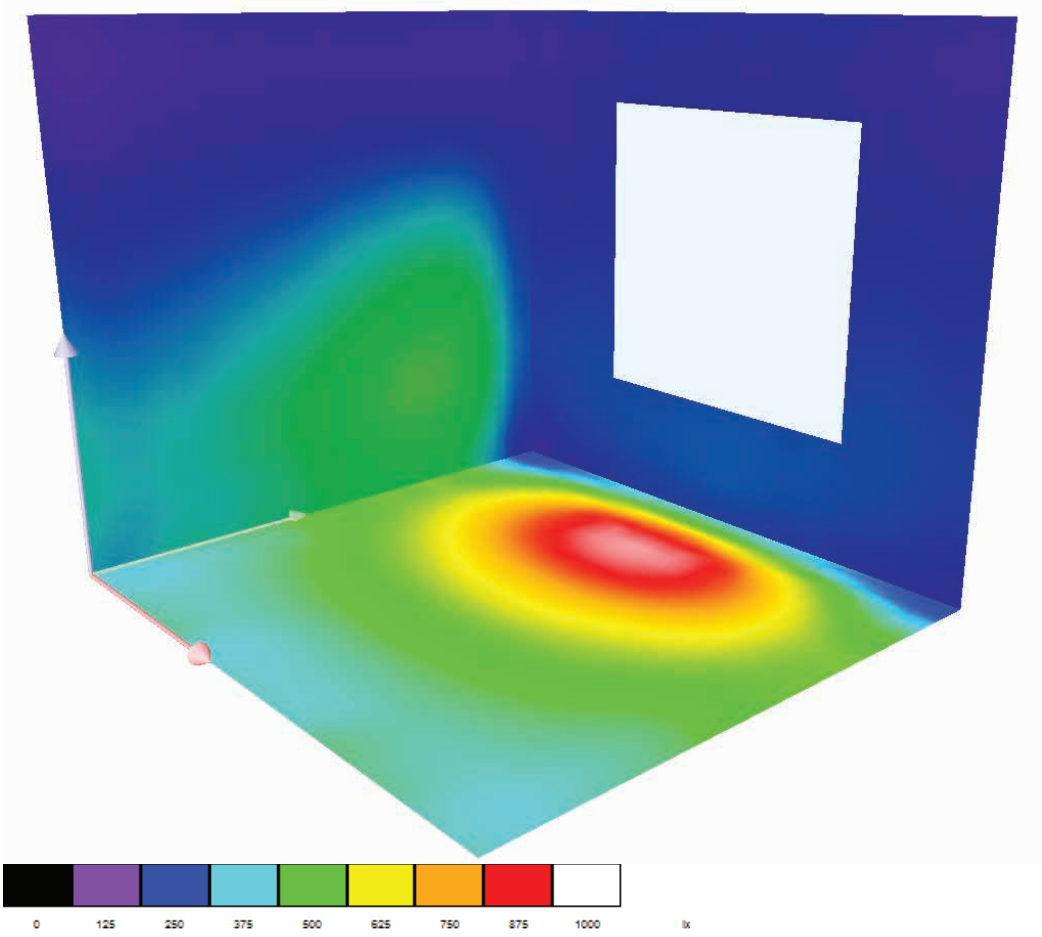


Figure 2.76 — *3D model of the diagram of the natural illumination of the room (in lux).*

Now we show the lux values inside the room after considering the natural external illumination of 10806 lux in the bigger bedroom.

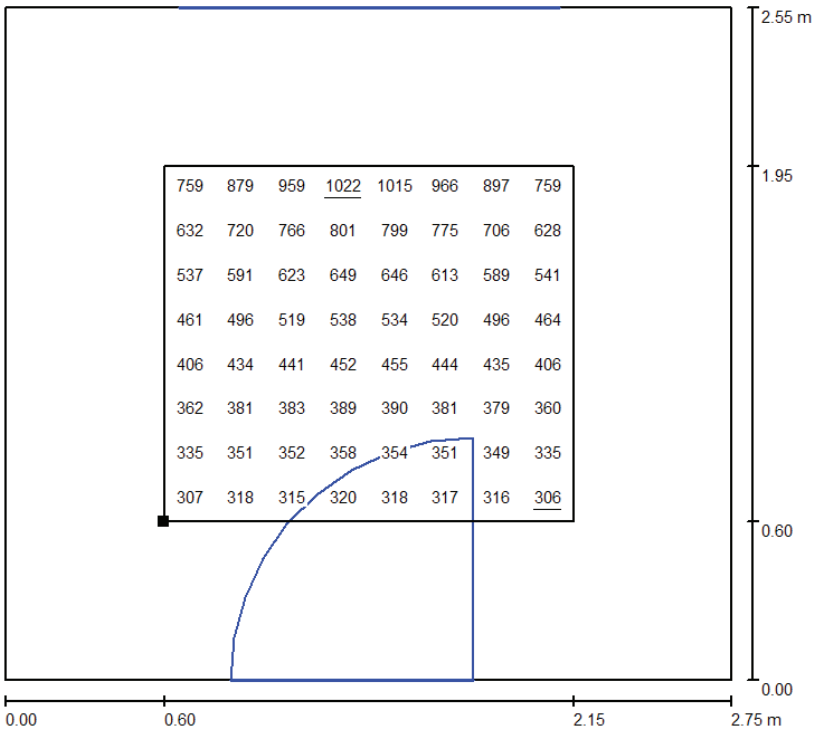


Figure 2.77 — *Results of the lux levels inside the smaller bedroom.*

Then we consider the Daylight Factor insider the room.

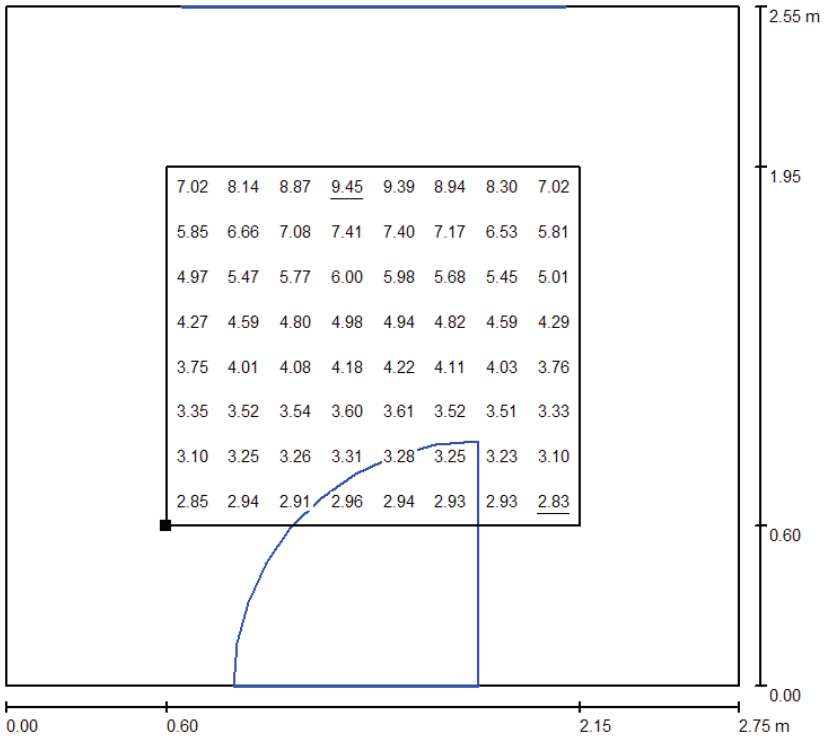


Figure 2.78 — *Results of the Daylight Factor inside the smaller bedroom.*

We immediately observe that this type of room is designed with a much lower requirement than a living space. We will notice a higher reduction of the natural light from the following graphs. From the lux levels, and considering the external illumination, we expect much lower light levels. Especially if we consider a distance bigger than 2 meters from the windows.

As a daylight factor, we see that the values are really low and in some parts of the room we can even observe something lower than 2 %. This room is going to be really one of the most difficult points to solve, as soon as the influence of the glasshouse will be considered.

2.3.7 Dutch law verification

In this part we are taking care of verifying and calculating the Daylight surface, according to the Dutch law NEN 2057, for a verification that we will need later. According to the rule, if the obstruction angle α is smaller than 25°, then we have to set it equal to 25 °. It is important to state that, according to the law, the transparent surfaces below 0,6 m are neglected for the calculations.

First we analyze the windows in the living room:

- North façade window:

  $A_d = 3,66\ m^2$
  $C_b = 0,86$
  $C_u = 1$

  $A_e = A_d * C_b * C_u = 3,66 * 0,86 * 1 = 3,15\ m^2$

- South façade window 1:

  $A_d = 2,72\ m^2$
  $C_b = 0,86$
  $C_u = 1$

  $A_e = A_d * C_b * C_u = 2,72 * 0,86 * 1 = 2,34\ m^2$

- South façade window 2:

  $A_d = 1,1\ m^2$
  $C_b = 0,86$
  $C_u = 1$

  $A_e = A_d * C_b * C_u = 2,72 * 0,86 * 1 = 1,1\ m^2$

Then we sum the up to discover the daylight surface of the living room:

$A_{e;t} = A_{en} + A_{es1} + A_{es2}$

$A_{e;t} = 3,15 + 2,34 + 1,1 = 6,59\ m^2$

This parameter will be taken in consideration for the analysis of the glasshouse, to see how much it needs to be improved for the future.

Now an analysis of the two bedrooms are calculated.

- South façade window 1:

  $A_d = 1,92\ m^2$
  $C_b = 0,86$
  $C_u = 1$

  $A_e = A_d * C_b * C_u = 1,92 * 0,86 * 1 = 1,65\ m^2$

- South façade window 2:

  Ad = 1,25 m2
  Cb = 0,86
  Cu = 1

  Ae = Ad * Cb * Cu = 2,72 * 0,86 * 1 = 1,08 m2

Then we sum the up to discover the daylight surface of the living room:

Ae;t = Aes1 + Aes2

Ae;t = 1,65 + 1,08 = 2,73 m2

This parameter will be taken in consideration for the analysis of the glasshouse, to see how much it needs to be improved for the future.

Analysis - Living room

In these analysis we are going to observe if there is going to be an improvement or a worsening of a current situation. Considering that we are applying a new glass structure on the south part, we are expecting the second situation. In this part we are going also to verify the house together with the NEN 2057, to see if this house can be built and realized as it is or it needs some adjustments.

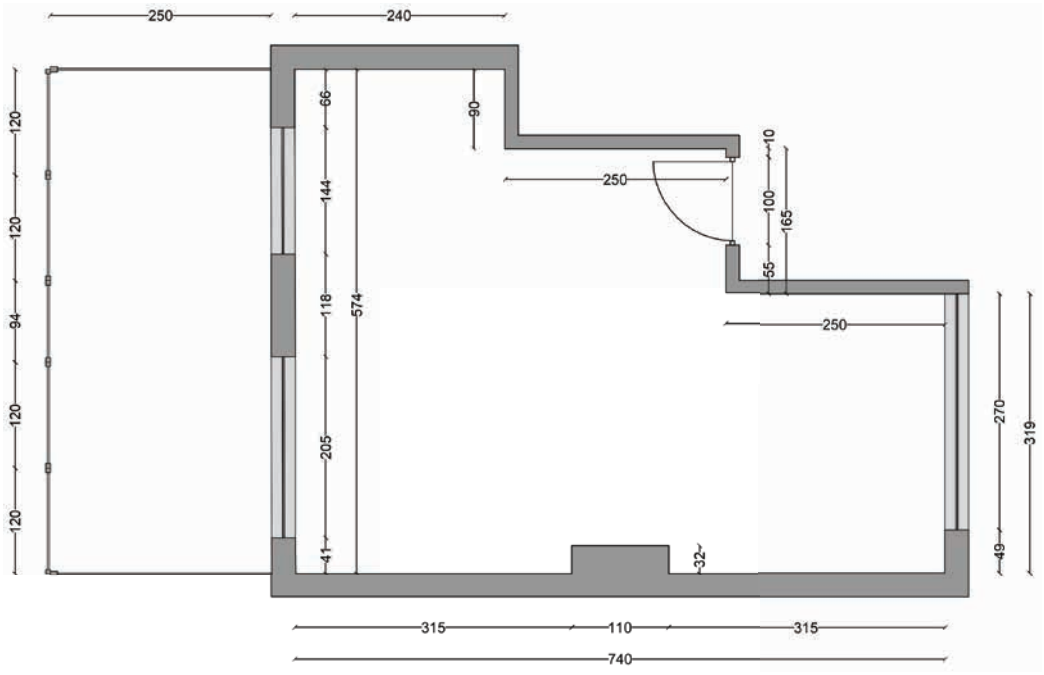


Figure 2.79 — *Plan with the measures of the living room of the glasshouse is applied in the house in Honselersdijk.*

The further calculation details are according the parameters inserted in the program. The windows show the following parameters:

Position	Glazing	Transmission	Reflection effect	Reflection coeff.
North facade	Double	75 %	80 %	10 %
South facade	Double	75 %	80 %	10 %
Glasshouse	Single	90 %	80 %	10 %

The drawing is just a slice of the original house because, for the competition only the analysis of the living room is required. In the following part the types of material used for the partitions are listed:

Element	Material	Color	Reflection coeff.
Walls	Plaster	White	80 %
Ceiling	Plaster	White	80 %
Floor	Light wood	Light Brown	52 %
Wall	Light wood	Light Brown	52 %
External wall	Brick	Dark Brown	20 %

In this particular analysis, it is also involved the obstruction of the shading and single glazed windows in the upper part. In the analysis, we considered the worst case scenario, where both the obstruction of the solar panels and of the shading system is taken in consideration.

To perform the calculations for the daylight factor, the following parameters are considered as input parameters for Dialux:

- Date: 21/03/2014

- Time: 12:30

- Location: Amsterdam

- Sky condition: Clear

- Eo: 10806 lx

The choice to calculate the DF during spring was taken as default value and to verify that the light was sufficient even in a period, where the external illumination has an average value through the whole year.

And then we consider the influence of the shading system

Element	Material	Color	Reflection coeff.	Transparency
Shading system	Textile	Dark Blue	18 %	37 %

Unlike the house in Versailles, a fewer numbers of solar panels will be implied.
This choice was taken because theoretically, it is really difficult to see the same amount of panels on a Dutch row house, due to their excessive costs. Furthermore the natural light levels inside the bedrooms, are much more important for the renovation in Honselersdijk. This means that for the analysis of the lux, we take in consideration a combined transparency of 90 % of the windows and of 37 % of the shading system.

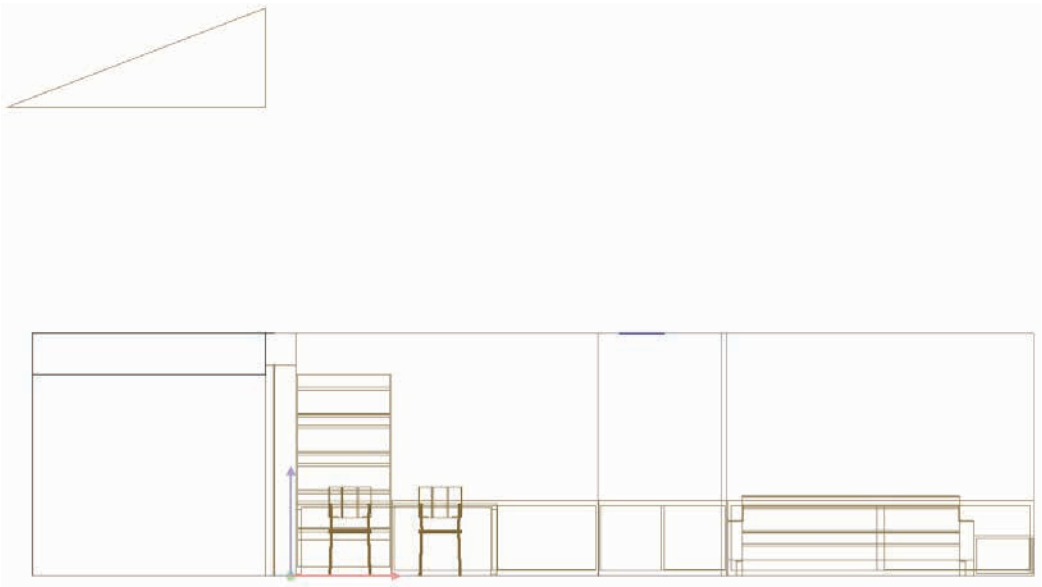


Figure 2.80 — *Dialux drawing where the influence of the glasshouse and the shading is shown.*

The combined value is 33 % and this is modeled in Dialux with an extruded triangle where, every surface can be defined with a different material with a different transparency. The oblique one is the only one affected by the shading system and the single glazed window, the other ones have a transparency of 100 %.

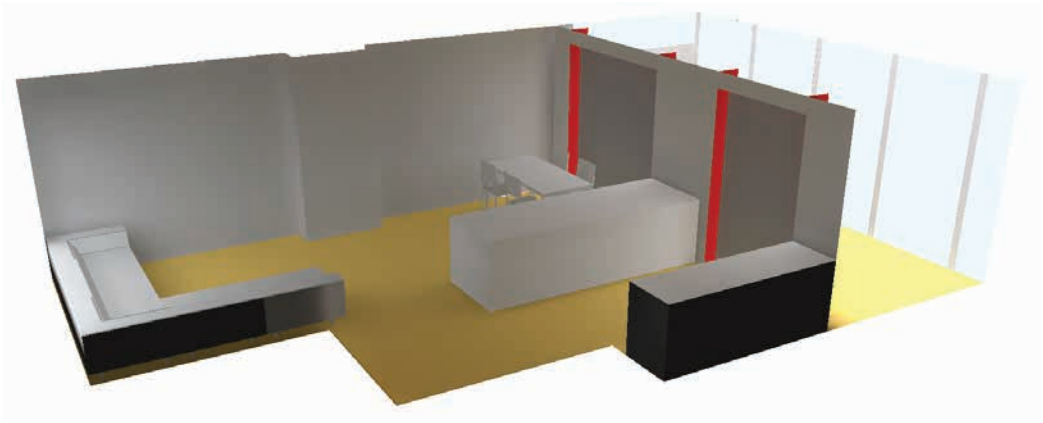


Figure 2.81 — *3D model of the illumination inside the living room with the glasshouse.*

And now the levels of the natural illumination are shown.

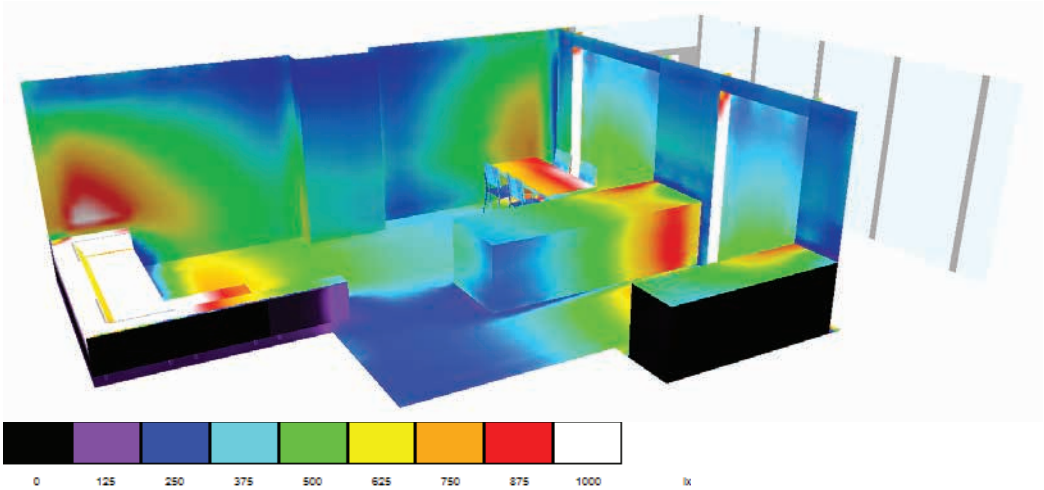


Figure 2.82 — *3D model of the diagram of the natural illumination of the room (in lux).*

We can see that the lux values are really improving in the second case and we can verify it with the graph of the levels of lux in the room. The measurements were taken at the useful height of 0.75 meters.
The external illumination Eo = 10806 lux, will be used as parameter to calculate the daylight factor.

Here it is shown the graph with the natural illumination in lux:

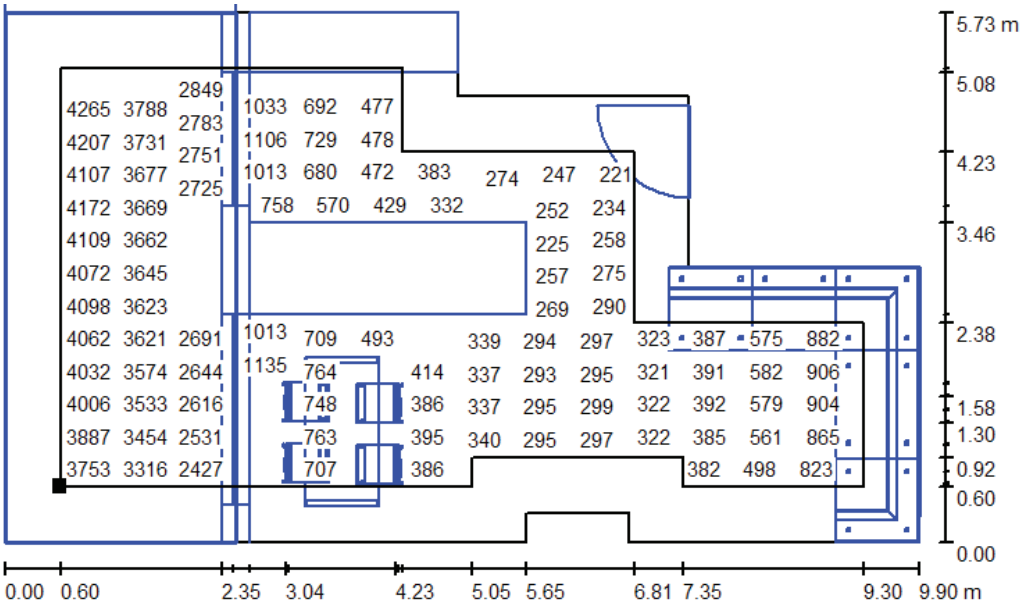


Figure 2.83 — *Results of the lux levels inside the living room with the glasshouse.*

And now the Daylight factor is listed:

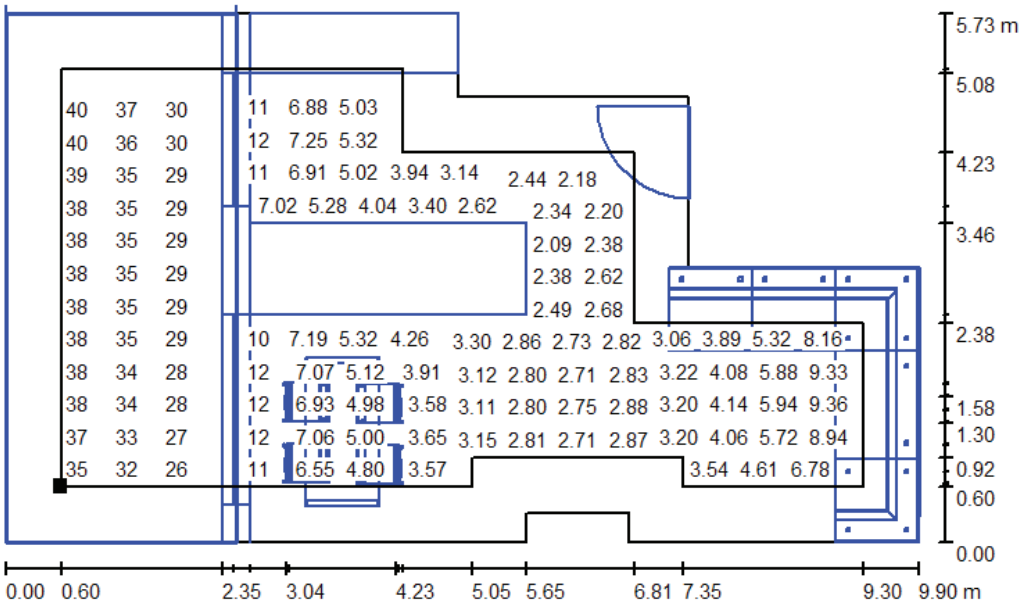


Figure 2.84 — *Results of the Daylight Factor inside the living room with the glasshouse.*

We can observe that the values have almost the same amount of light and this is because the glass surface is not affecting too much the daylight factor.

Analysis - Bedroom

For the upper floor an analysis is run, but for a more feasibility study we consider that for a Dutch house a much lower number of solar panels will be used on the roof. This is especially done to contain the budget and to ensure an acceptable amount of daylighting.

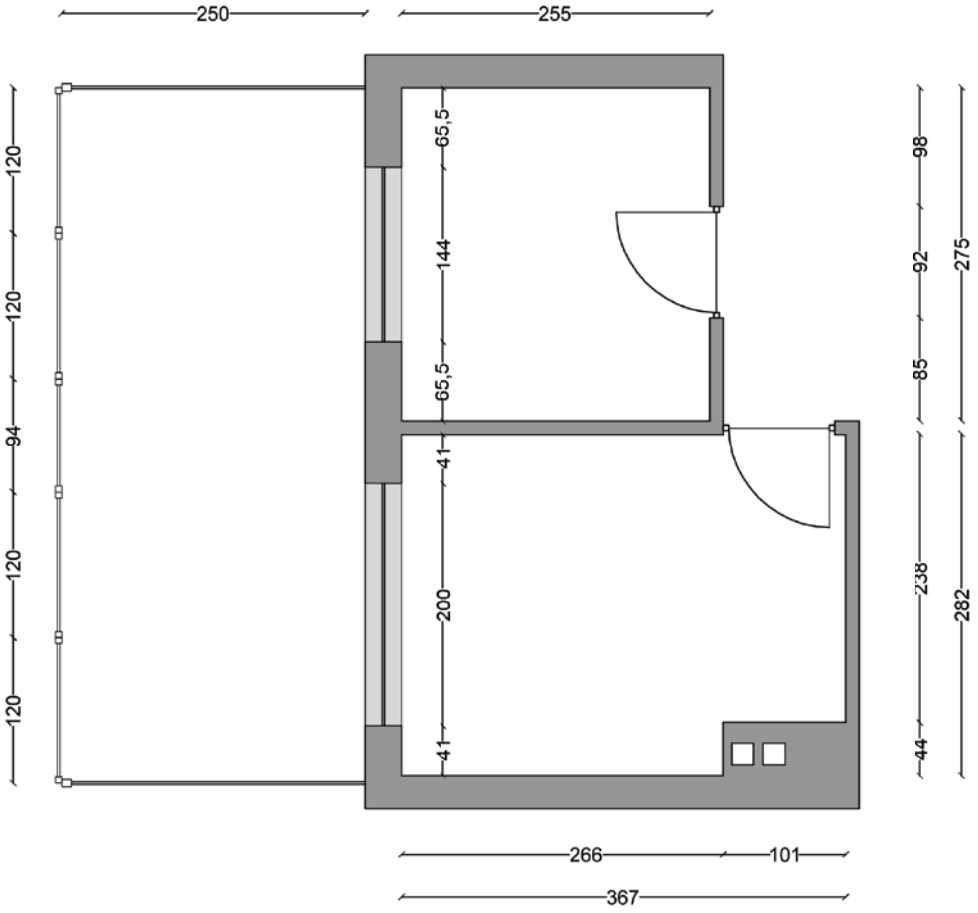


Figure 2.85 — *Plan with the measures of the bedrooms of in the house in Honselersdijk, when the glasshouse is applied.*

So in this case, we just consider for an overcast day, the impact of only the glass panels. This means that using windows with a transmission of 68% is enough for the calculations, as long as we consider the transmission of both the single glazed windows of the glasshouse together with the new double glazing windows. We do not consider the shading system because, for an analysis in an overcast sky they are not used.

Position	Glazing	Transmission	Reflection effect	Reflection coeff.
South facade	Double	75 %	80 %	10 %
Glasshouse	Single	90 %	80 %	10 %

Instead, for the inner part, the following types of material used for the partitions are listed:

Element	Material	Color	Reflection coeff.
Walls	Plaster	White	80 %
Ceiling	Plaster	White	80 %
Floor	Light wood	Light Brown	52 %
Wall	Light wood	Light Brown	52 %

As long as it was difficult to design the obstruction of the upper part of the glasshouse, we used a modified value for the windows listed in the upper part, due to the limits of Dialux. We also consider only the influence of the single glazed window for the upper part of the glasshouse, creating obstruction to the inner rooms.

And in the following part, the amount of natural illumination was analyzed. First a 3D view of the bigger bedroom is shown.

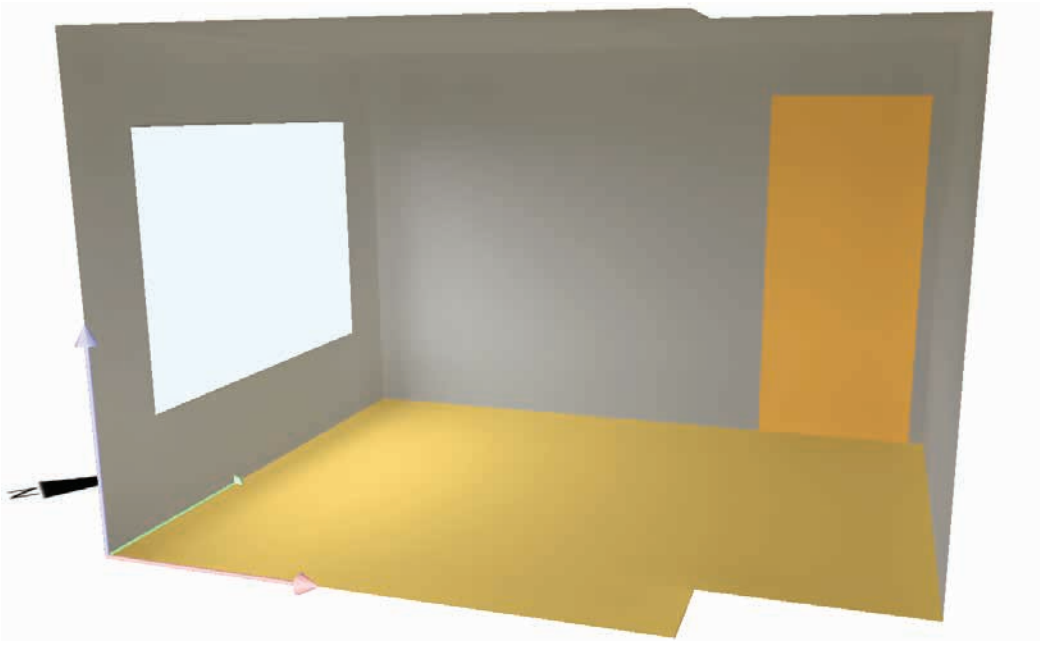


Figure 2.86 — *3D model of the illumination inside the bigger bedroom with the glasshouse.*

And in the following part, the amount of natural illumination was analyzed.

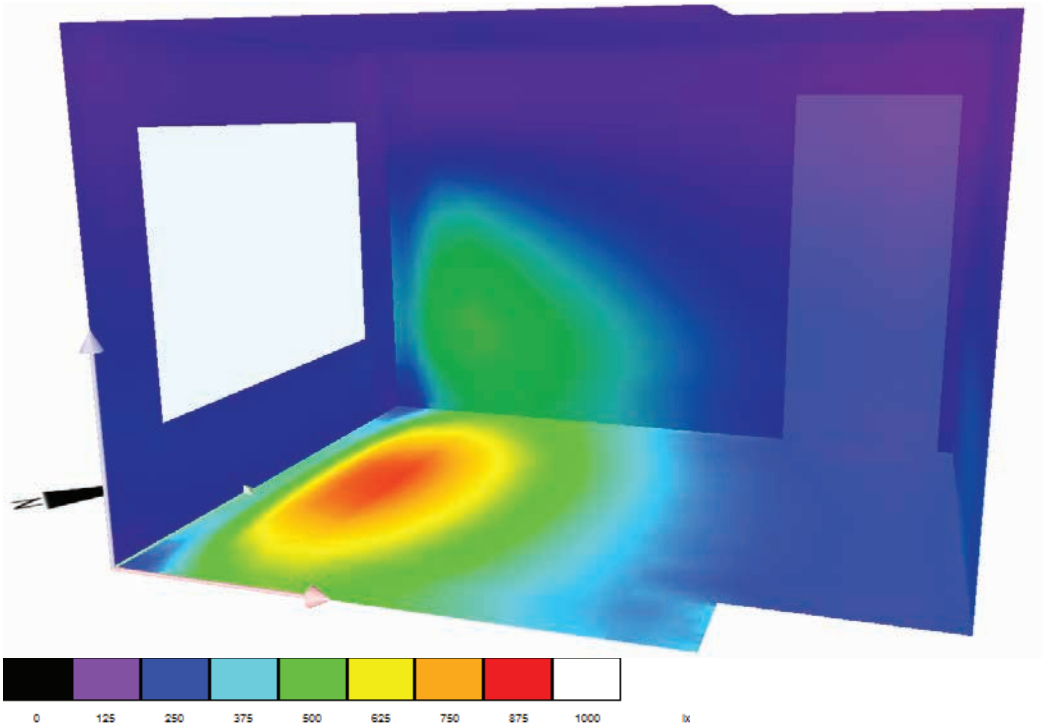


Figure 2.87 — *3D model of the diagram of the natural illumination of the room (in lux).*

Now we show the lux values inside the room after considering the natural external illumination of 10806 lux in the bigger bedroom. Now we analyze the amount of lux and the Daylight Factor inside the room:

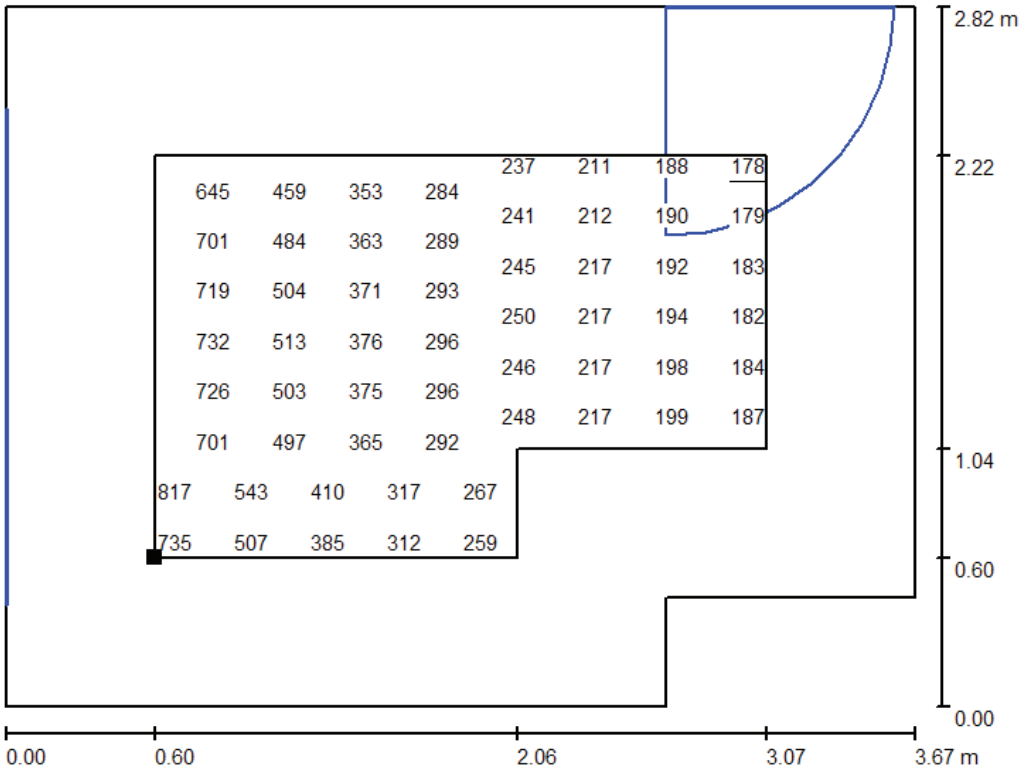


Figure 2.88 — *Results of the lux levels inside the bigger bedroom with the glasshouse.*

And now the Daylight Factor:

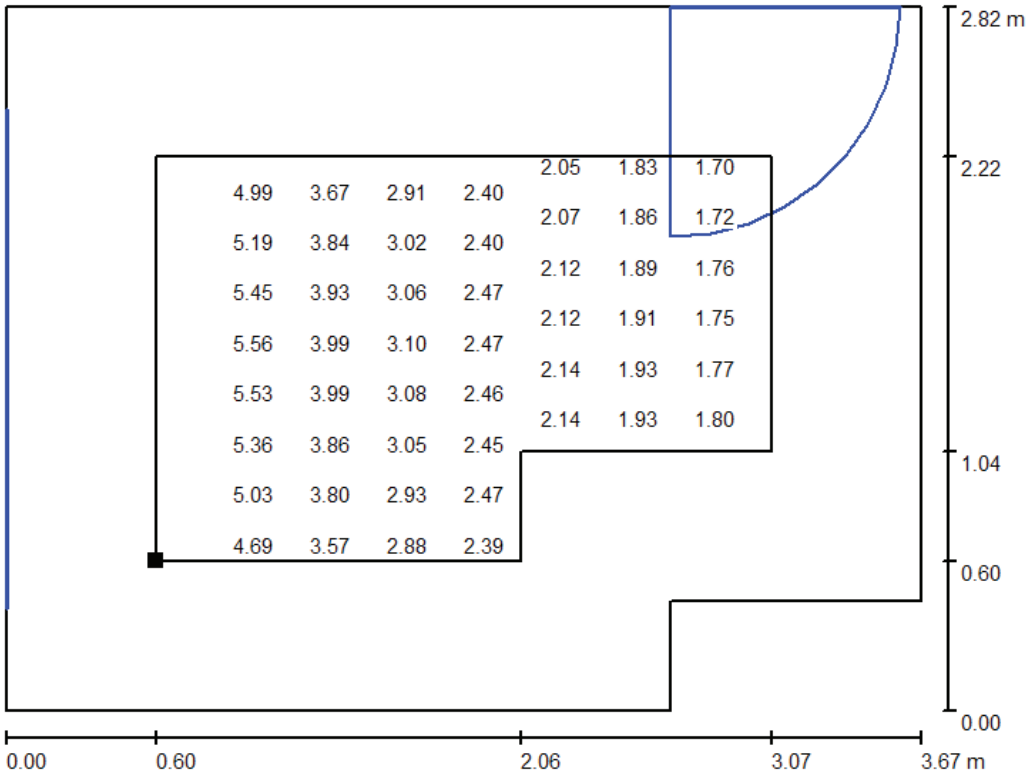


Figure 2.89 — *Results of the Daylight factor inside the bigger bedroom with the glasshouse.*

We immediately observe that this type of room is designed with a much lower requirement than a living space. We will notice a higher reduction of the natural light from the following graphs.

Now a 3D view of the smaller bedroom is shown.

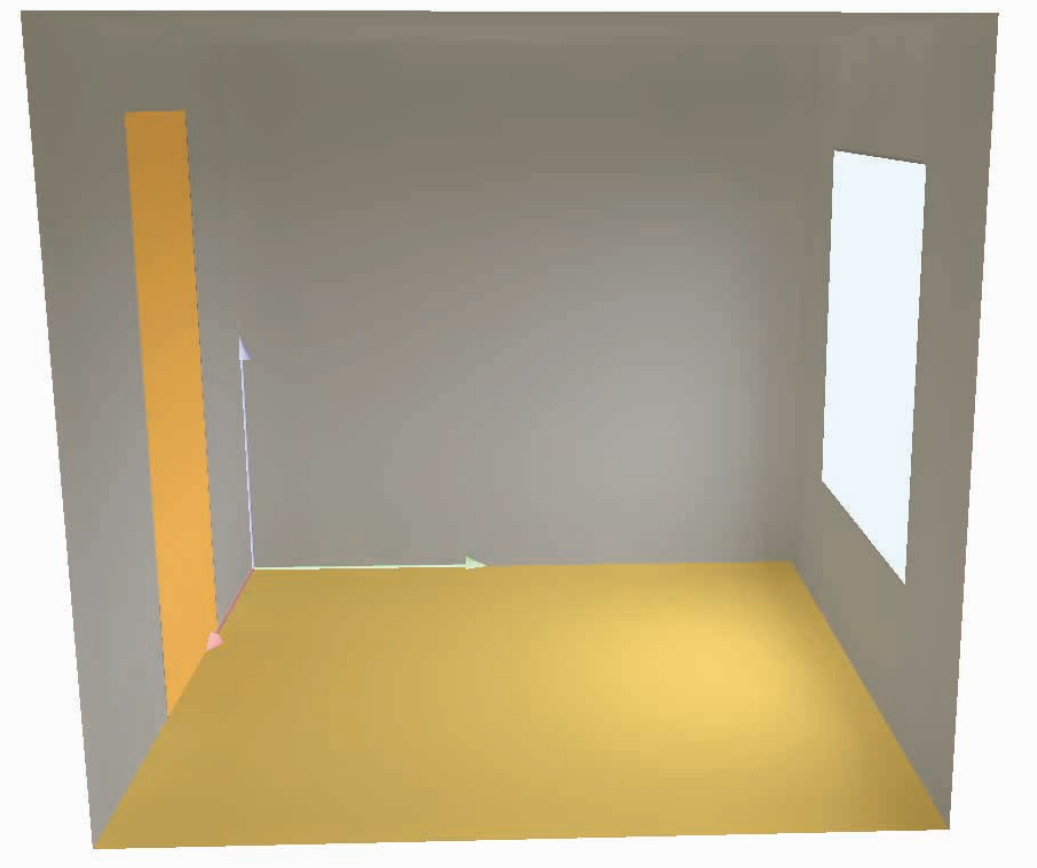


Figure 2.90 — *3D model of the illumination inside the smaller bedroom with the glasshouse.*

And in the following part, the amount of natural illumination was analyzed.

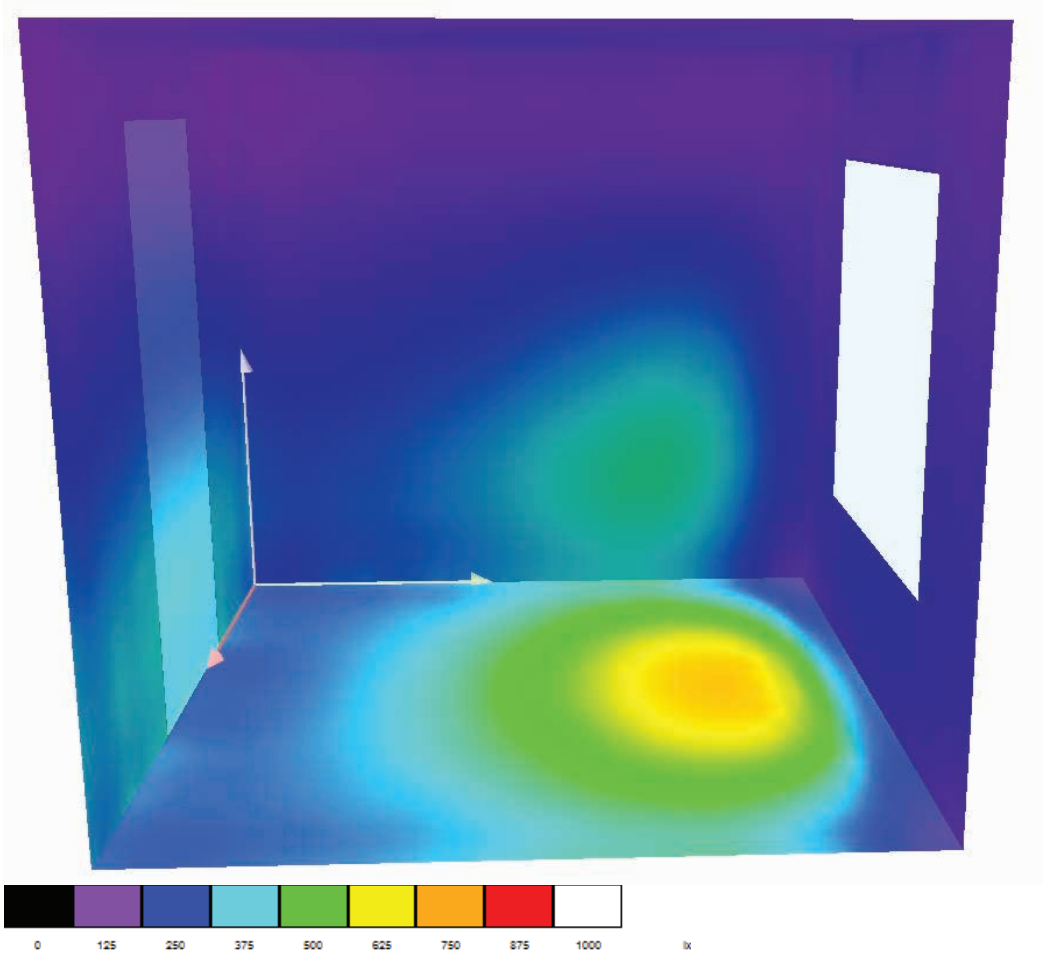


Figure 2.91 — *3D model of the diagram of the natural illumination of the room (in lux).*

From the lux levels, and considering the external illumination, we expect much lower light levels. Especially if we consider a distance bigger than 2 meters from the windows.

Now we show the lux values inside the room after considering the natural external illumination of E_o = 10806 lux in the bigger bedroom. Now we analyze the amount of lux and the Daylight Factor inside the room.

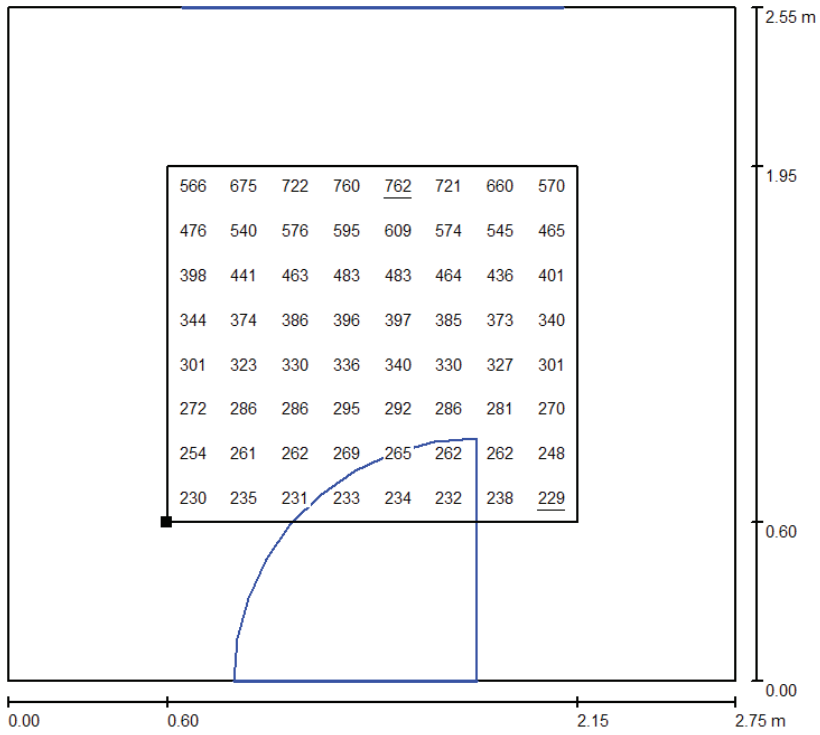


Figure 2.92 — *Results of the lux levels inside the smaller bedroom with the glasshouse.*

And now the Daylight Factor

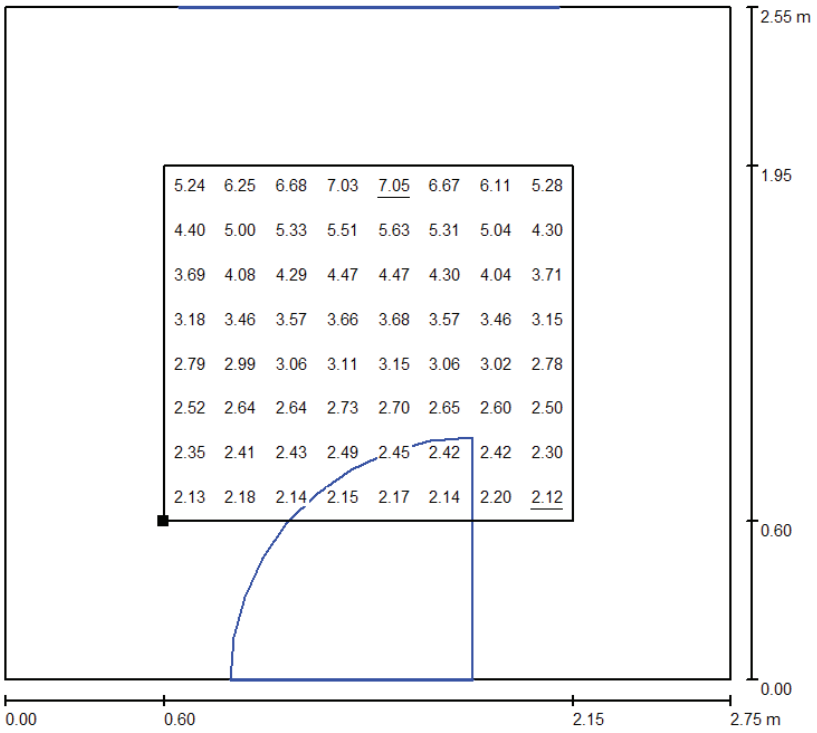


Figure 2.93 — *Results of the Daylight factor inside the bigger bedroom with the glasshouse.*

As a daylight factor, we see that the values are really low and in some parts of the room we can even observe something lower than 1 %. This room is going to be really one of the most difficult points to solve.

2.3.9 Dutch law comparison

In this part we are taking care of verifying and calculating the Daylight surface, according to the Dutch law NEN 2057, for a verification that we will need later. Instead of the previous example, due to the glasshouse we have to use an Exterior reduction factor of $C_u = 0,8$.

First we analyze the windows in the living room:

- North façade window:

  $A_d = 3,66\ m^2$
  $C_b = 0,86$
  $C_u = 1$

  $A_e = A_d * C_b * C_u = 3,66 * 0,86 * 1 = 3,15\ m^2$

- South façade window 1:

  $A_d = 2,72\ m^2$
  $C_b = 0,86$
  $C_u = 0,8$

  $A_e = A_d * C_b * C_u = 2,72 * 0,86 * 0,8 = 1,87\ m^2$

- South façade window 2:

$A_d = 1,28\ m^2$
$C_b = 0,86$
$C_u = 0,8$

$A_e = A_d * C_b * C_u = 1,28 * 0,86 * 0,8 = 0,88\ m^2$

Then we sum the up to discover the daylight surface of the living room:

$A_{e;t} = A_{en} + A_{es1} + A_{es2}$

$A_{e;t} = 3,15 + 1,87 + 0,88 = 5,9\ m^2$

This parameter will be taken in consideration for the analysis of the glasshouse, to see how much it needs to be improved for the future.

Now an analysis of the two bedrooms are calculated.

- South façade window 1:

$A_d = 1,92\ m^2$
$C_b = 0,86$
$C_u = 0,8$

$A_e = A_d * C_b * C_u = 1,92 * 0,86 * 0,8 = 1,32\ m^2$

- South façade window 2:

$A_d = 1,25\ m^2$
$C_b = 0,86$
$C_u = 0,8$

$A_e = A_d * C_b * C_u = 2,72 * 0,86 * 0,8 = 0,86\ m^2$

This parameter will be taken in consideration for the analysis of the glasshouse, to see how much it needs to be improved for the future.

2.3.10 Results discussion

From the previous results, we can compare how much m^2 of glass that we need to apply to the renovated house. We make a subtraction of the two parameters and the result is the amount that we need to apply.

- Living room:

  $A_{e;t} = A_{eo} - A_{eg}$

  $A_{e;t} = 6,59 – 5,9 = 0,69\ m^2$

- Big bedroom:

  $A_{e;t} = A_{eo} - A_{eg}$

  $A_{e;t} = 1,65 – 1,32 = 0,33\ m^2$

- Small bedroom:

  $A_{e;t} = A_{eo} - A_{eg}$

  $A_{e;t} = 1,08 – 0,68 = 0,4\ m^2$

The above mentioned parameters need to be applied to the house in Honselersdijk, if the intention is to respect the Dutch law. There are several ways they can be added, but the best one would be to change the windows having with a slimmer type of frames for the windows.

According to the law, this is just applied for the Opened Daylight Area. If the calculation show a reduced level of lx inside the rooms, we are still allowed to apply the renovation as long as the A_e is met.

2.3.11 The glasshouse in Versailles

Intro

The natural lighting level measurements will take place at the scored period in the Competition Calendar.
Photometer(s) will be located in the living room. Light intensity of the area will be measured according to the spectral levels defined by the organization. All available points are earned by keeping the Daylight Factor, ratio lighting level / exterior (direct and indirect) lighting above 4% during measurement periods (cloudy sky). See the Competition Calendar for the schedule of scored periods.

- Reduced points are earned if the ratio is between 2,5% and 4%.
  Reduced points values are scaled linearly.
- The measurement point height is 0,8 meters and the minimum distance to a window is 2 meters.

Direct light-emitting devices and direct sunrays are not permitted on the sensor.

Improvements

From the last deliverable, we observed that from the calculations the measurements would have provided a general low value of the daylight factor. This was given by different causes:

- The glass-house structure on the South due to the presence of single-glazed windows, wooden walls on the sides and the roof an additional shading is pro vided to the project house.
- The house in Versailles is a scaled version of the house in Horsjendjik (or how the hell it is called), which means that the obstructions outside are having an higher impact due to a lower general height of the house.

After these considerations, it was taken the decision to supply the house with three solar tubes to provide natural daylight inside the living room and especially, in the central part of the room, where there was the most absence of light. For the house in Versailles, France, a verification of the Dutch law is not required.

Input for the calculations

To perform the calculations for the daylight factor, the following parameters are considered as input parameters for Dialux:

- Date: 21/03/2014

- Time: 12:30

- Location: Paris

- Sky condition: Clear

- Eo: 14006 lx

These are the details of the 3 solar tubes with a diameter of 35 cm that we are using to bring natural light inside the living room:

Analysis - Living room

The living room is the area where the analysis will be performed, so in this part all the details of the room will be listed in this part.

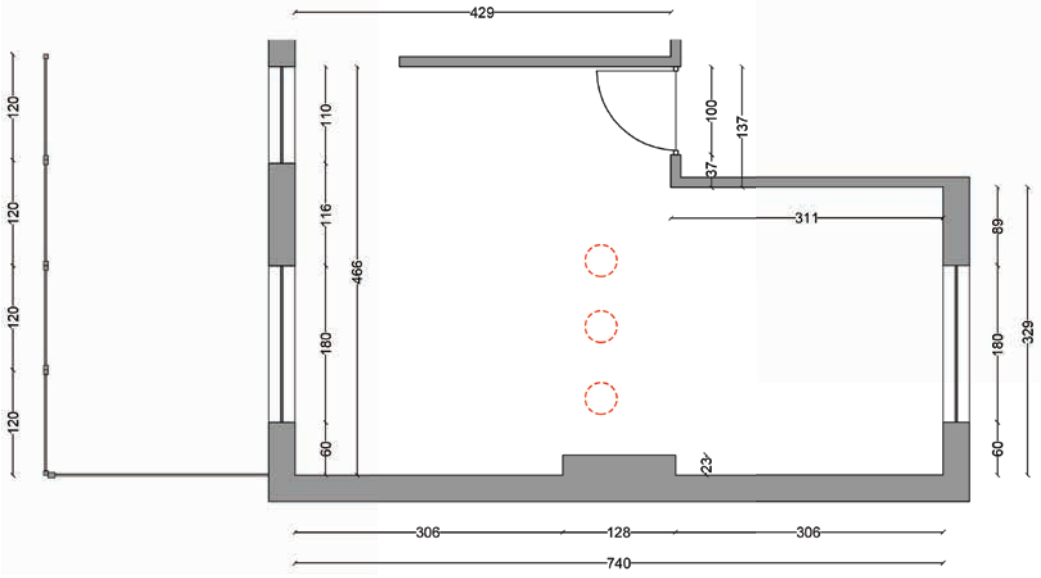


Figure 2.94 — *Plan with the measures of the living room that will be built in Versailles.*

The further calculation details are according the parameters inserted in the program. The windows show the following parameters:

Position	Glazing	Transmission	Reflection effect	Reflection coeff.
North facade	Double	75 %	80 %	10 %
South facade	Double	75 %	80 %	10 %
Glasshouse	Single	90 %	80 %	10 %

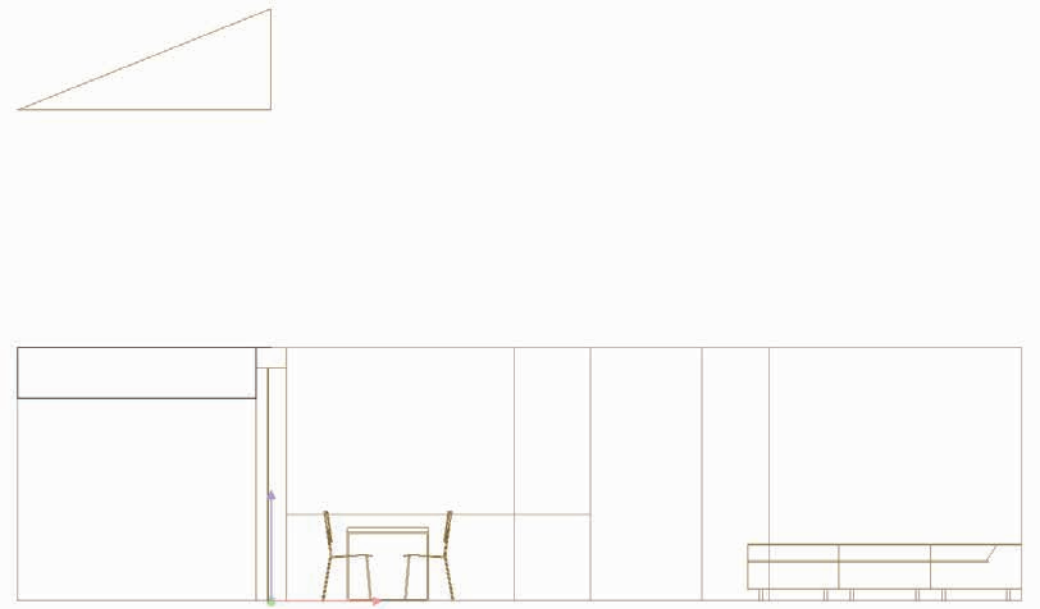
The drawing is just a slice of the original house because, for the competition only the analysis of the living room is required. In the following part the types of material used for the partitions are listed:

Element	Material	Color	Reflection coeff.
Walls	Plaster	White	80 %
Ceiling	Plaster	White	80 %
Floor	Light wood	Light Brown	52 %
Wall	Light wood	Light Brown	52 %
External wall	Brick	Dark Brown	20 %

In this particular analysis, it is also involved the obstruction of the shading and the solar panels on the upper part of the house. In the analysis, we considered the worst case scenario, where both the obstruction of the solar panels and of the shading system is taken in consideration.

Element	Material	Color	Reflection coeff.	Transparency
Shading system	Textile	Dark Blue	18 %	37 %
Solar Panels	Silicium	Blue	20 %	50 %

By considering the influence of both systems, we get a transmission coefficient of 18 %. Even if under an overcast condition the shading system won't probably be used, the worst case scenario was taken in consideration for the current analysis.



The sides of the triangle shaped for the shading of the roof, each side is designed with a different transparency considering the materials they are done. The side parts are single glazed windows, the front part will be the shading system and the solar panels. The last two sides have a transmission grade of 100%.

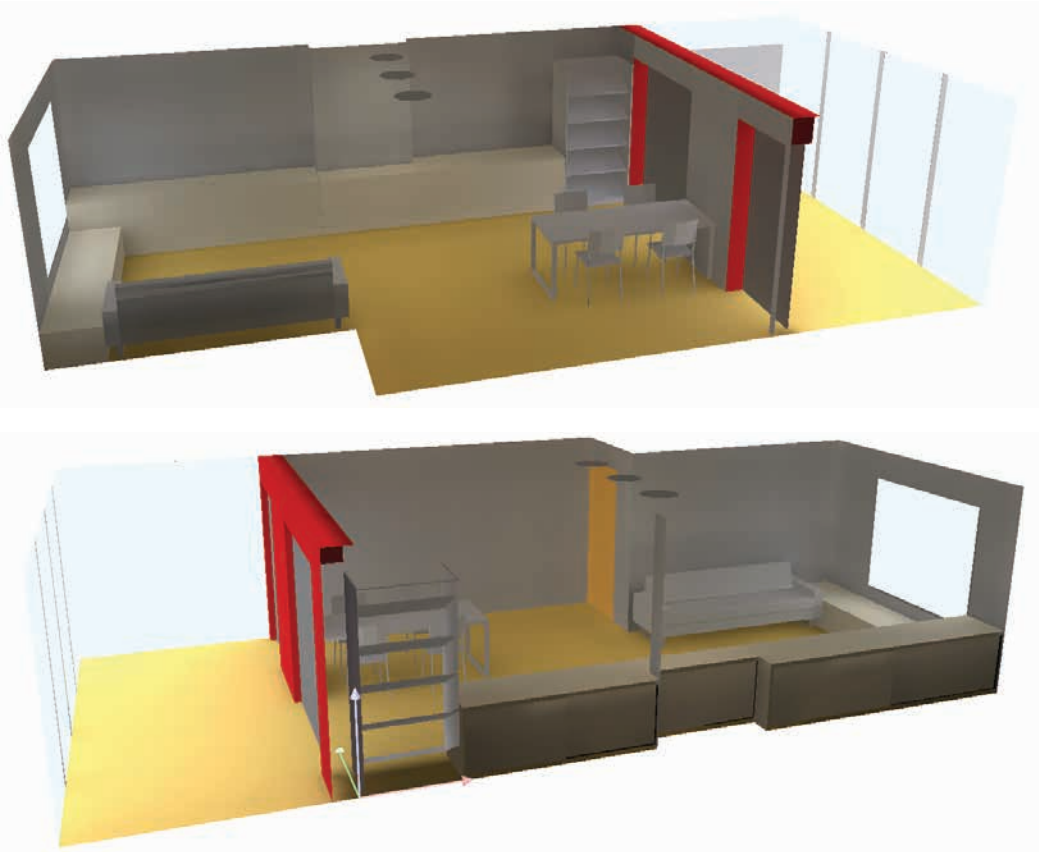


Figure 2.95 — *3D model of the illumination inside the living of the house in Versailles.*

After that we run the analysis, this are the lux that we get in the house. We can compare both versions, with and without the appliance of the solar tubes:

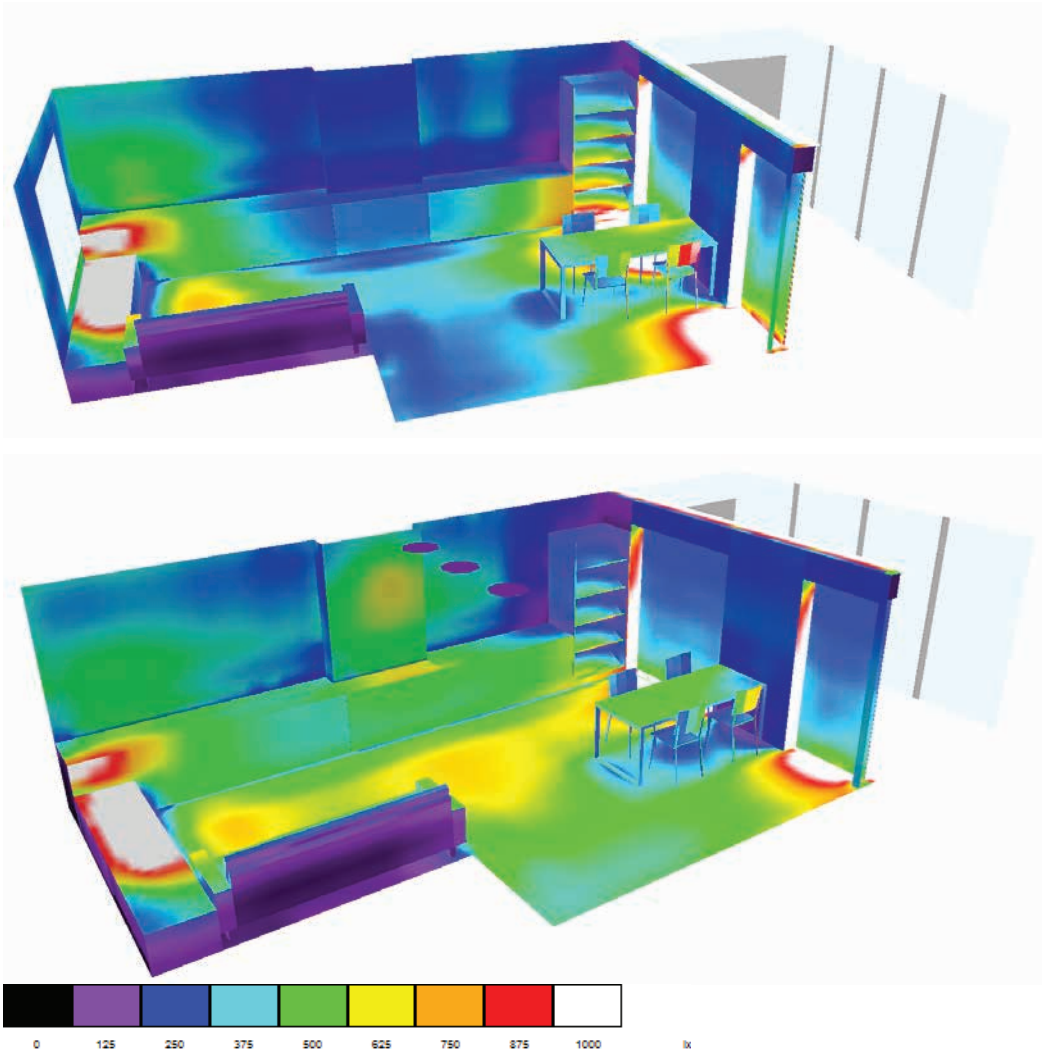


Figure 2.96 — *3D model of the diagram of the natural illumination of the room (in lux). It is shown also the difference between the illumination values and with the insertion of the solar tubes*

We can see that the lux values are really improving in the second case and we can verify it with the graph of the levels of lux in the room. The measurements were taken at the useful height of 0.75 meters. The drawings of the solar tubes are contained in the appendix of this section.

In the next part, the difference between the external illumination (Eo = 14006 lux) and the internal values of the room are calculated. We are going to consider the middle values, the lowest ones in the corner and the ones at a distance of 2 meters from the windows.

Now in the next page the values with the graph of the lux will be analyzed. The first one presents the ones from the original situation, then the room with the solar tubes is shown.

Here it is shown in the graph without the use of the solar tubes.

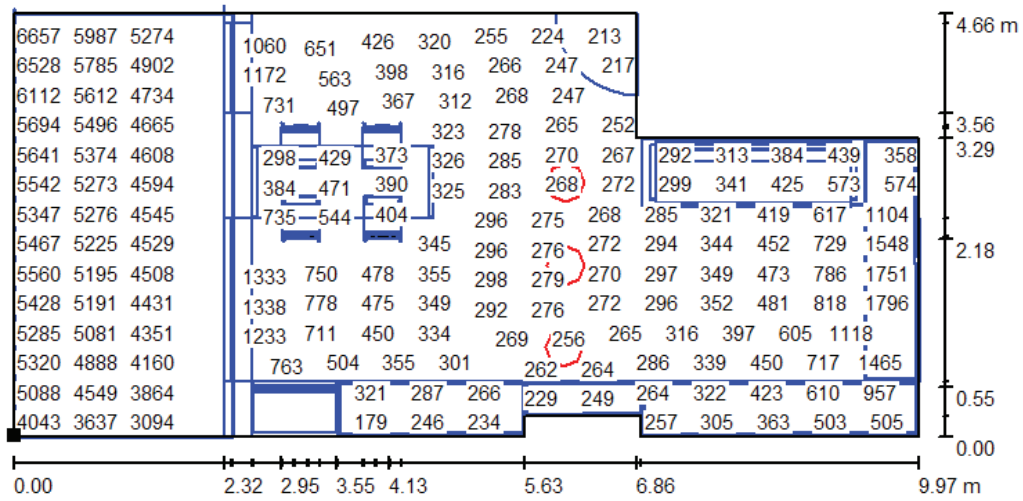


Figure 2.97 — *Results of the lux levels inside the living room of the house in Versailles.*

Together with the Daylight factor values we can observe that we obtain really low values especially in central part of the living room. For this reason the decision to use some solar tubes, bringing natural daylight to the central part of the room, was taken.

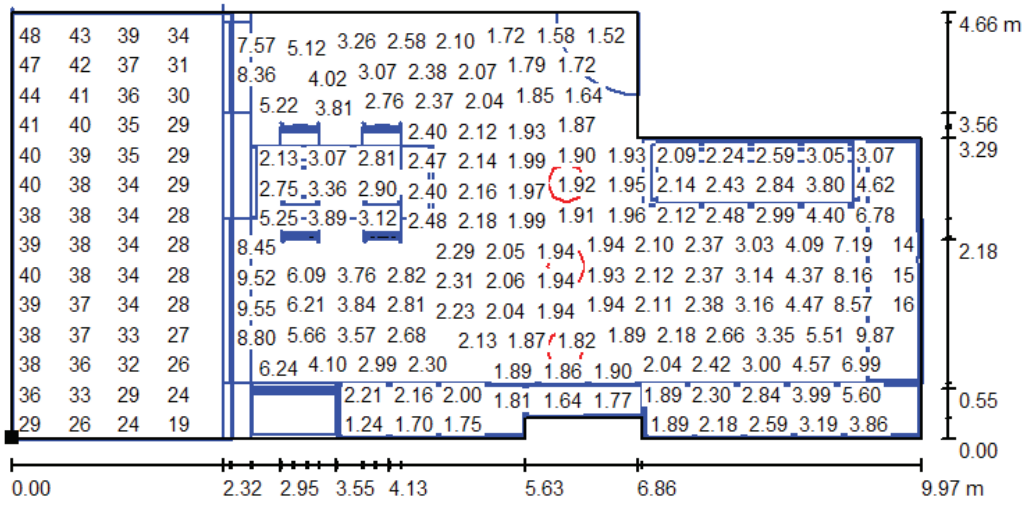


Figure 2.98 — *Results of the Daylight Factor inside the living room of the house in Versailles.*

As explained before, the values are really low and this means that we have to improve the existing situation in order to make it livable.

For the next steps, as long as the solar tubes are seen by the program as artificial lights, the graph with the daylight factor outputs was not possible to be displayed. To calculate them we divided the external illumination with the internal one.

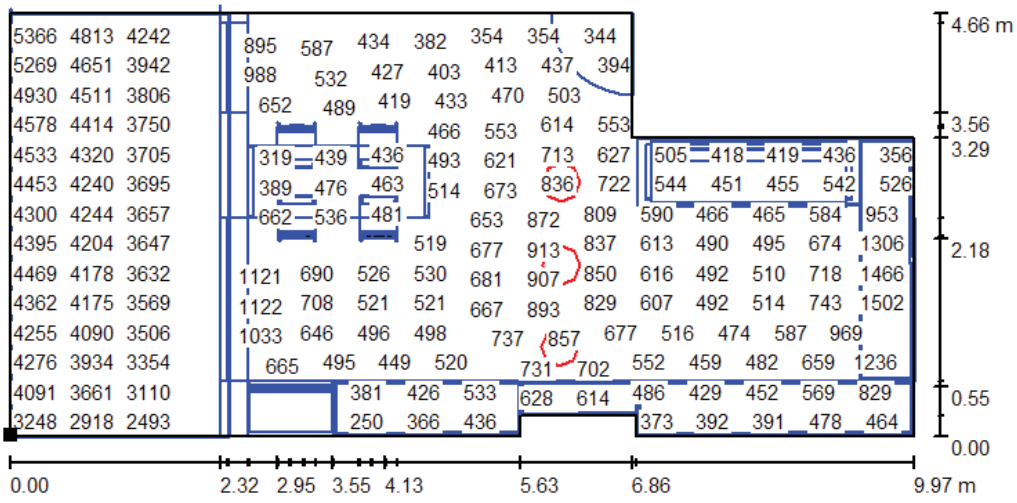


Figure 2.99 — *Results of the lux levels inside the living room of the house in Versailles, with the solar tubes.*

Then we obtain the following values in the defined points in the map using the following formula, by also considering an E_o of 14006 lux.

$DF = (E_i / E_o) \times 100$ [%]

Considering the values that we have to reach, we need a Daylight Factor of 4% to score 100 % of the points. So we can consider this lux value as the minimum one to reach all the available points.

$4 = (E_i / 14006) * 100$
$E_i = (4 * 14006) / 100 = 560,24$ lux

And the minimum value to gain points, the daylight factor has to be less than 2,5 % to earn points. This is still enough to earn the maximum available points even in the reduction points of the analysis.

$2,5 = (E_i / 14006) * 100$
$E_i = (2,5 * 14006) / 100 = 350,15$ lux

So we can say that all the values above 2,5 % will score points, which equals to a minimum of 350 lx. But we can observe that, especially in the central part, the 560 lx indicated as maximum point where the 100 % of the points, the natural illumination is very satisfactory.

Appendix - Solar Tubes

Detail of the solar tubes applied on the construction in Versailles, to provide an higher amount of natural light inside the living room.

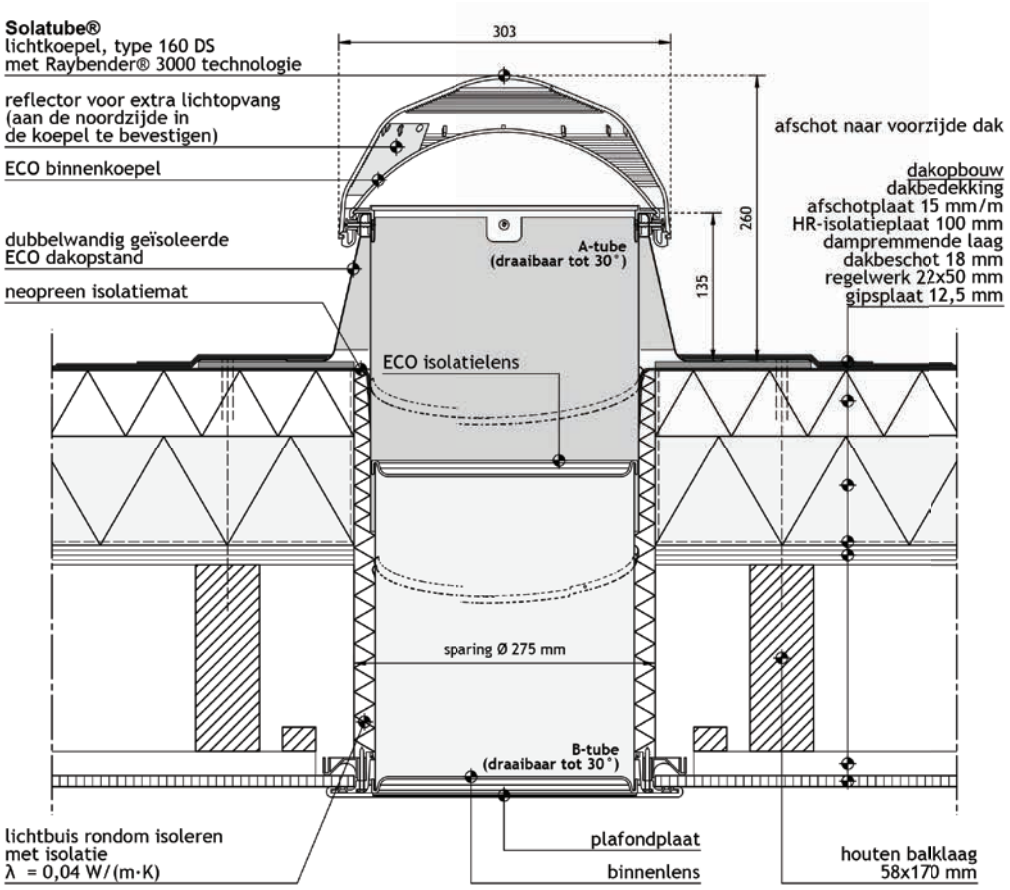


Figure 2.100 — *Section of the solar tubes applied on the roof and taking the natural light, inside the living room.*

2.3.12 Conclusion

By adding an additional glasshouse to the existing structure of a house, a reduction of the natural illumination was expected. The light has to go through the windows of the glass house and the obstruction of the other components of the structure, with eventually also the intervention of the shading system. This of course means a lower amount of natural light inside the room.

But first, the most important thing to consider is that we are dealing with an existing situation that does not comply at all with the requests of the Solar Decathlon competition. Without the application of the Solar Tubes, the daylight levels would have scored a really low percentage of points. Furthermore all the possible optimization solutions needs to be provided to the room. The easiest ones is changing the color of the wall and the ceiling to a very reflective ones, together by using furniture of a very light color.

By scaling the dimensions of the house in Versailles, we expect even an additional reduction of the values for the house that will be built in France.
This was given due to the following reasons:

- Smaller dimension of the surfaces of the windows, together with a lower height of the room, provide a less amount of natural height inside the room.
- By reducing the height of the floors, of course the shading on the higher part of the glass house increases the shadow with an higher angle on the house and of course a reduction of natural light inside the room.
- All the amount of glasses used, a single glazed layer of the windows of the glasshouse together with the ones on the existing house, reduce the amount of natural light due to the amount of different materials that the light has to go through.

This analysis was performed for a house fully covered with solar panels, which is something that probably is not likely to be applied on a row house in the Netherlands.
Especially because of the excessive costs to provide such an installation of a huge number of solar panels.

Of course, if on one side we increase the dimensions of the windows and of the transparent surfaces, the daylight factor will increase but also the heating consumptions and the heat loss will be increased. And nowadays, reducing the consumption of energy of an house, is the most important parameter on which the modern building industry has to guide its choices in the coming future. But even with this consideration, from the analysis we observe that we both reach satisfying values for the house in Versailles and that if we apply a glasshouse to the existing house in the Netherlands, we do not have to apply a very invasive intervention to the openings of the house.

2.4 Acoustic design narrative

2.4.1 Acoustic performance

Acoustic comfort is one of the major issues influencing on the well-being of a person in his habitat. High levels of noise pollution can influence not only on the daily activity of the inhabitant, but can a have a negative impact on one's health as well. The urban areas are being the most exposed to noise pollution, which basically is coming from daily urban activities, traffic and citizens. Pollution can be caused by interior sources as well, as personal activities. If architecturally this issue was not addressed in the designing phase of any dwelling, the interior pollution can cause high discomfort. In the case of high populated areas or apartment buildings, noise pollution can come from neighbouring flats. This is also the case of the building in Honselersdijk. Important solutions have to be provided for the separation walls between different apartments or dwellings. In the following chapter the mentioned issues have been addressed and evaluated. Calculations were provided for reverberation time within the house, façade airborne sound insulation and the insulation of the HVAC systems. Numerous architectural and technical solutions were considered in order to avoid uncomfortable conditions in terms of acoustics.

2.4.2 Reverberation time calculations

Reverberation time represents the time interval between the first direct arrival of a sound wave and the last audible wave reflected within an enclosed space. This characteristic is used to determine the time echoes travel in a room as the sound pressure is absorbed by the walls and physical objects present in that room.

The reverberation time is a major issue to be considered in design phase, since as a result an uncomfortable environment for inhabitants could be created if the one is neglected. Among the most common measuring methods is the Sabine's method, which uses the Sabine's equation to determine the reverberation time in an enclosed space [Appendix 4.2 - pp.1536].

From the Sabine's equation it can be easily determined that the most important characteristic to influence the reverberation time is the absorption coefficient, which represents the amount of sound an object/covering/surface is able to absorb. The absorption is usually represented as proportion, thus having a value between 1 and 0.

Regulations.

The evaluation of the reverberation time will be performed during the competition based on ISO 3382-2:2004. The total reverberation time value has to be within 0.8 and 1.2 sec limit.

2.4.3 Calculations

a) Living room.

An evaluation of the reverberation time was performed considering only the surfaces of the room, in order to evaluate the characteristics of the construction and geometry in terms of acoustics. Evaluation was performed for 6 representative frequencies. No furniture or surface coverings were considered for the current calculation.

Frequency (Hz)	125	250	500	1000	2000	4000	TOTAL
Reverberation Time (sec)	0.7	0.9	1.2	1.4	1.4	1.2	1.1

Table 2.2 — *Reverberation time living room*

The results presented in the table above prove that the characteristics of the surface materials within the living room will not satisfy the limit of 0.8 sec reverberation time. Is to be noticed that in Simulation-A no furniture, curtains or other covering materials were considered.

b) Living room - adjusted.

A new evaluation was performed, this time considering soft covered furniture, a carpet on the floor of the room, curtains, which would cover 60% of the windows in size and several plants. The new results are presented in the table below, and this time they totally satisfy the conditions mentioned. The reverberation time calculated is 0.7 sec, which is lower than the limit of 0.8 sec, thus, condition is satisfied.

Frequency (Hz)	125	250	500	1000	2000	4000	TOTAL
Reverberation Time (sec)	0.6	0.7	0.8	0.8	0.8	0.6	0.7

Table 2.1 — *Reverberation time living room (adjusted)*

Considering only several absorptive surfaces, the results show that the reverberation time within the living room is satisfying the regulations. It is important to mention that the reverberation time will decrease even more due to numerous furniture units and absorptive materials which will be added in the living room for the comfort of the inhabitants and have not been considered in the calculations presented above. Thus, there is no need in considering reverberation time for the living room as an issue.

c) Glasshouse

More important however is to evaluate the acoustic performance of the glass house unit (Prêt-à-Loger design). Because of the hard surface materials which form the envelope of the glasshouse, there is a high risk that the reverberation time could reach uncomfortable levels, especially if the new construction is considered as a new living space within the existing dwelling. Also there is a high probability of flutter sound being created within the glasshouse. It is unlikely that the new structure will perform negative in terms of acoustics if we consider the summer scenario, when the glass enclosing units of the glasshouse are fully (or partially) opened. Due to the openings the sound pressure would dissipate and not concentrate in the room itself, thus causing no discomfort for the inhabitants. However, evaluation of the reverberation time is important considering the winter scenario, when the glasshouse would be fully closed and the area of the glass material being so high. In the [Appendix 2] there is a detailed explanation of the calculation process, where it can be observed that the glass material has a high negative impact on the reverberation time, due to its low absorptive characteristics. The results of these calculations are presented in the table below:

Table 2.3 — *Reverberation time Glass-House.*

Frequency (Hz)	125	250	500	1000	2000	4000	TOTAL
Reverberation Time (sec)	1.0	2.0	2.5	2.1	1.7	1.3	1.8

d) Glass House - adjusted.

As expected, the results of the calculations show that the acoustic performance of the new structure would be poor. Since only the basic materials were considered in simulation (C), a new simulation was performed (simulation D). In the new model the details as sun shading and furniture were considered. As seen in the calculations provided in the appendix, important positive impact is provided by the wooden floor. Another solution which was developed in order to decrease the reverberation time within the glass house was the use of high absorptive panels attached to the separation walls, placed between the glasshouses of adjacent dwellings. The panels have high absorptive characteristics which would considerably contribute to adjusting the reverberation time to the comfortable limits. An important characteristic of the panels would be their size, which would define the amount of highly absorptive material within the room. Thus, the decision was taken to insulate the separation walls with absorbing panels with a height of 1.6 m, forming a total absorptive area of 8 sqm. Another measure used to decrease the reverberation time was the use of plants. The benefits from plants in terms of acoustics are well-known, and since the glasshouse area will be used as a winter-garden in the coldest periods, it was important to consider the presence of the plants as absorbing material as well in the calculations. More information about the acoustic benefits of plants will be presented in the following chapter. The new results (Simulation D) are presented in the following table:

Table 2.4 — *Reverberation time Glass-House - adjusted.*

Frequency (Hz)	125	250	500	1000	2000	4000	TOTAL
Reverberation Time (sec)	1.0	1.1	0.9	0.8	0.7	0.5	0.8

The presented results prove that the acoustic performance has been increased considering the improvements explained and show that the condition of maximum reverberation of 0.8 sec reverberation time has been achieved.

The detailed calculations can be found in the apendix 4.2 - p.1319.

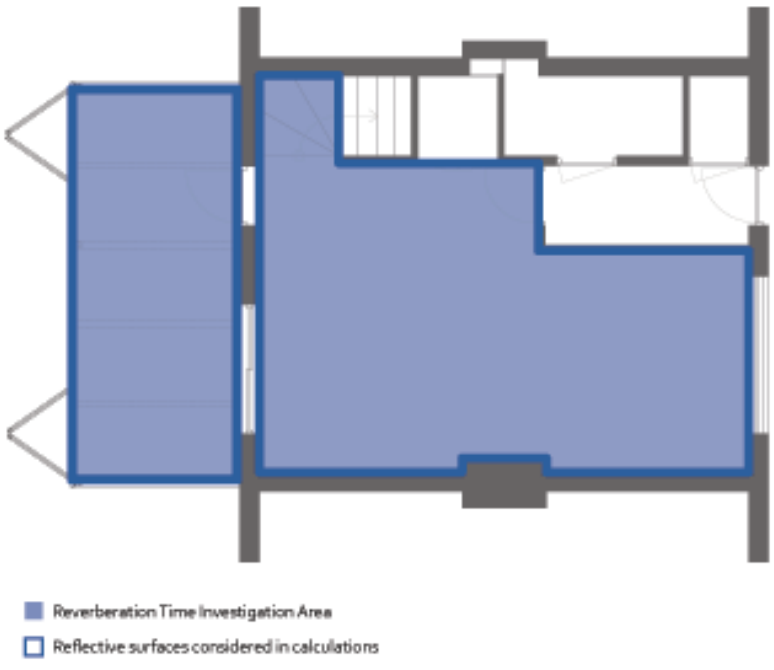


Figure 2.101 — *The surfaces considered in calculations*

Acoustic benefits of plants.

It is well known that already for many decades, trees and bushes have been used near the roads and highways to reduce the traffic noise. With the number of cars increased, modern solutions as acoustic fences started to be used. However, the acoustic benefits of plants shall not be neglected. If used and placed properly, the plants can have a positive impact on the acoustic performance of an enclosed space as well, one example being the glasshouse of Prêt-à-Loger design. Some plants and their characteristic absorption coefficients are presented in the table below:

Plant	Absorbtion Coefficients per frequency					
	125	**250**	**500**	**1000**	**2000**	**4000**
Ficus benjamina	0.06	0.06	0.1	0.19	0.22	0.57
Dracaena fragrans	0.13	0.14	0.12	0.12	0.16	0.11
Schefflera arboricola	0.13	0.06	0.06	0.22	0.23	0.47
Bark mulch	0.05	0.16	0.26	0.46	0.73	0.88
Howea forsteriana	0.21	0.11	0.09	0.22	0.11	0.08
Philodendron scandens	0.23	0.22	0.22	0.29	0.34	0.72

Table 2.5 — *Absorbtion Coefficients of some examples of plants*

However, for the calculations presented in the previous chapter a value of 0.15 was considered for the absorption coefficient of the plants, at every frequency. This allows Prêt-à-Loger team to consider multiple types of plants for the glass house.

It is important to remember that many factors can influence these numbers and the basic acoustic characteristic of plants. Some important issues have to be addressed while performing the interior design, issues which would assure proper acoustic benefits from plants and high performance of these. Some of these issues, which the team also considered in the interior design, are:

- The size of the plants is very important. The bigger plants have a higher absorption characteristic. Also, beneficial would be to place the plants in arrangements (groups) of 3-5 units together.
- Spreading the arrangements or plants within the enclosed space is very important, and is better in terms of acoustics comparing to the case in which these plants would be concentrated in one single point.
- It is important to place the plant near the reflected surfaces (walls) or right in the corners. This way, the sound reflected from the walls could be easily absorbed by the plants.
- Evaluation of the surface area of a plant is complicated, that is why the reverberation coefficients are considered per plant unit. The size difference can be an issue.

2.4.4 Façade airborne sound insulation

The façade airborne sound insulation expresses the capacity of the façade construction to limit the access of sound pressure inside a habit, the sound source being an external one. Because of the high activity and traffic noise, in urban areas it is important to satisfy high insulation coefficients in terms of acoustics in order to assure comfortable environment for the people living in the area. Besides the materials used for the façade construction, and especially their densities, other important construction issues have to be addressed if a proper insulation unit is to be constructed. The glazing unit is a major noise leakage unit, and especially because of the sealants and connections between the glaze panels and window frame, or between the window frame and the wall construction. In order to create comfortable environments in terms of acoustics, preliminary simulations have to be performed, considering all the issues mentioned above.

In order to evaluate the façade acoustic performance of the house Prêt-à-Loger is designing, we used the BOA Acoustics Software.

The BOA software evaluates the façade's acoustic performance mainly using the Mass Law Theory, which states that the performance of a material in terms of acoustics is based on one's density. The entire software is based on the calculation of the sound pressure within an enclosed space, based on the properties of the materials used in the construction of the separation unit (wall).

The sound pressure of the noise source is considered in the calculation of 60 dB. This is characteristics to typical urban areas (considering that the noise level from a highway is estimated to 75dB).

The input for the BOA software is based on the characteristic materials of the separation structure. Usually the complex constructions are available in the software's library. It is important to consider the sealants and linear connections of different construction elements, which usually are the leakage points for noise penetration. Besides the construction elements, another important characteristic influencing on insulation value would be the reverberation time in the enclosed space. This value was calculated and was being presented in the previous chapter 'Calculation of Reverberation Time'.

Calculation procedure

Two different structures were evaluated in terms of acoustic performance, those being the façade walls of the house in Honselersdijk and the prototype to be built in Versailles, Paris. It is important to mention that both structure have important design characteristic which has to be considered, 'the Skin'. This second layer placed above the existing structure will have not only a positive impact in terms of climate comfort, but will also bring important advantages to the acoustic insulation of the structure.

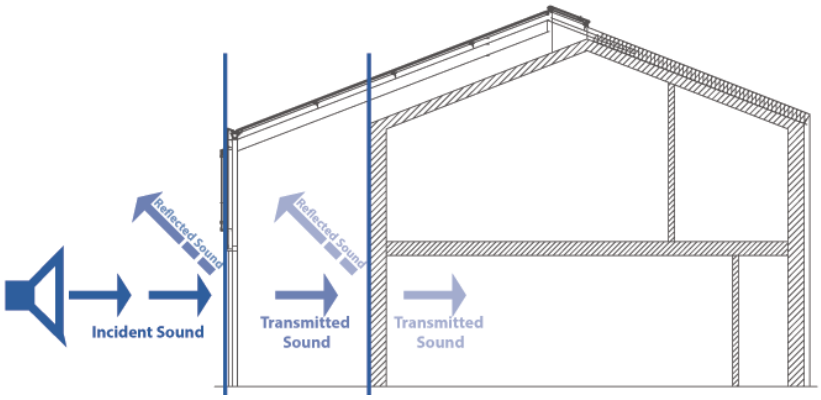


Figure 2.102 — *Sound transmittance through the facade construction*

The results of the simulations are presented in the following table:

Models	Values	Octave bands (frequencies) Hz					Dls,2m,nT,w
		125	250	500	1000	2000	
Honselersedijk House (plus Skin)	G_A (Dls,2m,nT,i)	40.5	41.1	54.6	61.2	62.8	48.6
Prototype House Paris (plus Skin)	G_A (Dls,2m,nT,i)	38.2	32.7	54.8	67.2	69.4	57.8

Table 2.6 — *Results of the facade sound insulation calculations*

The BOA output tables of the calculations can be found in Appendix 4.2 - pp.1536

Conclusions

After performing the simulations we can observe that the house in both of the cases (Honselersdijk and the Paris prototype) perform well in terms of acoustics. An impact has the glasshouse structure attached to the south facade, which forms a cavity construction and provides an extra acoustic insulation layer.

2.4.5 Sound level of HVAC and active systems

People as inhabitants become more concerned about the acoustic comfort conditions they live in. The comfort can be disturbed not only by external noise sources, but also by noise coming from house installations and appliances. One major issue in acoustic comfort is considered the HVAC acoustics. This represents the noise pollution within an enclosed space, caused by the HVAC installation and its components. The degree to which the HVAC installation can affect the comfort of the inhabitants is dependent on the strength of the noise source and the transmission conditions.

The sound transmission of HVAC systems has several possible pathways:
People as inhabitants become more concerned about the acoustic comfort conditions they live in. The comfort can be disturbed not only by external noise sources, but also by noise coming from house installations and appliances. One major issue in acoustic comfort is considered the HVAC acoustics. This represents the noise pollution within an enclosed space, caused by the HVAC installation and its components. The degree to which the HVAC installation can affect the comfort of the inhabitants is dependent on the strength of the noise source and the transmission conditions.

The sound transmission of HVAC systems has several possible pathways:
-Wall transmission;
-Airborne (supply units);
-Airborne (return units);
-Supply breakout (transmitted through the envelopes of the supply units).

In order to evaluate the impact of the HVAC system on sound comfort inside a building all the above mentioned pathways have to be considered and evaluated.

For the Honselersdijk renovation concept developed by our team, the HVAC Installation system is being placed in one of the bedrooms on the first floor, as represented in the scheme below. Placing it so close to the used bedroom, solutions in terms of acoustic insulations have to be provided for the floor slab and for the separating walls. The air ducts of the systems are placed in the existing and non-functioning chimney, or in the separating walls, meaning that insulation solutions have to be provided for the ducts as well, since the pathways are placed close to the bedrooms.

Among possible solutions our team was considering for attenuating the noise pollution caused by the HVAC system are the following:

- Sound blankets (for the chimney and separation walls);
- Duct lagging (for the ducts and pipes);
- Silencers (to reduce the sound in the supply/return units);
- Vibration Isolation (to reduce the effect of vibration of the installation).

These solutions were also considered for the prototype house which is to be built in Versailles, Paris. More details about the acoustic performance in the prototype house are being discussed in one of the following chapters. For the Solar Decathlon competition the design goal is to achieve noise values lower than 25 dB from the HVAC Installation and additional appliances. The installation's position and construction can be depicted from the figures below:

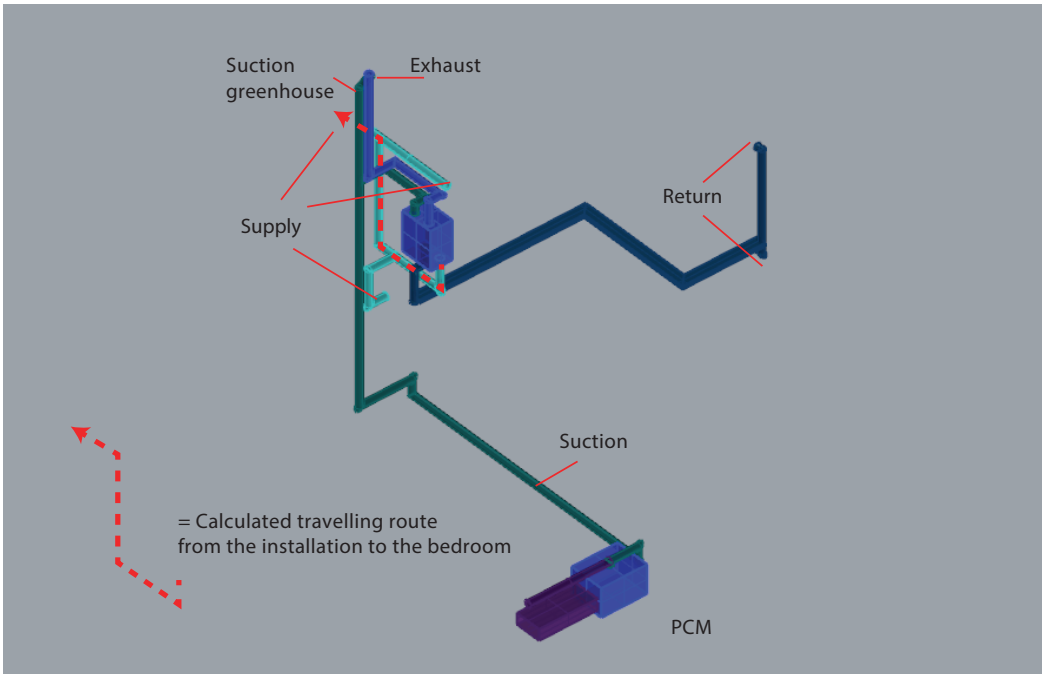


Figure 2.103 — *Scheme of the installation unit*

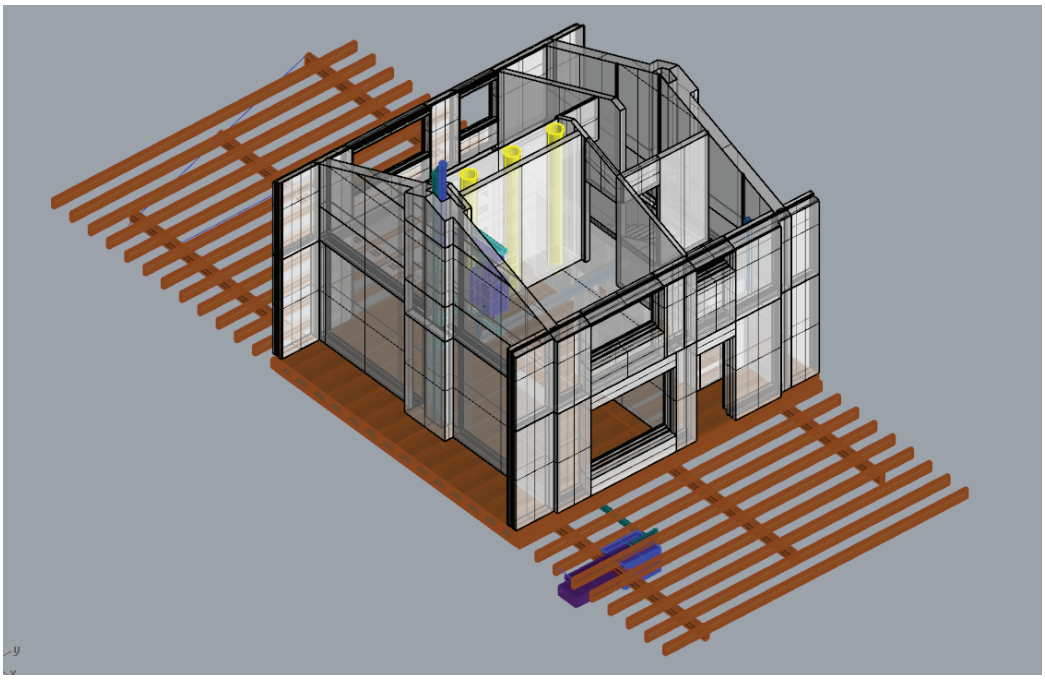


Figure 2.104 — *Installation positioning within the house*

Two types of calculations have been performed for the HVAC acoustics. The first calculation was performed with the objective to evaluate the sound transmittance from the installation room to the adjacent bedroom. This calculation was based only on the separation wall between, and the material characteristics of the installation room. The results of the calculations showed that the sound pressure in the used bedroom will reach a level of 29.3 dB, which does not fully comply with the competition regulations. That is why the decision to replace the sound unit was taken. Initially the unit was hanged on the wall which is separating the installation room from the bedroom. The unit was repositioned to the exterior wall, as represented in figure 2.89 - pp.147. This way the sound pressure in the used bedroom was reduced. This calculation was performed for the House designed by Prêt-à-Loger for Paris exhibition. As for the one in Honselersdijk, the noise from the HVAC system will be even lower, mostly because in that case the HVAC unit is planned to be placed in the attic space (which was not possible for Paris house due to competition limitations). Placing the HVAC unit in the attic reduces the noise pollution for the living spaces and for the adjacent dwellings as well. Detailed calculations can be found in the excel file attached to the Appendix.

The second calculation was performed in order to evaluate the sound traveling through the system itself, having as a source the HVAC unit, and as exhausts the air supply units which are placed within the rooms. The calculations depend on the transmission system, the type of materials used and the supply units. All these factors were considered in the calculations, which can be found in the Appendix. For the first considerations the typical materials were used and the results showed that the sound pressure at the supply unit would be around 61 dB, which is unacceptable. That is why, improvements were considered and another calculation was performed considering the ducts lagged. The new results showed that the sound pressure at the supply unit would be 19 dB. Also in the second calculation more performant roosters were considered, which have sound reducing characteristics.

The results of the calculations prove that the HVAC unit and the installation methods comply with the Solar Decathlon regulations and will assure comfortable living conditions for future inhabitants.

References:

ExecuFlora. (2013). The acoustic benefits of plants in buildings: Bidvest, Execuflora. Available: www.execuflora.co.za/articles/research-information/the-acoustic-benefits-of-plants-in-buildins. Last accessed 28th March 2014.

ISO. (2013). NEN-EN-ISO 717-1 Acoustics. Rating of sound insulation in buildings and of buildings and of buildings elements. (part1), p1-18.

Linden, A.J. van der (2013). Building Physics. Amersfoort, NL: ThiemeMeulenhoff.

Rijksoverheid (A). (2013). Woningvoorraad Europa naar type, 2011. Available: http://vois.datawonen.nl/report/cow13_110.html. Last accessed 1st March 2014.

Rijksoverheid (B). (2013). Woningvoorraad naar bouwjaar en aantal kamers. Available: http://vois.datawonen.nl/Quickstep/QSReportAdvanced.aspx?report=cow13_104&geolevel=nederland&geoitem=1&period=1985,1990,1995,2000,2005,2010,2012. Last accessed 1st March 2014.

SAE BV Amsterdam. (2012). Sound absorption values. Available: www.sae.edu/reference_material. Last accessed 28th March 2014.

SENTER NOVEM (A)(ed.) (2007). Cijfers en Tabellen 2007. The Hague: Senter Novem.

SENTER NOVEM (A)(ed.) (2007). Voorbeeldwoningen bestaande bouw 2007. The Hague: Senter Novem.

3 Engineering and construction design narrative

3.1 Structural design

3.1.1 Initial Premices

One of the greatest challenges of the theme of Prêt-à-Loger for Solar Decathlon is essentially the idea of working with existing structures. By itself the theme is mainly about applying refurbishment techniques in inefficient houses in order to make them energy neutral and upgrade their architectural quality. It is natural that complications are arising from the combination of this theme with the competition itself to the point that a pavilion has to be constructed that will showcase the application of these techniques in a real house. The representation of the existing is therefore the main subject of this initial structural design. The material and systems proposals below are based on different philosophies in the idea of this representation and their evaluation along with the preferences of the construction partners will lead to the final design.

It then further noted that since only the structural system of the house is discussed, the construction design section will be referring only to this and not yet in the interconnection with the rest of the systems (e.g. the PV systems, piping etc).

Finally, to avoid misunderstandings on the nomenclature used in this section, the existing house that was documented and analyzed in Honselersdijk, Netherlands is referred as “Existing house” while the house-pavilion to be built in Versailles is referred as “Prototype house”

3.1.2 Existing House in Honselersdijk structural analysis

Introduction

Although the Dutch house subject of the present analysis belongs to the building estate of the 60’s, period in which the concrete prefabrication was extremely widespread in its use, its load bearing façade is composed by small bricks as the typical Dutch buildings. This house is not the stereotype of the Netherlands (which should be searched belonging to some centuries ago), however it is composed by a largely common building material and can very well represent the Dutch building stock, in terms of typology, structure, climate and energy.



Figure 3.1 — *Photo of the front elevation of the existing house*

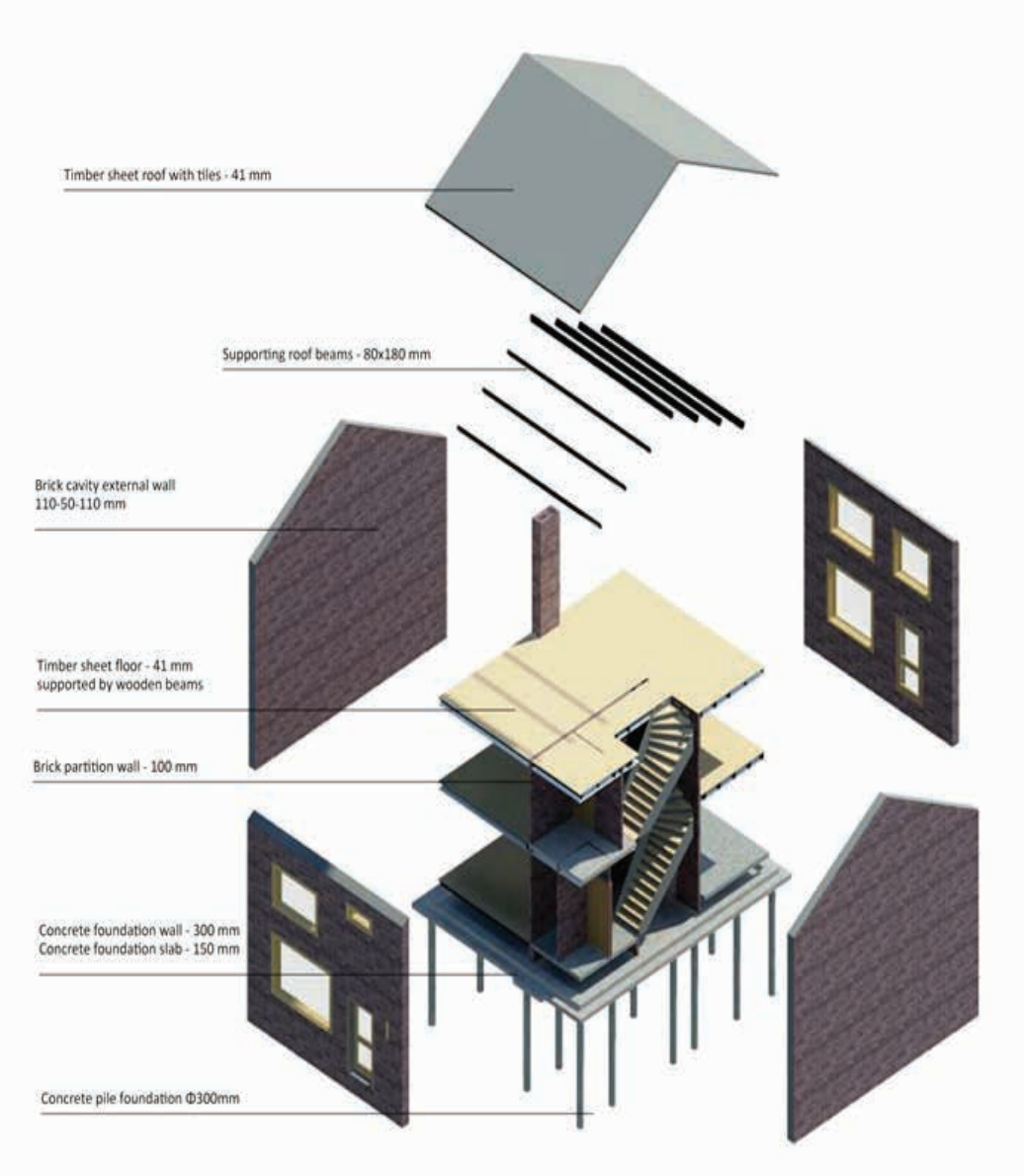


Figure 3.2 — *Structural system of existing house*

As mentioned, the house is composed by load bearing walls.
The stability is then provided:

In the longitudinal direction by the massive external, shared cavity brick walls, these have a thickness of 0.27 m with a cavity of 0.05 m.

In the latitudinal direction in a smaller degree because of the openings (doors/windows) and in a probably larger degree in the transverse wall in the middle right part of the house. Above the openings a reinforced concrete beam is situated to provide a connection between the two smaller walls.

Either way, the wall is connected directly with the shared cavity brick walls and through

a tie with a brick chimney structure that also contributes to the stiffness of the structure. Externally the bricks provide water- and air tightness, on the entrance and back sides, since the lateral ones are shared with the other houses and obey exclusively to the separating and loadbearing functions.
Their capacity is assessed from a simplified calculation following the conservative method provided by Eurocode 5. The calculation is presented in the annex of the deliverable #2 and the results that are derived are the following.

Capacity of the wall
The capacity of the specific part of the wall is calculated on the lower part – in contact with the foundation:

$$\frac{q_{sum}}{N_{Rd}} = \frac{81.29}{234.06} = \mathbf{0.34}$$

The capacity of the specific part of the wall is calculated on the finishing layer of the ground floor:

$$\frac{q_{sum}}{N_{Rd}} = \frac{74.84}{168.52} = \mathbf{0.44}$$

Therefore it can be derived that on average, more than 50% of the capacity of the load bearing wall is not used.

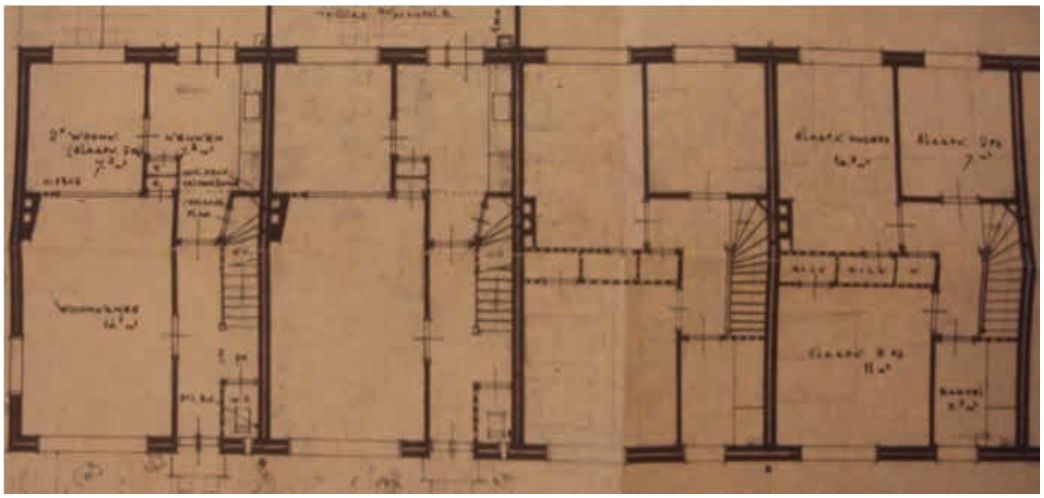


Figure 3.3 — *Original floor plan of terrace houses*

Foundations

The Foundations are made out of reinforced concrete. Given the high water percentage in the land, those are deep pile foundations. Below the walls a reinforced concrete plate, keeps the structure at a certain distance from ground level and connects the piles with the walls and with each other.

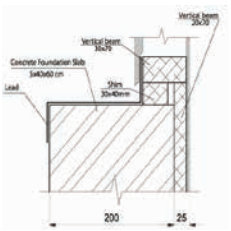


Figure 3.4 — *Foundation elevation structure connection*

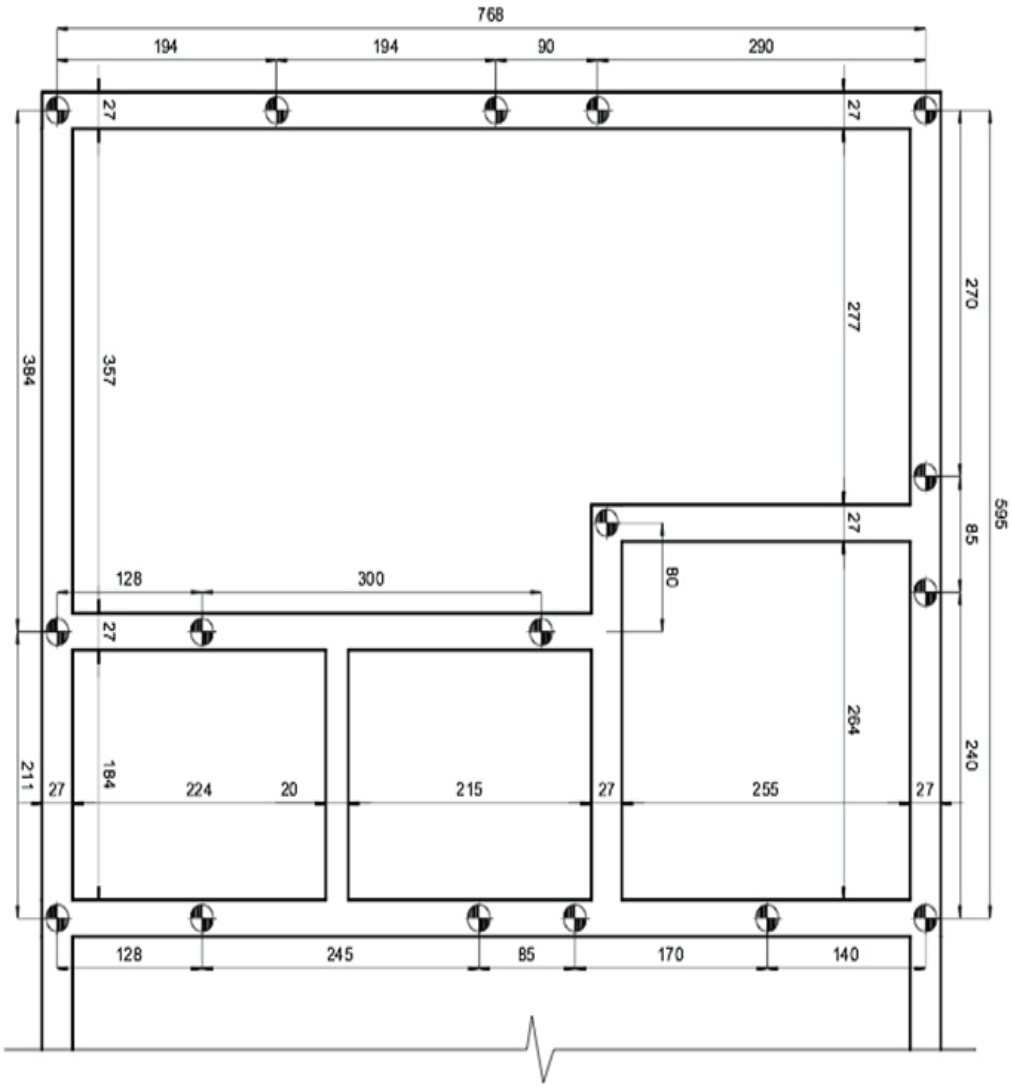


Figure 3.5 — *Foundation plan - pile position*

Internal divisions

Floor slab

The floor slab is composed by wooden panels, which are supported by wooden beams. Those can be probably filled with mortar.

The wooden beams are positioned approximately every 0,60 m covering a maximum span of 3.62 m transferring the load to the perimetral and inner load bearing walls. The section of the beams clearly vary with respect to the span, having a section of 0.08 X 0,18 m for the larger spans, a section of 0.065 X 0.18 m for the medium and of 0.035 X 0.18 m for the smallest.

Inner walls

The walls with the separating function for the house have also a loadbearing function. Those walls do not have a cavity and are characterized by a thickness of 0.10 m.

Roof structure

The roof structure is supported on the side (shared) walls by wooden beams 0.08x0.20 m inside the structure and 0.063x0.18 m in the facades.

The wooden beams support a simple wooden deck probably made of boards of about

1.5cm + 1.8cm thickness. The deck then supports the blue wooden roof tiles with small roof battens. It is possible that the wooden boards contain or work as a watertight layer or they support it as a separate system, below the roof tiles.
To the longitudinal side, the deck is supported on the outer brick wall of the façade. The supporting element above the brick wall is also used for supporting the gutter of the house.

The roof structure features openings on both the longitudinal sides. It is furthermore interrupted in both the centers of the edges of the width-wise side by the chimney structure. The holes for the chimney at the wooden deck part are about 1.5x0.25 cm. The highest beam is then rested on both sides on secondary smaller beams of about 2m length, perpendicular to the main roof beams. These are supported on the main beams on each side of the highest beam.
The supporting beams are placed at about 1m c.t.c.
The length of the beams is 5.95m.

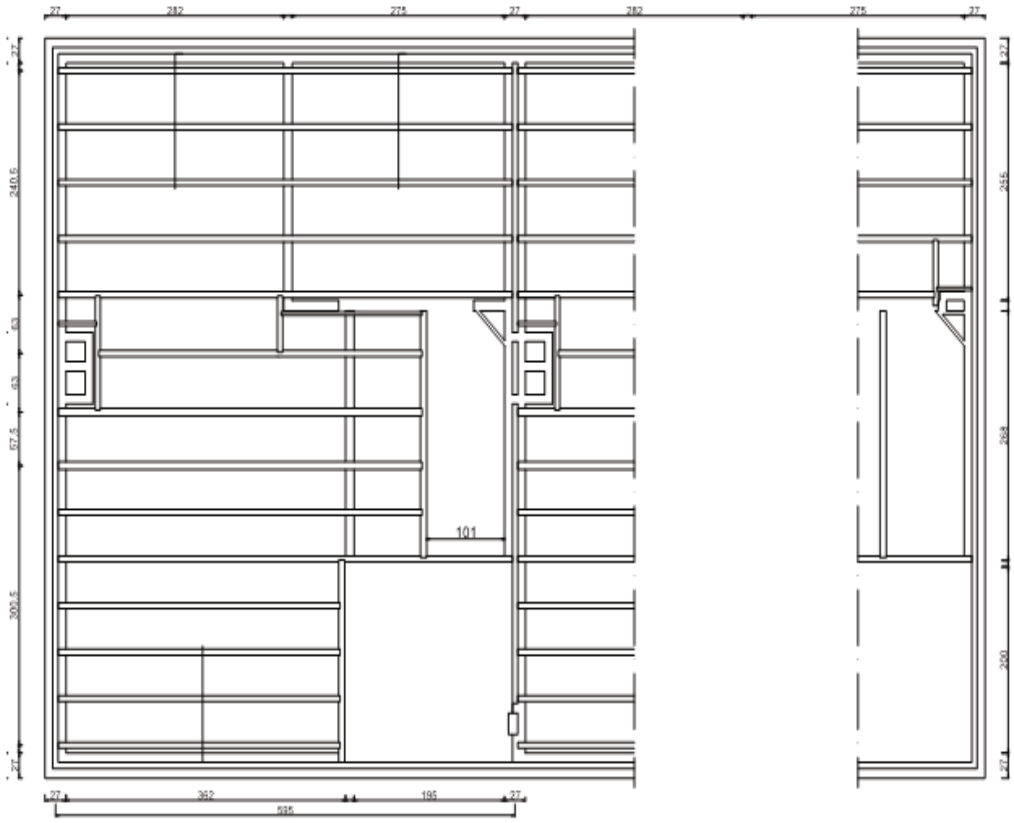


Figure 3.7 — *Floor plan - floor slab*



Figure 3.6 — *Roof lining and wooden beams*

3.1.3 The Skin - application on Honselerdijk

Design criteria

In this chapter the structural aspect of the toolbox is discussed as well as its application in the previous case study in Honselersdijk. Most of the renovation components are concerning layer additions or low-scale substitutions of parts of the house such as walls, roofs, windows etc. These components do not include any complicated structural design, as they mainly use simple connections towards the existing parts and are many and tested construction solutions for most of them.

Concerning the structural design, the most challenging component is the Skin system, a glasshouse-like addition to an existing row house. The Skin is in fact an integrated system, combining energy production through the PV panels on the roof and the facade, a thermal buffer for the house, reducing the energy required for heating and most importantly, creating new, high quality space by forming a direct connection between the exterior and the interior.

In relation with the design described in the rest of the chapters of the project manual, the following criteria were taken into account to define the structural system of the Skin system:

1) Spatial performance and climate performance: the skin system needs to be adaptable, possible to open up completely during summer. To achieve the maximum transparency, columns should be avoided in the middle of the skin opening.

2) Affordability: the skin system is based on simple greenhouse constructions that are very typical in the Netherlands and especially in the region of Honselersdijk.

3) Applicability: the whole system needs to be easily applicable to the different typologies of rowhouses in the Netherlands.

After research and in coordination with the sponsors and stakeholders of the team, it was found that all the criteria could be achieved through a system based on a light steel skeleton supporting an aluminium frame system that the PV-panels are then fixed on. The system comprises of modular components, standard steel and aluminium sections , that allow for many possible variations of PV panels to be fixed upon. Modularity also leads to the adaptability of the system, as the different typologies of the row houses have different structural design and capacities and the support of the Skin has to be adapted to each of them. Finally, it could also allow customization of the Skin according to the preferences and design criteria of each customer, whether it is for a large scale application or for private housing.

In the following, the main points of the Skin will be elaborated, as well as examples of its applicability to the different typologies and finally the application to the Honselersdijk existing house.

Structural design of the Skin

The aluminium structure usually follows the grid of the photovoltaic panels, according to their number and energy production requirements. Therefore it can be customized according to the needs of the client, following nevertheless simple construction principles and standard profiles. An example will be shown below for the Honselersdijk house.

The steel skeleton is composed by a system of main and secondary beams and purlins, supporting the aluminium frame and the photovoltaic panels above. The c.t.c. distance of the secondary beams is following the grid of the panel dimensions and are also minimizing the span of the aluminium skeleton on top, while the main beams (rafters) are on the grid of 1.20m, following the functional grid of the row-house.

The main beams are then distributing the load to a ridge steel beam on the top and a steel portal frame on the bottom. The ridge beam can be then connected to the existing house through the chimneys or any other structural elements that will be discussed further. The portal frame is used for many functions. Vertical PV panels can be installed upon it to produce more energy. It is also used to achieve enough structural height to hold the glasshouse door that is usually quite heavy. Finally its diagonals are used to create a bracing for the wind coming from the side. This was imperative, as it is preferrable for modularity and easy construction to connect all the parts with bolts instead of welds, that would have offered adequate stiffness to the frame.

The Skin is also simply connected to the existing house on its upper side and on surface foundations on its lower part, thus dividing its weight and the wind forces on both. Since the self-weight of the total added construction is minimal, the bearing capacity of both the ground and the existing house is not exhausted. The connection with the house is achieved through steel plates and bolts in the chimneys of the house. As it is usual in Dutch row houses, the chimneys are made by single or double brick masonry, without any structural role other than keeping their self weight. Nevertheless, the connections are minimised after careful analysis of the existing capacity of the house, to facilitate the

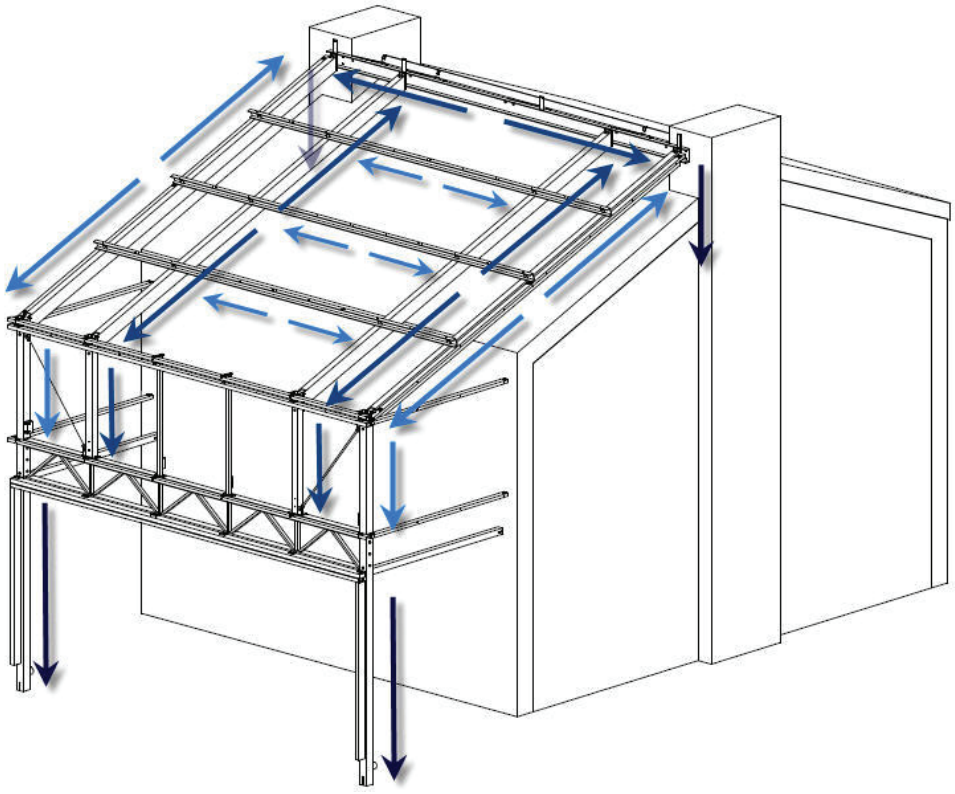


Figure 3.8 — *Structure of the skin system*

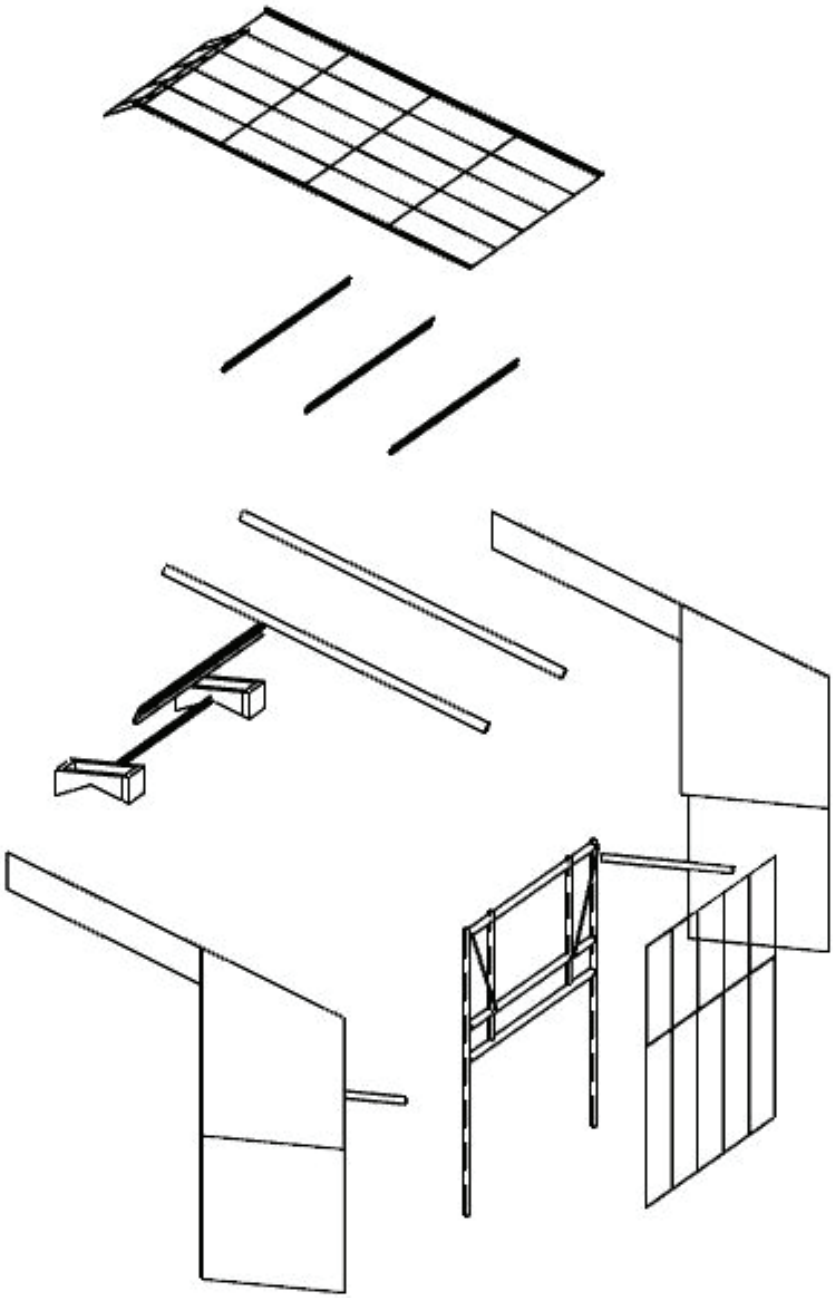


Figure 3.9 — *Load sequence of the skin system (here based on a draft version of the glasshouse, but nevertheless, the same load sequence applies)*

Connecting to the existing - Adaptability

Following the principal of low impact renovations, the skin system structure should be supported on the house as little as possible. The main reasons for this are the ambiguious structural integrity of the existing structure and the afore-mentioned adaptability on the different typologies.

- option 1: connecting the rafters to a ridge beam and then to the chimneys

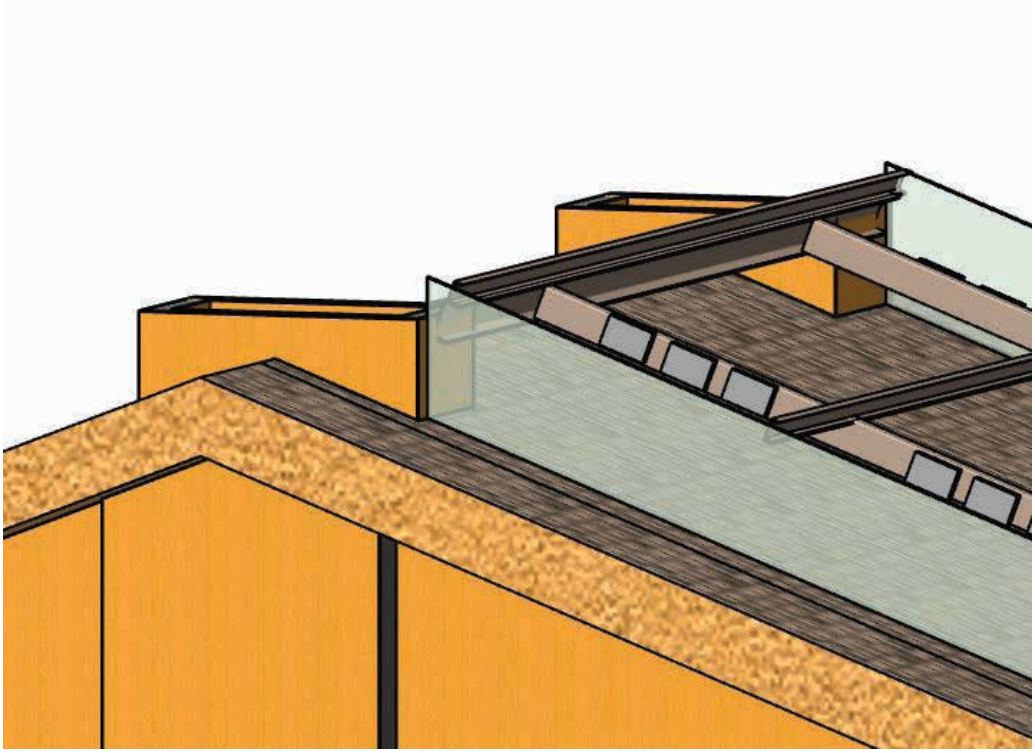


Figure 3.10 — *Chimney connection - demonstrated in the prototype house*

This solution, although its supporting on the existing structure, it is doing so in the chimneys that are normally made from heavy brickwork and dont have any special supporting role in the original house. Thus they can be used to support the glasshouse loads, , which are not particularly large as it will be seen later on the structural calculations.

- option 2: putting a frame over the complete house

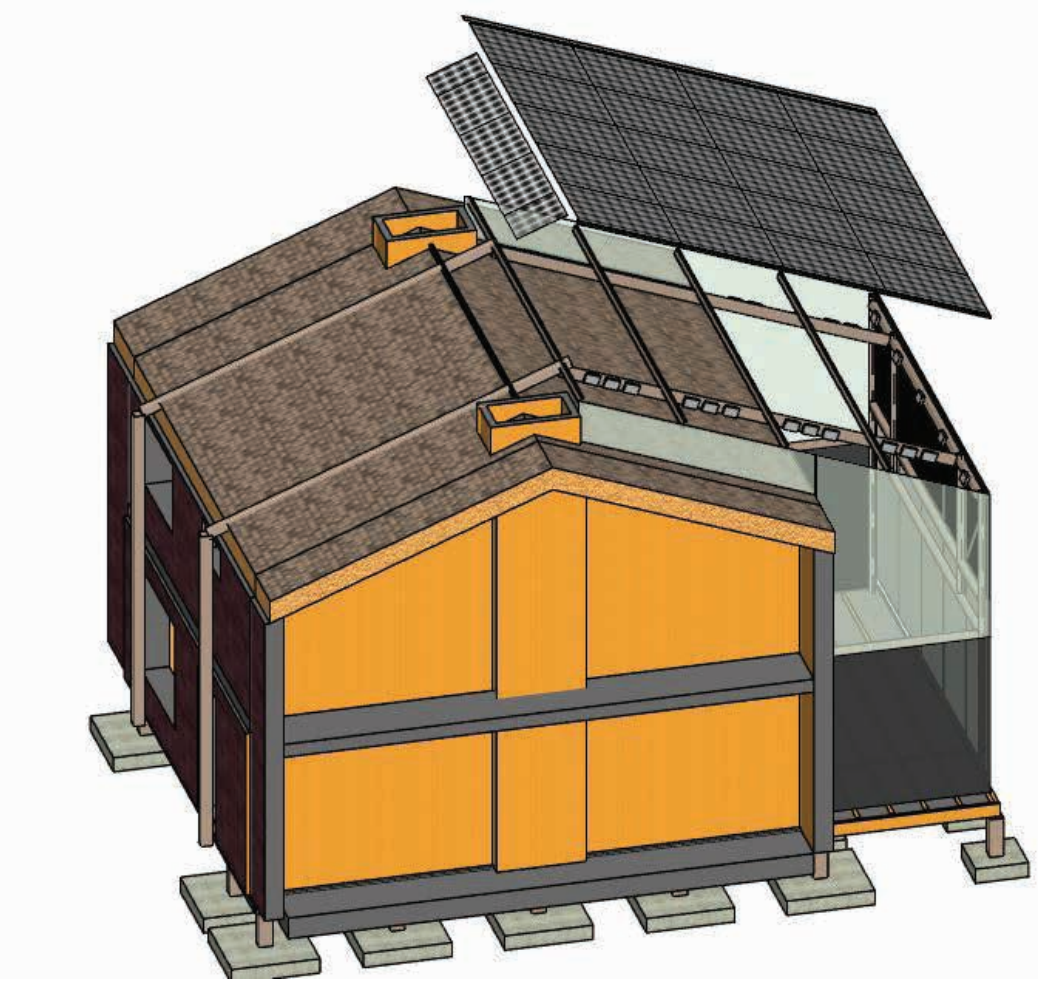


Figure 3.11 — *Overframe conection - demostrated in the prototype house*

This solution is having the main advantage that is not supporting at all on the existing structure, thus making the skin applicable on different typologies and structural conditions. The steel structure is forming frames above the house that can be easily assembled. Nevertheless, careful integration has to be performed with the northern wall renovation so for the steel frames to “hide” inside it.

Application on the existing house in Honselersdijk

For the house in Honselersdijk, the solution of supporting the glasshouse on the chimneys is used. As shown in the previous analysis of the existing structure, the chimneys are forming a double tube made by single line of brickwork (figure 4.7).

Since this element is not used for supporting the floor joists and is not subjected to extreme thermal loads (as it is not used as a chimney anymore), it can serve as a support for the glasshouse loads. The detailing of the connection will be based mainly on anchors and steel plates, attaching the ridge beam in as many points/surface of the brickwork as possible. Regardless of the detailing, precise structural analysis and evaluation of the current structural integrity of the chimneys should be performed before the applcation of the skin.

As for the support on the ground, two concrete Stelcon plates, one for each side, can be used, as shown later in the foundation narrative.

3.1.4 The Prototype house

Even by a first look to the previous SD competitions and the rules of the current edition, It is clearly visible that the structure of the prototype should to have the following characteristics:

- Fast mounting/demounting
- Easy to transport to the competition and back (most preferrably on a truck)
- Light self-weight
- Simplicity in structural elements and construction order
- Sustainability of the materials or the possibility to be recycled etc.

A possible solution to adhere to these criteria is a light panel construction system with simple connections, made from highly sustainable materials, producing low CO2 values for their construction. Nevertheless, the main philosophy of this project is about renovating an existing row house in the Netherlands and thus its translation to the prototype of the competition should be as exact as possible. Thus, the choice of structural systems and materials is not as straightforward as it seems to be, but needs some justification taking the above points into account.

In the following section an elaboration on the possible structural systems is made, followed by the final choice for the prototype house in Versailles.

Possible materials and systems

A first solution can be made with cross laminated timber panels (CLT panels). A variant of this technique is found by the “Leno” system [1]. The elements are consisting of wooden boards that are glued together with a durable adhesive bond. This stabilizes the boards, ensuring their structural collaboration and avoiding warping. They can be produced with dimensions of up to 4.80 m x 20 m with thicknesses between 50 and 300 mm. They can be used as standardized panels for ceilings, roofing or walls or they can be produced as general construction kit for an entire building.



Figure 3.12 — *CLT panels [1]*

This system therefore can possible provide a very efficient way of constructing the “Prototype house”, reducing all the building elements in a small number of panels that can be very easily mountable and demountable. Possible connections include:

- dowels/bolts
- nails
- screws

The system is also sustainable to some degree to the point that it can be recycled or be used for energy production and produce thus minimal waste.

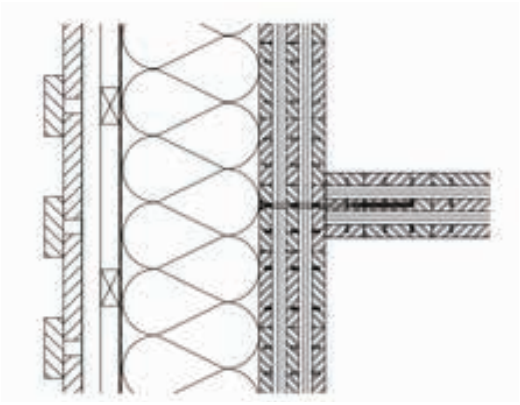


Figure 3.13 — *Wall to floor connection [1]*

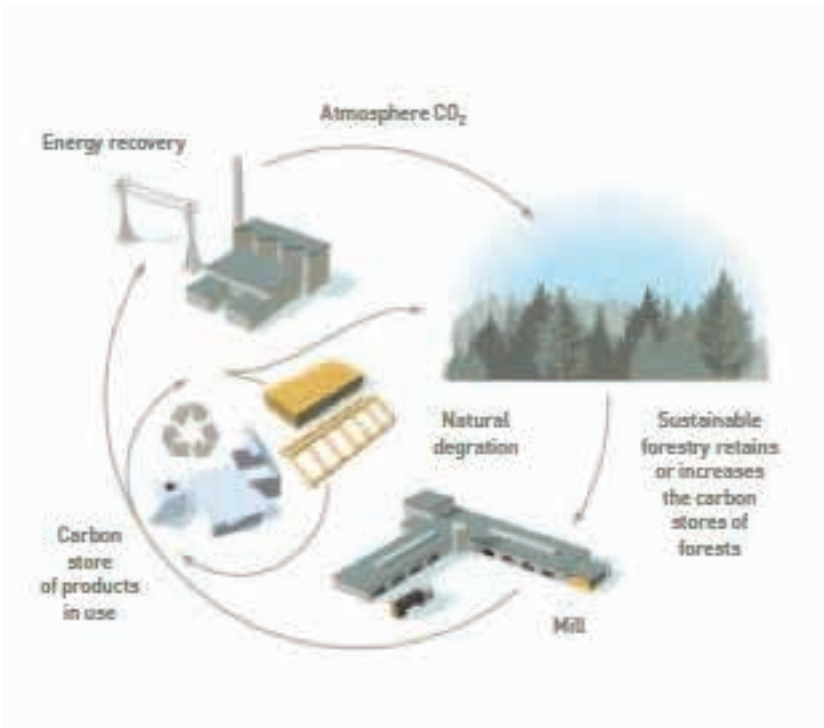


Figure 3.14 — *Carbon cycle [1]*

With this system, the house created can be perceived as a wooden model of an existing house in a 1:1 scale. The representation therefore is only taking place in a geometric shape sense without keeping anything else from the existing character, such as materials, climate interior conditions or the robust feeling of a brick structure.

In an attempt to address the possibility of transferring also the above characteristics of an old house (without moving it from its original position), the next structural system was analyzed. Since the manufacturing and moving of fully prefabricated brick walls is not economic and structurally feasible, another material was selected with material properties close to the one of the brick wall.



Figure 3.15 — *CASCO system[2]*

This material can be lightweight concrete and the system that has been studied is the Casco lightweight concrete panel system, as described by the Dutch company Spaansen [2]. The Casco system was used for many years to create thousands of row house in Netherlands and abroad and is based on:

- Wide and cheap prefabrication systems of concrete side walls, floors and foundations.
- Easy and fast construction with simple connections between the elements (usually, they are just simple supported on each other.)
- Use of brick as a cladding and for the formation of cavity in the external walls.

The thermal properties and even the density of the lightweight concrete used to this system [2] is very close to the one of the brick wall as it can be seen in the following table:

Thermal Conductivity	0.7000 W/(m·K)
Specific Heat	1.0000 J/(g·°C)
Density	1,700.00 kg/m³

Figure 3.16 — *Thermal properties of lightweight concrete [2]*

Thermal Conductivity	0.8100 W/(m·K)
Specific Heat	0.8400 J/(g·°C)
Density	1,700.00 kg/m³

Figure 3.17 — *Thermal properties of brick*

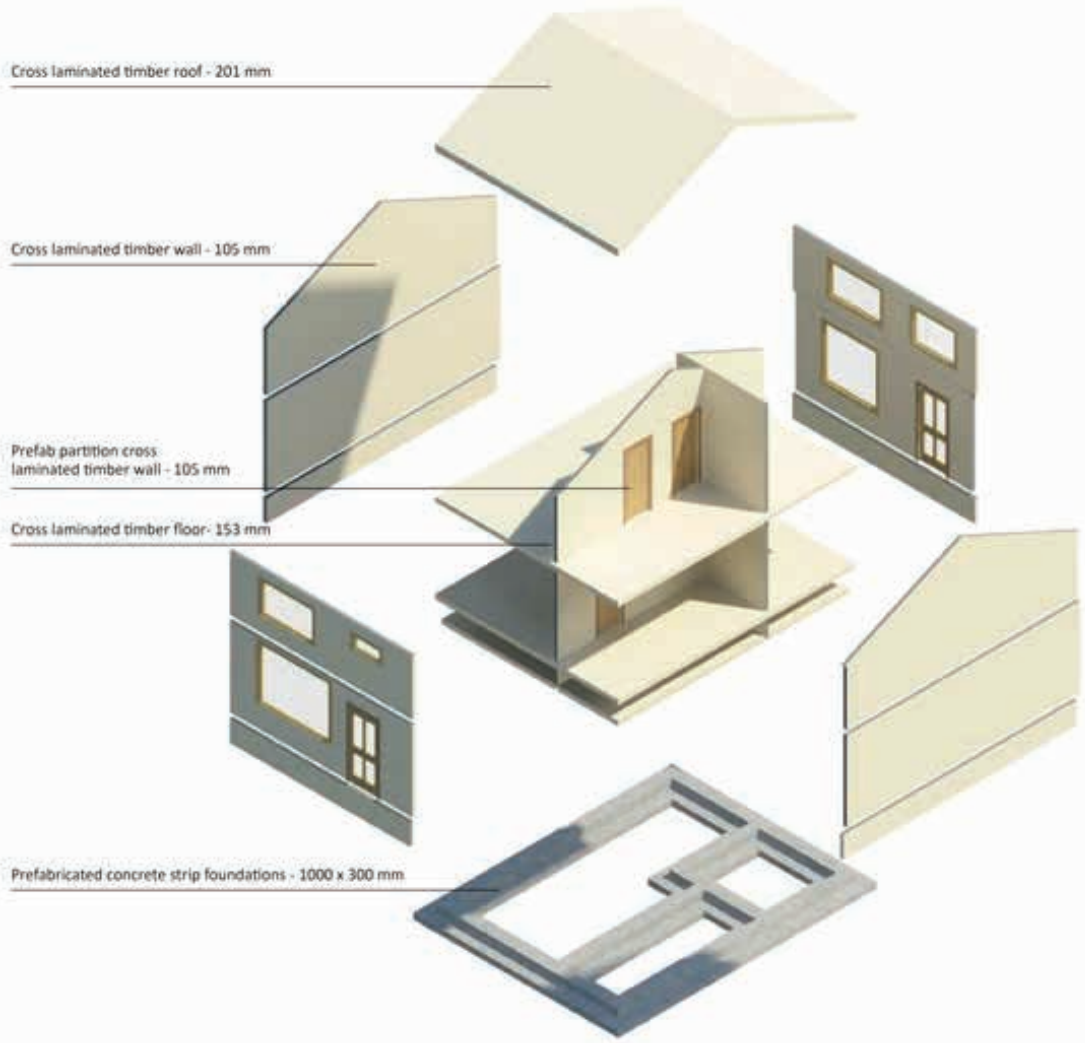
In comparison, the thermal properties of the CLT panels are:

Thermal Conductivity	0.1300 W/(m·K)
Specific Heat	2.1000 J/(g·°C)
Density	500.00 kg/m³

Figure 3.18 — *Thermal properties of CLT panels*

Therefore, a good material representation of brick walls can be performed in theory by lightweight concrete walls with equivalent thickness. That means that the walls of the Prototype house can be constructed by lightweight concrete panels with the exact positioning and thickness of the brick walls of the Existing structure. That way, the character of the existing structure can be possibly be highlighted in a larger extent than a model house representing only its form. This is further reinforced by the fact that many row houses in Netherlands were built with the exact same “envelope” system, which means that the climate conditions in the Prototype and the real houses are not very far from each other. To further enhance the similarities, the floors and the roof can have a wooden structure to resemble the materials used for the original house. The wooden structure can be also panelised, leading to a hybrid structure that nevertheless keeps the same simplicity in construction and connection of elements.

Finally, an overview of the two systems is presented below. It is supported by a self-weight calculation of the two structural solutions, if these are applied to the geometry of the house at hand. The calculation is performed taken into account the mean weight per m^3 and the geometric characteristics of the prototype house.



+

Lighter

More sustainable

Easier transportation

Simple construction

Same structure can be used for the rest of the prototype

-

Does not "feel" like an existing house

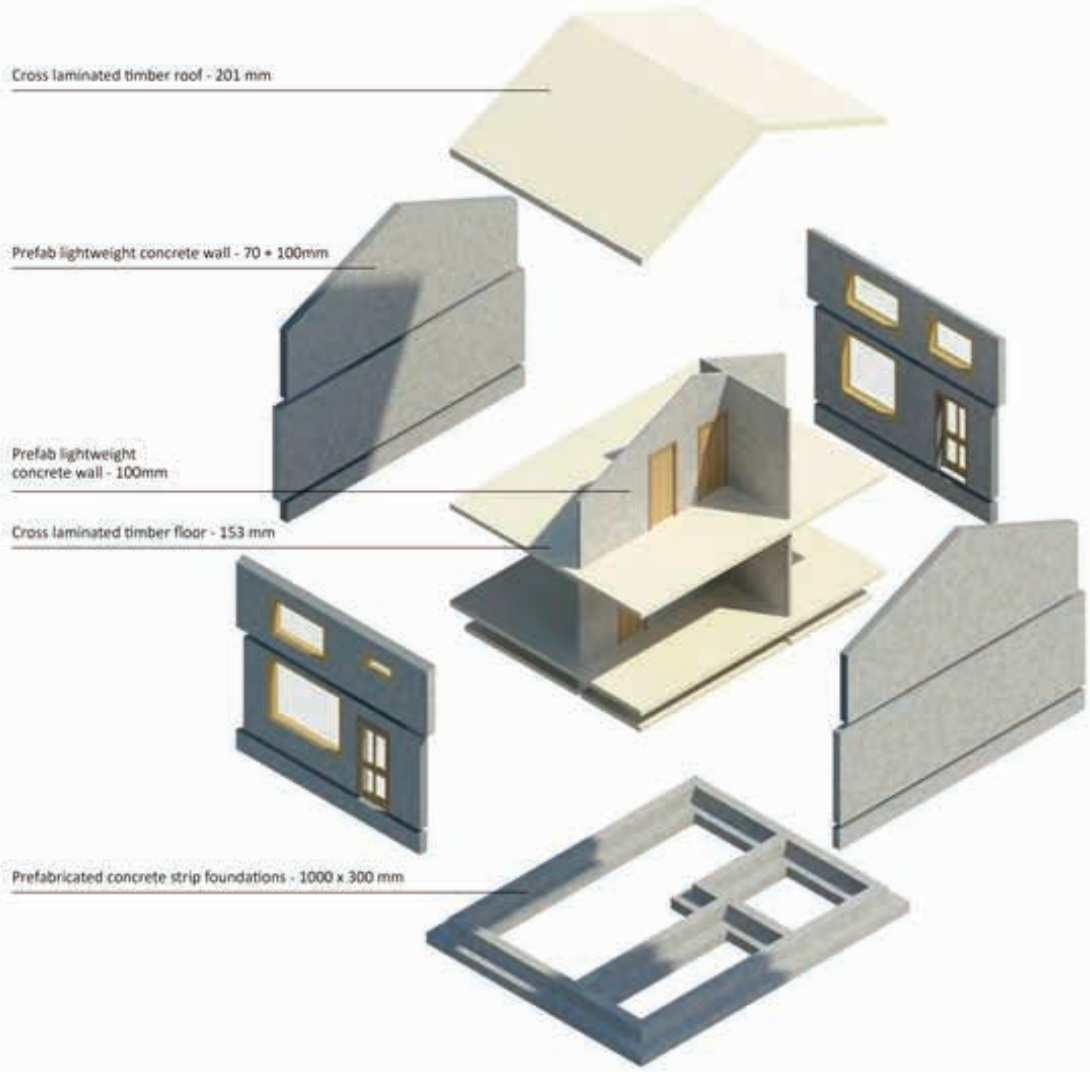
Difference from the original in thermal capacity

Difference inherent thermal resistance of material



Configuration 2 : Laminated wood panels structure		
walls	Cross laminated timber panels	213.25 KN
floors	Cross laminated timber panels	331.02 KN
roof	Cross laminated timber panels	72.83 KN
	TOTAL	**617.10 KN**

Figure 3.19 — *System with CLT*



+

Economic

Closer to the thermal attributes of the real brick house

Using typical existing technology for constructing houses in NL

Structure that represents a large percentage of the existing houses

-

Heavier

Expensive in transportation

Not sustainable – more CO_2 emissions

Combination of concrete panels (walls) with wooden panels (floor)



Configuration 1 : Concrete panels structure		
walls	Prefab concrete panels	657.42 KN
floors	Cross laminated timber panels	346.82 KN
roof	Cross laminated timber panels	72.83 KN
	TOTAL	**1077.07 KN**

Figure 3.20 — *System with concrete panels*

It can be readily seen from the above results, that the two solutions have a quite significant self weight, with the concrete solution being totally unfavorable towards the criteria of transportation and assembly ease, even if it is a more accurate translation of the existing house. After analysing the possible construction and transportation problems in collaboration with the sponsors and the stakeholders of the project, it was decided to opt for only the geometric representation of the existing house, as this can be achieved through the much lighter wooden panels.

Nevertheless, the CLT panels are in fact a massive timber wall system, with significant structural capacity. From the initial structural analysis of the loads of the structure it became evident that this capacity is not needed in the simple structure of a two storey house, especially if it is also combined with the large self weight of the elements. Therefore, a more lighter timber system was chosen and this is what is finally used to construct the prototype house. This system represents one of the main construction systems in Netherlands the so-called “houtskeletbouw” – timber frame construction.

Timber frame structure - The structural system of the prototype

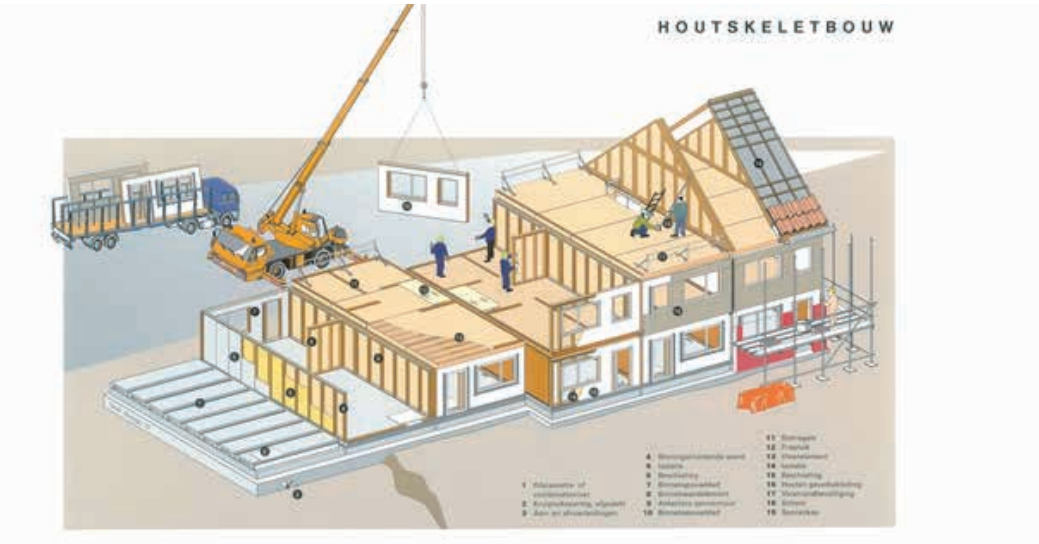


Figure 3.21 — *Timber frame house costruction*

As mentioned above, light weight structure is one of the main criteria for choosing the system. Construction of the panels, transportation and assembly become quite simple and fast procedures, without requiring extensive construction equipment and machinery. It also allows for a more practical design and construction of the foundations and makes it the perfect material for interventions in renovation, as it is not overloading the load bearing structure. Apart from the low weight, another main reason of the team adopting this type of structure lays in its wide recognisability in the Dutch house construction, leading to large construction experience that minimizes mistakes on site , while the extensive prefabrication ensure large quality standards. The sustainability of the wood, its insulation properties as well as its demountability (both for prefabrication and on site construction) were further reasons for choosing the specific method. In a way, the house will be both a representation and an original, even if the existing Honsel-

ersdijk house that is represented is having load bearing masonry walls.

Nevertheless, by using brick strips on the facades, the aesthetic results on walls is quite similar to the existing masonry house, as can be seen in the model of the prototype house below:

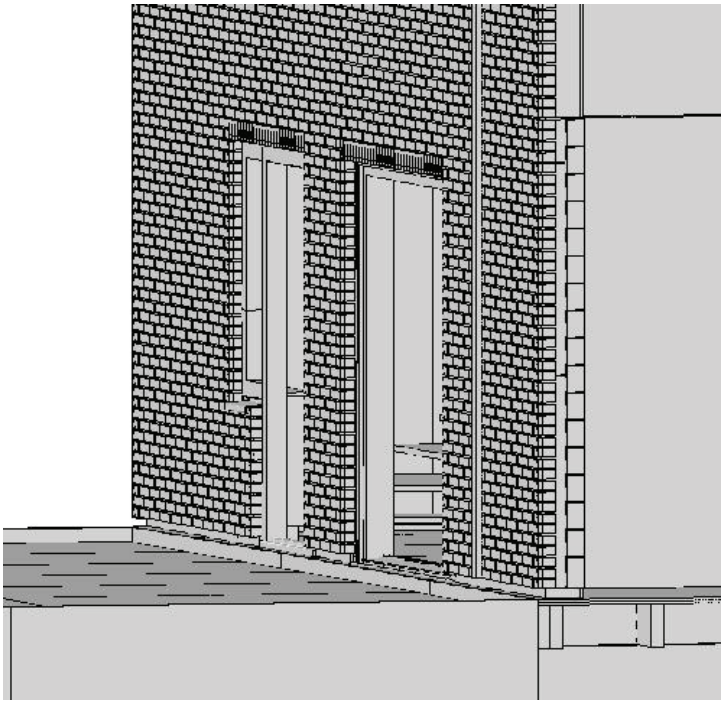


Figure 3.22 — *Brick slip facade of prototype house*

The core of the panels of floors, walls and roofs is a structural timber frame system, filled with insulation and closed by OSB plates (Oriented Strand Board).



Figure 3.23 — *Timber frame*



Figure 3.24 — *Cross section of the finished panel. (the timber frame is in the same level as the two insulations)*

More layers can then be added to the structural core, such as extra insulation, brick slips and gypsum panels, as it is the case for the final structural walls of the prototype. An indicative cross section and timber frame, similar to the one used for the prototype can be seen above.

The main structural concept for the wall panels is that the frame system is bearing the vertical forces (self weight, snow, live loads from the house) and transfers the horizontal forces (wind on the facades) to the OSB, that acts then as a shear bracing. Through this function, the wall panels can bear in general the wind loads of the facades in their transverse direction, providing stiffness to the total structure. The cooperation between the two elements is ensured through dense nail connections, producing a stiff panel element with adequate structural capacity and low self-weight. A diagrammatic explanation of the concept is also presented below.

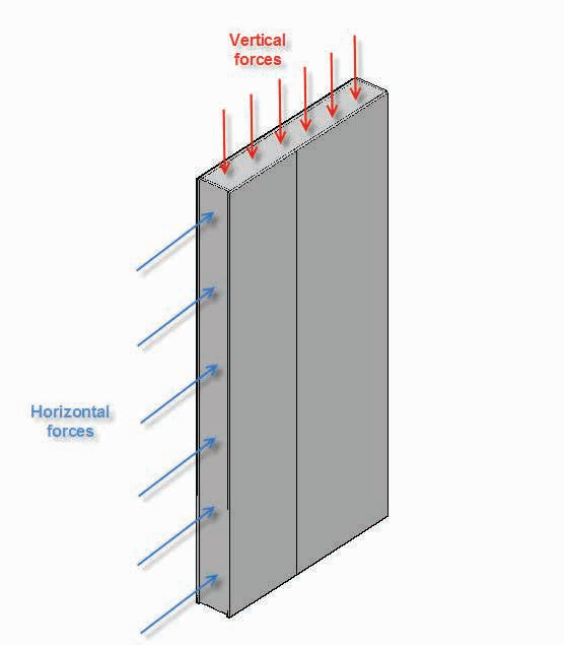


Figure 3.25 — *External forces acting in a timber frame wall*

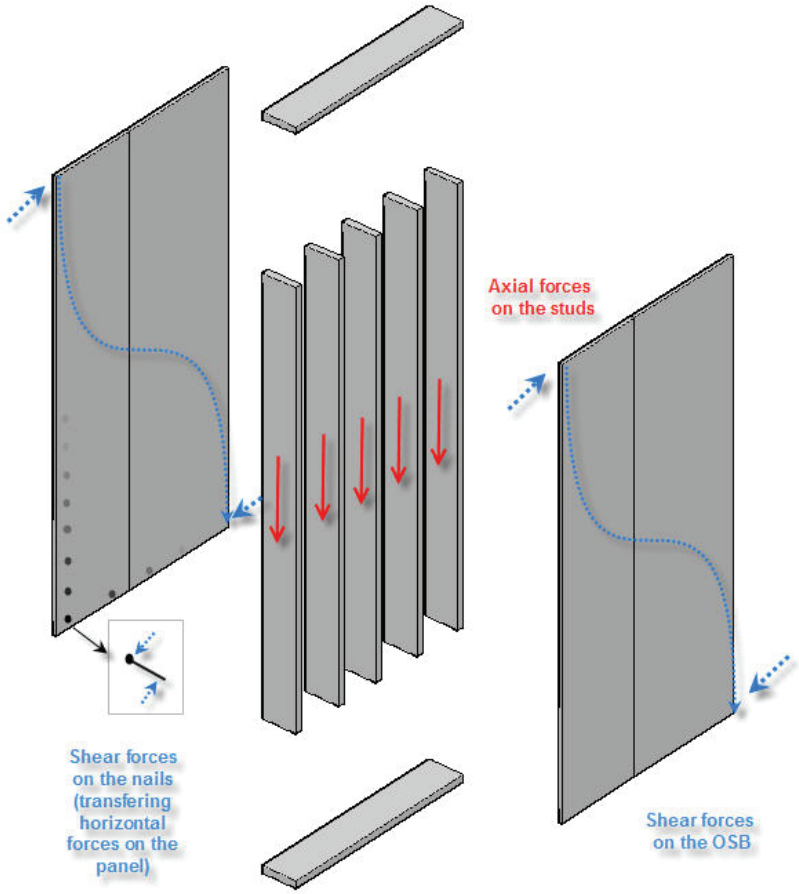


Figure 3.26 — *Internal forces in the components of the wall panels*

For the horizontal and diagonally placed panels in the floors and the roof, the timber frame acts as a beam system that bears the live, wind and snow loading and transfers them to the perpendicular beams and then to the walls below.

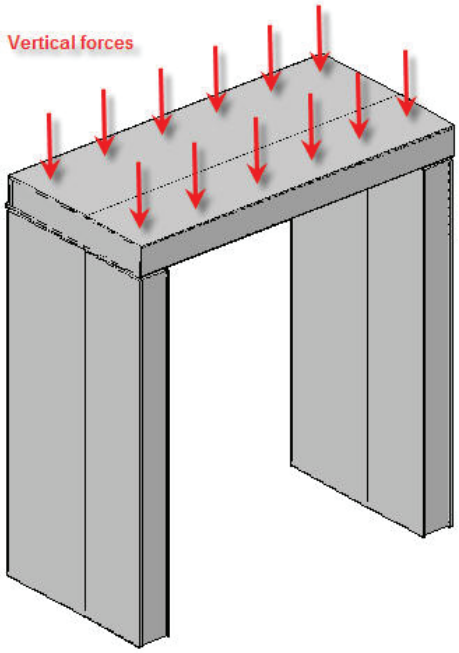


Figure 3.27 — *External forces acting in a timber frame floor*

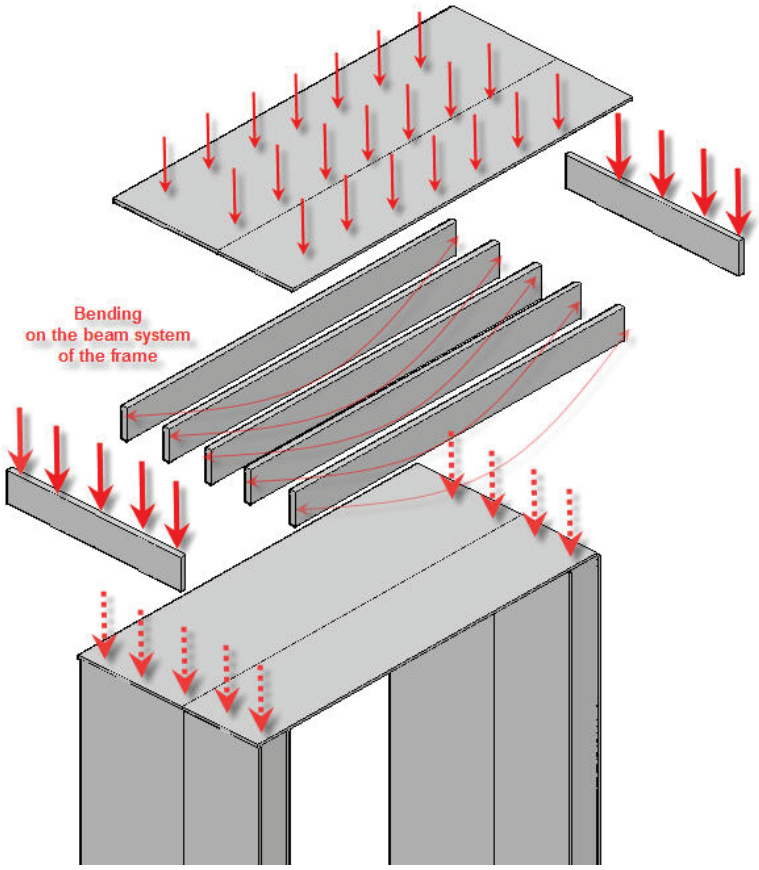


Figure 3.28 — *Internal forces in the components of the floor panels*

The connection between the wall, floor and roof elements is succeeded through steel double L-shaped connectors, bolted in the elements in the manner seen below. The distance between the connectors is about 210mm c.t.c.. Thus the structure of the prototype can be easily dissassemblied after the competition into panels again and transformed back to Netherlands.

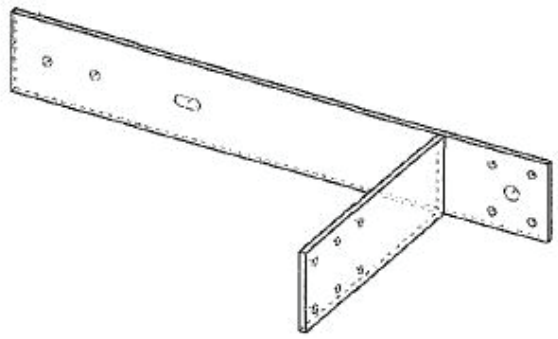


Figure 3.29 — *Steel strip connector*

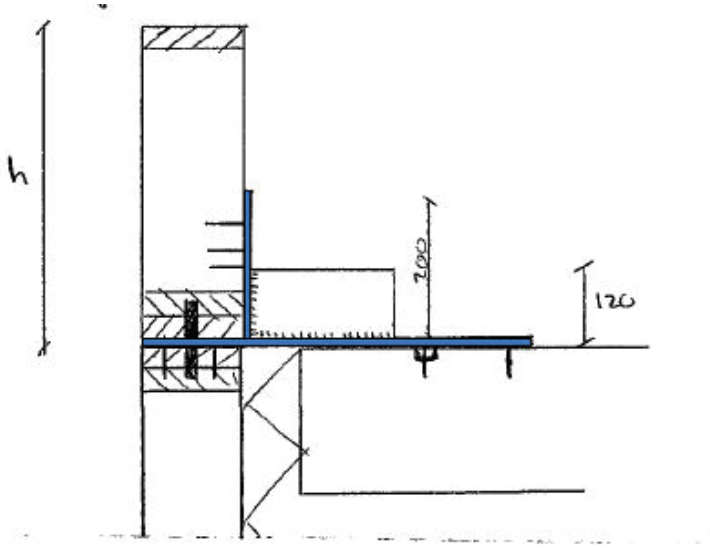


Figure 3.30 — *Connection between walls and a floor (with blue the above connector is highlighted).*

The usual construction process for timber frame structures in the Netherlands is the so called platform construction method in which the vertical elements are interrupted by the floor elements. All the elements are prefabricated, transferred from the factory to the site and lifted directly from the truck for the assembly. That leads to a very fast assembly duration that lasts usually a few days but can be even performed in only two, while the connection process usually includes only bolting. It is becoming therefore evident that this structural system was preferred even more, as it facilitates the construction in Versailles, where a working crew of professionals and students have to finish the house in just 10 days.

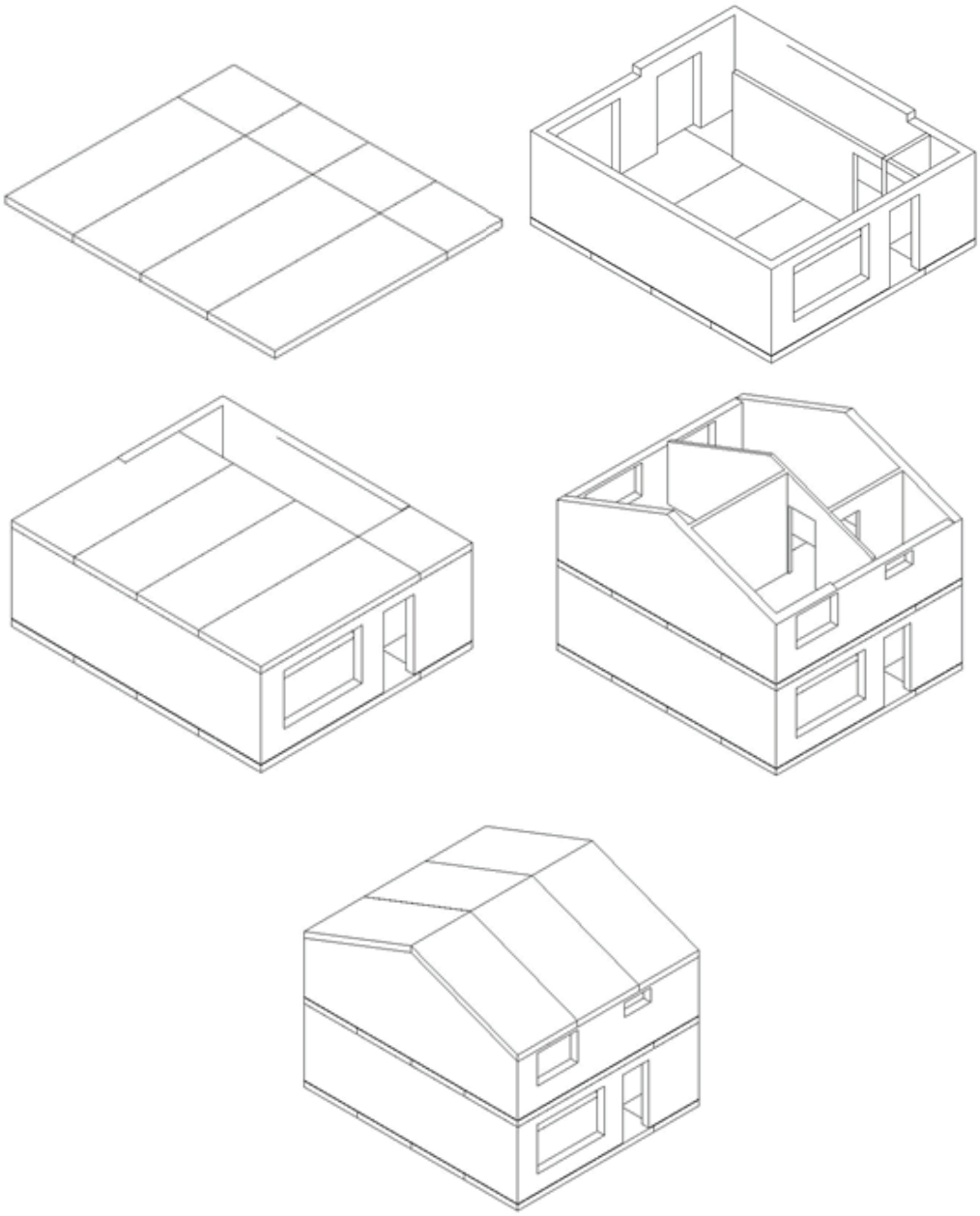


Figure 3.31 — *Indicative construction sequence of a similar house to the prototype*

The above described structural system is used to materialize and support the prototype in the Netherlands. An overview of the total construction elements of the prototype house and and the main timber frame beneath them is shown in the next images (without the green roof or the Skin). It is noted that the wall, floor and roof panels on the sides that represent the neighbouring houses of the row do not have any other structural function except from supporting their own self-weight and for this reason will not be examined in detail. Finally, the total self-weight of the prototype house was calculated at around 450kN (or 45tn), prooving that is the lighter solution from those examined.

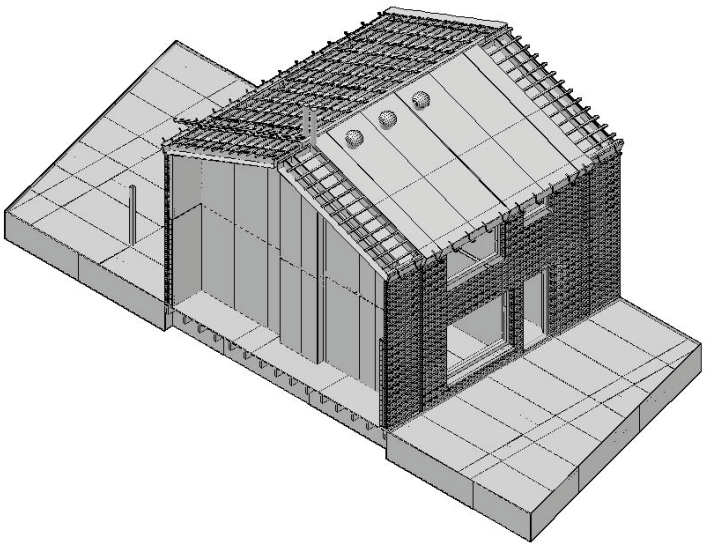


Figure 3.32 — *Overview of prototype house construction*

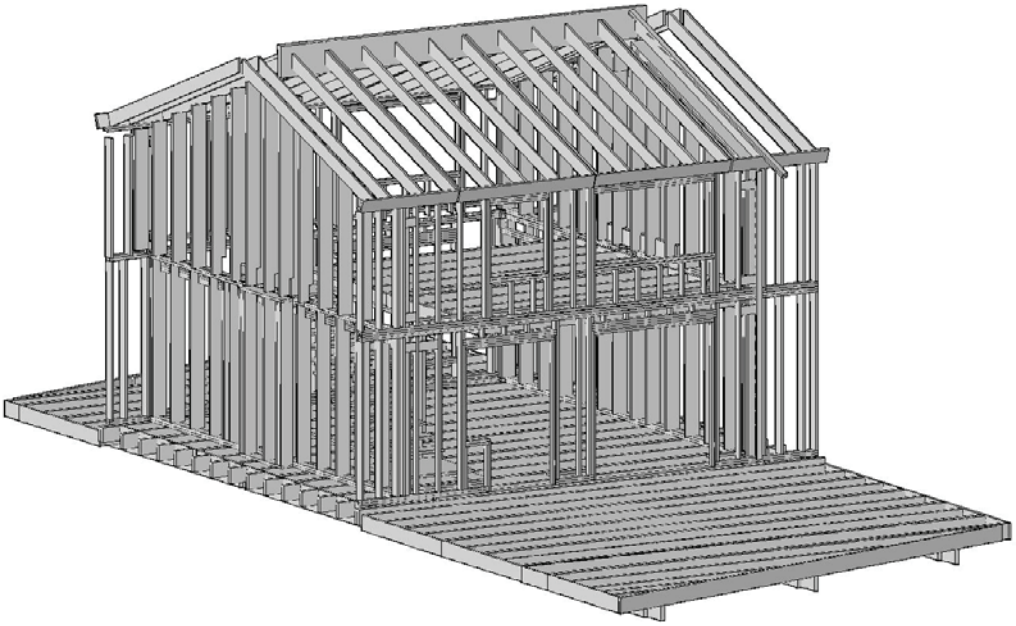


Figure 3.33 — *Exposed timber frame system of the prototype house.*

3.1.5 Footings

Initial premises

The footings and foundations methods considered, are taking into account the following demands from the current competition rules:

- No excavation possible
- Limited allowed load bearing distribution
- Limited details for the substrate prepared by the competition commitee
- Easy assembly/disassembly

As it is also addressed in the rules, “low impact foundations” are suggested. Similar to the case with the structure of the house, an elaboration of the possible choices is presented initially to take into account diverse factors, such as self-weight, easy construction, sustainability, durability after the competition etc.

Possible materials and systems

Three typical solutions are considered:

1. Strip foundation
2. Slab/raft foundation
3. Separate footings

Unfortunately the above solutions are not very typical in the construction tradition of Netherlands. Due to the low ground capacity as well as the high and even dynamic water level, pile foundations are mostly preferred, especially for the usual housing constructions. This limits therefore the choices and the availability of shallow foundations. Even if those solutions are used in non-permanent structures in NL, the problem is that the prototype house weights far more than the usual case. Also, although that the structure will be constructed in Versailles for less than a month, it will be situated after the competition in Delft for a far larger duration, leading to durability requirements, if the same foundation is used. From the perspective also of sustainability, it would also be ideal to re-use than to construct a new one, especially from in-situ concrete etc.The application of the first two foundation systems that were considered during the initial project development can be seen in the following plans:

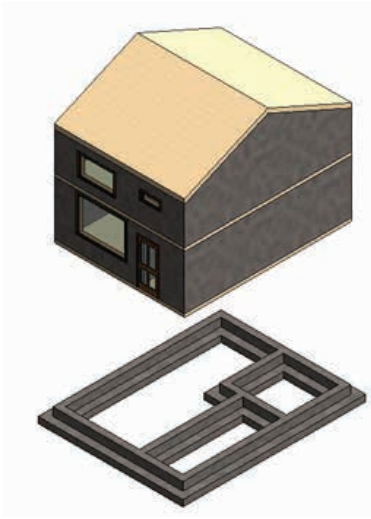


Figure 3.34 — *Strip foundation*

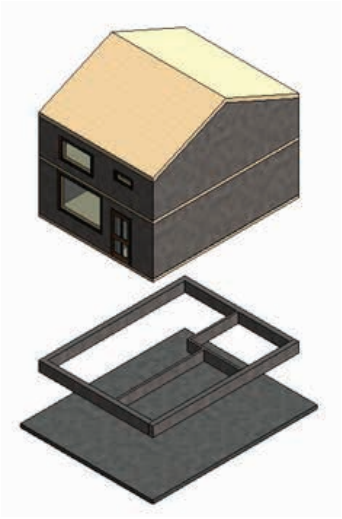


Figure 3.35 — *Slab foundation*

The material mainly considered for both them can be concrete, taking into account the usual solutions found in the country.

The first solution is consisting of concrete strip components that are easily prefabricated in convenient lengths for transportation with a truck or containers and then are hoisted and placed on the correct places on site without excavation. The strips can have dry connections between them, ensuring that the foundation can be dismountable. On top of the strips the ground space floor can be placed. These can be simple supported there or make use of dry connections.



Figure 3.36 — *Example of construction of strip foundation*

The second solution consists of a slab foundation connected with a bearing wall system that is transferring the forces from the above structure. In addition, the slab is acting as a floor system covering the crawl space and the bearing walls as the side cover the space (in comparison with the open structure of the strip foundation). The slab can be divided in as many different parts as possible for ensuring easy transportation. The connection between the items should again respect the demountable character of the pavilion. Also, depending on the precast possibilities, the bearing walls of only the crawl space can come connected with the slab to ensure the structural synergy. Otherwise a dry connection with protruding steel studs can be designed jointly with the precast company. The thickness of the slab will be defined by the soil conditions and the bearing capacity design.



Figure 3.37 — *Example of slab foundation construction*

It is noted that the same foundation techniques can be used regardless of the position

of the internal walls, thus their foundations can change be situated elsewhere inside the house plot. Nevertheless, the structure is estimated to be too heavy to be supported only by the foundation strips of the external walls so that a third strip should be used.

Apart from prefabricated solutions, the possibility of custom made foundations was examined. One of them, derived in fact from a similar design in a previous version of Solar Decathlon, comprises of wooden pads supporting a wooden deck and upon this the house as seen below.

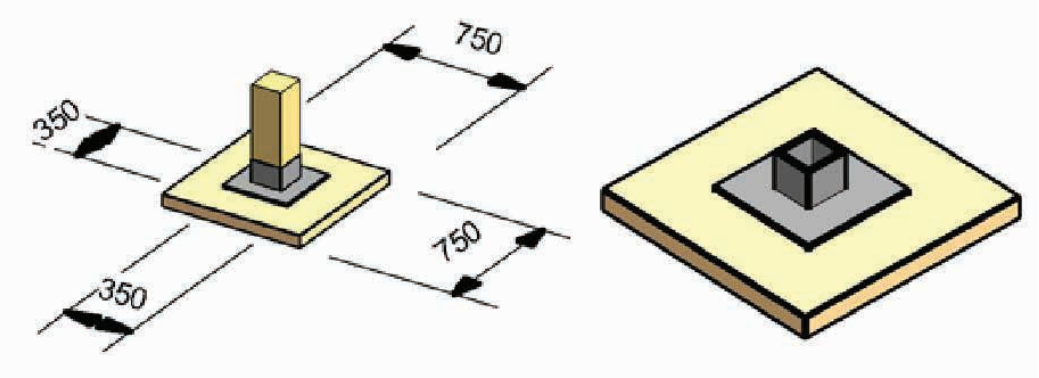


Figure 3.38 — *Design example of the timber pads*

An indicative application to the prototype house can be seen below:

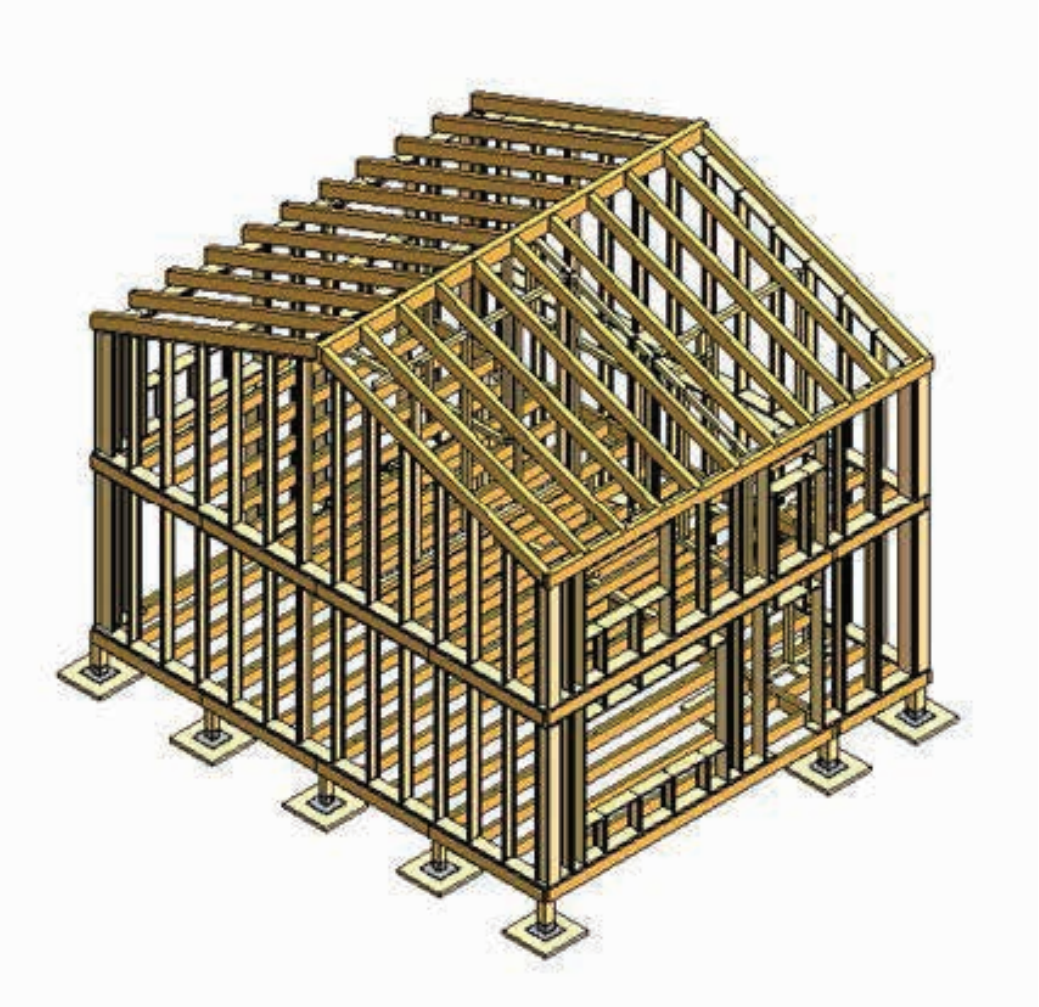


Figure 3.39 — *Application of the timber pads to the prototype*

The possible problems with the above solutions are the large weight and volume for the first two of them that could lead to a very expensive transportation and complicated construction process. Also, for such a small weight of the house, the capacity of the usual prefabricated strip and plate foundations stays largely unused. From another point of view, the timber pads might be very light but they are not durable enough for the post-competition use.

Therefore, a final solution was designed, combining the advantages of the previous presented. It consists of prefabricated "Stelcon" concrete plates with dimensions of 2000x1000x160mm as the main foundation element, supporting double timber beams that upon them the floor panels of the ground floor are situated. The connection between them is achieved through steel elements and bolts, as shown below.

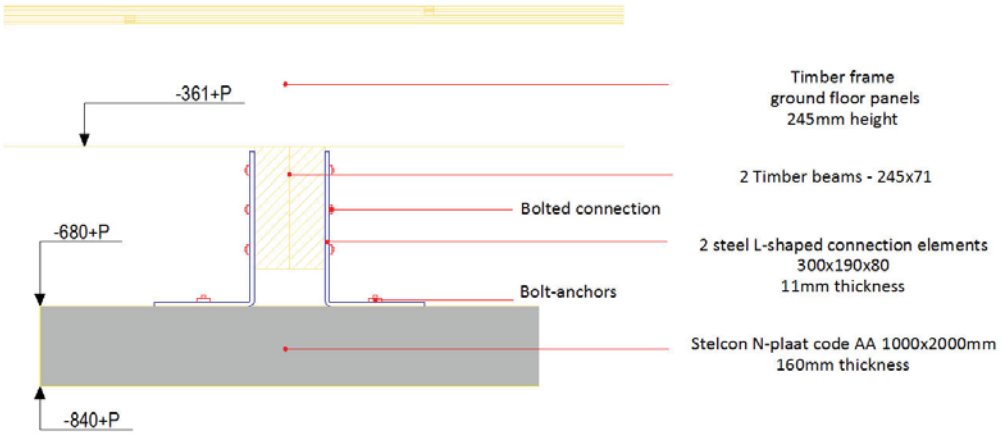


Figure 3.40 — *final foundation design*

The vertical forces are transferred from the floor panels to the beams in a continuous manner, instead of using posts that would require larger dimensioning. The beams are then transfering the load to the many connections on their sides through the shear capacity of the bolts. From there it arrives to the stelcon plate through the 12mm thick L-shaped steel plates and then it is distributed almost uniformly to the substrate. The details of this load transfer can be found in the section of structural calculations.

The Stelcon plates, are the most typical foundation type for the support non-permanent structures. They are very durable, made from cement of high quality and they are also unreinforced, leading to easier customization of the connection with the above

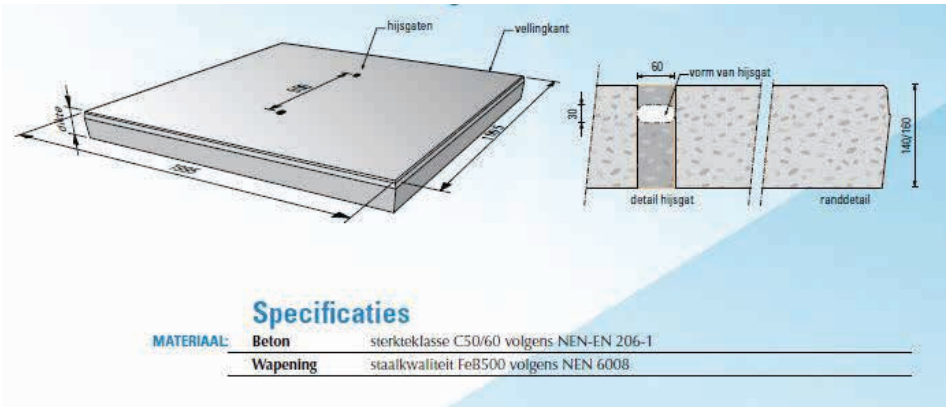


Figure 3.41 — *Stelcon foundations*

structure, as they can be drilled anywhere. In the design, two holes are made on its top side, to add stabilizing anchored connections for the timber beams on top. Some further characteristics can be seen below in the excerpt of their brochure.

After a first structural analysis and calculation of the possible bearing loads reaching the ground, the foundations are designed as three lines of continuous Stelcon plates and timber beams, parallel to the side walls of the prototype house. Two of the lines are situated under these walls, transfering most of the floor panel load and the third is in the middle, reducing the span of these floor panels to 3m instead of 6m, leading to an even lighter structure. The final form of the foundations can be see below on the photos from the initial construction of the prototype in the factory of one of the sponsors of the team.



Figure 3.42 — *View of the foundation lines in the construction plot.*



Figure 3.43 — *Side view of the foundations as constructed*

3.2 Construction Design

It is noted that the construction design is covered sufficiently in the stuctural design above and other chapters, thus leading to its current small size.

3.2.1 Materials and systems

Pret-a-Loger is designing an innovative system of refurbishing an existing Dutch house, making it sustainable and energy efficient. The basic concept behind this idea is to develop a system of tools and materials, which once applied to an existing structure, will increase its insulation, will reduce the infiltration, will increase the energy efficiency and more important, will create a comfortable climate environment for the people living there.

The research part of the project is taking place in Netherlands, where an actual house is analysed in terms of energy consumption and climate. After a proper evaluation will be performed, a system of innovative technologies will be applied in the house which will make the building perform better in terms of climate, energy and comfort.

For the competition however, Pret-a-loger is planning to build a representation of an existing Dutch house, and apply directly on the site the tools and materials. The list of materials used is presented below

Partner	Element	Material
Groothuis	Timber frame structure	Sawn timber, softwood, raw, air dried, u=20%, at plant/RER U
	Roof insulation	Glasswool
	External insulation - external layer	Glasswool
	External insulation - interior layer	XPS
	Concrete foundations (33 pieces)	Concrete - C50/60
STO	Insulation panels - North side	BIO - EPS
Nobutec	steel skeleton for skin support	structural steel of S235 quality, coated
Robisol	aluminium frame for PVs	normal aluminum frame, coated

fabricated paneling system. Since the construction time is limited, the panels will reduce considerably the time spent on the building process itself, and will permit to spend the rest of the time on the improving system. A prefabricated paneling system will be easy to transport and mount on site, and will reduce considerably the workload.

For the mounting of the panels a mobile crane will be sufficient, with the lifting capacity of min. 3000kg. Its working max radius should be not smaller than 25 m and max lifting height – 10m, considering the construction site conditions in France, and Solar Envelope Dimensions. For the transportation of the paneling the team will need a truck which can load the panels (sizes) and has the capacity to assure a proper transportation.

Besides the transportation of the panels, the team will need to transport small quantities of materials, tools and equipment. For this kind of transportation a small truck fitted with a crane (max load 3500kg) should be enough.

Besides the paneling works, the foundation of the building will be initially constructed, from prefabricated concrete. Finally the brick cladding appearance can be approximated in both the construction systems by brick wall strips as can be seen in the next image.



Figure 3.44 — *Brick strips cladding*

3.3 Plumbing Design

3.3.1 Existing plumbing design

The plumbing system of Existing house can be defined as the conventional plumbing system In Netherlands. It consists of the piping that brings the cold water inside the house, a boiler which distributes hot water to the rest of the house and the waste water system. In buildings built before 1940 the pipes are made of lead. Lead has a bad influence on the drinking water. After 1940, also in the case of the building examined, they are built with copper. The advantages of copper are the flexibility and the easiness to use. The disadvantage comes with the advantage, the possibility for the pipes to change easily leads to many possible different diameters and qualities, as the tenants woud have changed them throughout the life-cycle of the building. There are also flexible pipes in the market from Polythyleen and Alluminium. The advantage is that they can not be easy placed.

A schematic showing the cold and hot water piping system in the Honselersdijk house can be seen below:

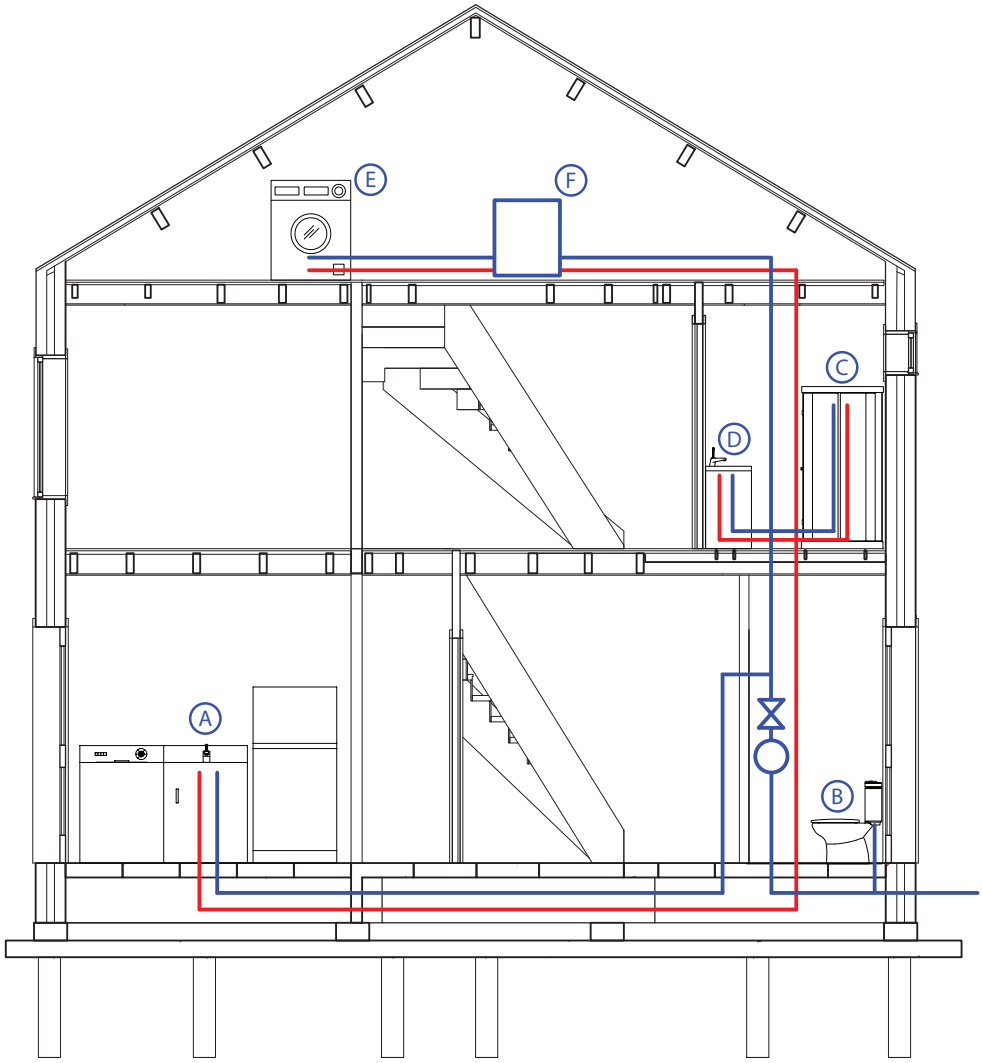


Figure 3.45 — *Water systems inside the house*

3.3.2 Proposals for the Honselersdijk application

As a general philosophy regarding the water consumption inside the «Competition Prototype», the following text can be mentioned from Hoekstra et al: “Consumers can reduce their direct water footprint (home water use) by installing water-saving toilets, applying a water-saving showerhead, turning of the tap during teeth-brushing, using less water in the garden and by not disposing of medicines, paints or other pollutants down the sink. However, the indirect water footprint of a consumer is generally much larger than the direct one and consists of consumer products with a big water footprint” [6]. Therefore, smart techniques will be used in the plumbing system to promote these water-saving attitudes. The elaboration and justification behind them can be found in the sustainability chapter. Furthermore, the use of grey-water or rain water, will contribute to the water-use limitation.

It has to be stressed again that the proposals above and below are referring to Honselersdijk house. For the prototype in Versailles **these proposals are simulated taking into account the limitations of the competition** as stated in the rules:

- The use of domestic water tank and waste water tank instead of connecting to the grid.
- **The grey (or rain) water tank in the competition will only be used to water the plants.** For this reason a smaller water tank will be used for Versaille integrated with a soil box, as described in the chapter of garden design.
- The toilets will not be connected in the competition

Finally, for the Delft situation after the competition, the waste water tank will be reused as a rainwater tank and the above restrictions will be lifted.

3.3.3 System description

In the next, the plumbing design as shown in project drawings is elaborated, using the references from there for the piping and the appliances. It is noted that in the parenthesis the applicable house situation is clearly defined.

Domestic water (All)

The water supply network is designed from the very beginning considering the use of solar collectors as sustainable source of energy to pre-heat the water. The network is formed of a system of horizontal and vertical flexible pipes, with a size of 20mm or 16mm, and planar connectors, which connect the pipes and the sanitary units. The pipes were selected PVC and the sizes according to Standard Dimension Ratio. We designed a branch system of pipes to combine hot and cold water. The cold water for the sanitary units is collected from the central source unit (city network), while the hot water is collected from the solar collectors. The hot water system is designed as a hybrid loop system. Vertical distributors (VPH-1 and VPC-1) assure circulation between different floor levels and connect the interior branches with the ones placed outside. The piping system can be further developed, as new utilities and installations are connected.

Grey water (Honselersdijk - Delft)

A grey-water collecting unit is added to the system. This way the grey water accumulated on a daily basis can be reused. The system was readjusted, so the grey water sources are not connected to VS-1 evacuation route, but to the vertical collector VS-2 (50mm). The collector connects the interior network with the grey water filtering unit. The toilets are not grey water sources, that is why they are kept connected to VS-1, and to the central collector respectively.

Waste water (Versailles only)

The sewage system in Dutch dwellings is typical, formed of pipes and conducts. The waste is evacuated from the dwellings and residential units into the urban collector. For the small villages however, there is no central discharge point, and the waste is collected on the property, usually in septic tanks.
For the Versailles design the same typology is used. The sewage system in the dwelling is formed of a network of horizontal ducts with 50mm in diameter, which connect each sanitary unit to the vertical pipe VS-1. This is the evacuation pipe which connects the house to the collector, or to the septic tank. The size of VS-1 is 100mm.

Water heating (All)

The main element of the Competition Prototype will be the skin. An important influence on the water system will be the heating of the water. The skin can function as an energy source and be customized with the Energy panels of Solar Compleet. A description of the system can be found in Earthscan [5] : “In the absorber is a system of pipes filled with a heat transfer medium (usually water or an antifreeze mixture). This flows to a hot water store. In the commonly used type of solar thermal systems the heat is then transferred to the domestic water by means of a heat exchange. For temperate climates, in a solar system for one- and two-family homes with dimension of about 0.6-1.0 m^2 of collector surface per person and approximately 40-60 l of storage volume per person. For the thermal heating system we would like to use vacuum collector. The volume in the glass tubes must be evacuated (to less than $10*10^{-2}$ bar to completely suppress thermal losses”. In this case a 300 liter tank is used and 2 Energy Panels which have a heating capacity of 2KWh.

Tank and pump calculation (Versailles and Delft)

The tanks are mainly calculated and dimensioned based on the event schedule for the contest in Versailes. The fresh water tank is retrofitted with an external pump, which should be able to send the water to the bathroom in the first floor. This pump can be reused as a rain water pump in the Delft situation as it will have to pump again the rain water to the bathroom for use in flashing the toilet.

The pump energy requirements are also calculated for the competition use and for regular use to be use in the energy balance.

Figure 3.46 — *Regular use of the water system [left]*

Figure 3.47 — *Table with competition analysis [right]*

	Number of equipment	Equipment performance	(L/min)	(L/sec)	Frequency of use (put 0 if no use)		Average time of use (seconds)	L/week	days/week	L/day	Seconds	Hours	kWh
					nb	Unit							
Shower	1	5 L/min (very efficient)	5	0,083	5	times/week/user	60	25					
Washbassin	2	5 L/min (very efficient)	5	0,083	8	times/day/user	20	93,3	7				
Sink	1	5 L/min (very efficient)	5	0,083	5	times/day/user	30	87,5	7				
Washing machines	1	40 L (efficient)	40		4	times/week/washing machine		1120	7				
Dishwashers	1	10 L (very efficient)	10		7	times/week/dishwasher		490	7				
							SUM	**1815,833**		**259,4048**	**518,8095**	**0,144114**	**0,053322**

		Consumption of other equipments			Unit
Other equipments					
ventilation air conditioning (eg misting patios, double adiabatic					m3/year/building

Sunmersible Pump (Wilo KTWU 30115 EM 3")	
Flow rate (m3/h)	1,8
Flow rate (L/sec)	0,5
Δp (bar)	3,1
P (Kw)	0,37

	Number of equipment	Equipment performance	Total L used	(L/min)	(L/sec)	Use times in competition	L/competition - 12 days
						nb	
Hot water draws (shower)	1	5 L/min (very efficient)	50	5	0,083	20	1000
Cooking	1	5 L/min (very efficient)	2,3	5	0,083	8	18,4
Washing machine	1	40 L (efficient)	40	40		10	400
Dishwasher	1	10 L (very efficient)	10	10		8	80
							1498,4
							100
							1598,4

	L/day	Use Seconds/	Use hours/	kWh per day	kWh per week	kWh per month	kWh per year
	133,2	**266,4**	**0,074**	**0,02738**	0,19166	0,84878	9,99

Sunmersible Pump (Wilo KTWU 30115 EM 3")	
Flow rate (m3/h)	1,8
Flow rate (L/sec)	0,5
Δp (bar)	3,1
P (Kw)	0,37

Tank capacities	**Capacity (L)**
fresh water tank	799,2
waste water tank	1598,4
rain water tank	100

3.3.4 Technical description of tanks and pumps

Fresh water tank

Type: Hori model C
Material: Strong polyethylen - PE
Cover: Equiped with plastic screw cap with hole Ø 300 mm (for filling)
Available connection: 1 x 1 ½ "+ 1 x 1"

Capacity: 750 liter
Dimensions: L x W x H (external): 1580 x 750 x 840 mm
Quanity: 2 tanks

Waste/rain water tank

Material: High quality HDPE
Cover: Equipped with a plastic screw cap with hole Ø 300 mm (for emptying)
Available connections in / out: Ø 50 mm.

Capacity: 1800 liter
Dimensions: L x W x H (external): 2500 x 2000 x 400 mm

Water pump

Description: Self-priming, maintenance-free, multi-stage, horizontal centrifugal pump designed specifically for rainwater use.
Type: Aspri 15-3 + KIT02
Materials: Pump housing stainless steel AISI 304, AISI-420 stainless steel impeller, suc tion and discharge from brass.

Technical Data Pump Engine: 0.6 kW (P1) - 50 Hz - 230 - 2900 RPM T / m
Pump capacity: Capacity Capacity: 3.5 m3 / h, 33 mwc Maximum height 15 m.w.k. (max. pressure 10 bar)

Pressure Control: Pressure Control KIT-02, a specially developed for rainwater use pump control. With integrated water hammer arrestor, pressure control, manometer and dry run protection.

The exact positioning and connectivity of the tanks and the pumps can be seen in the project drawings.



Figure 3.48 — *Pump model used*

3.3.5 Calculation of the non potable water and rainwater fall for Delft situation

Captured rainwater

Connected roof area: 46 m^2
Slope: 21°
Effective area: 42.95 m^2

Annual average system: 1004.5 mm
Performance system: 75%
Total annual volume rainwater: 68.3 m^3/year
Actual annual volume rainwater: 52.5 m^3/year

Usable no potable water

For flushing toilets: 26.28 m^3/year

Explanation buffer volume and seasonal availability:

Monthly average rainfall: 83.71 mm (1004.5/12) = 43.138 m^3
Lowest monthly prediction (normal): 32.3 mm= 1.387 m^3
Monthly rainwater use flush fixtures: 26.28/12=2.19 m^3

Conclusion:

The volume non potable water is enough for the flushing fixtures during a month.



Figure 3.50 — *Principles of the rainwater container.*

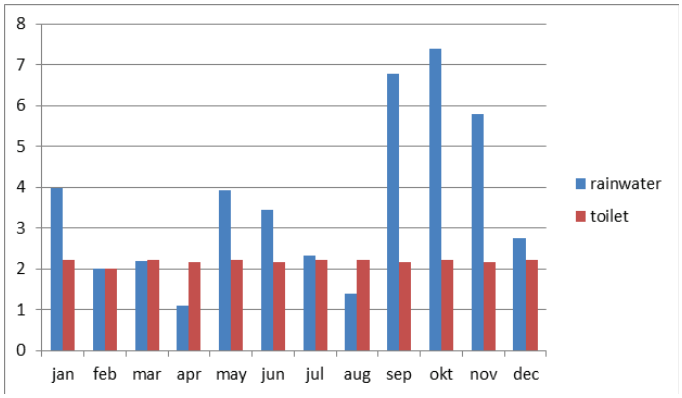


Figure 3.49 — *Monthly overview of rainwater and toilet water consumption (m3).*

Rain water tank requirement - for Delft situation

The annual rainwater demand is 26280 lt/year. To calculate the desired rain water capacity of the tank, it is taken as an assumption that the tank should be capable to hold the water of one month. Therefore the volume of the tank, taking into account the average raining days of 21 per month is 26280 * 21/365 =1512 lt.

Therefore the waste water tank is adequate to be used after the competition as a rain water tank. The pump needed for sending the water to the flash the toilets will be the reused fresh water pump of the competition.

When the water demand for flushing the toilets is higher than the rainfall collection, an automatic transfer switch to the drinking water without refilling the rainwater tank with the water of the system.

Finally the best month for maintenance the tank, depending on the less average monthly rainfall, which is in August.

3.4 Electrical System Design

3.4.1 Introduction

In this part of the deliverable, the electrical system of the Pret-a-Loger pavilion is going to be analyzed. For this reason, the design criteria of our design is going to be presented first. As it is already known, Pret-a-Loger is performing a renovation over an existing house. This existing house is located in Honselersdijk. It is a typical brick rowhouse. The renovation basically means that Pret-a-Loger team has to deal with an existing installation in terms of electrical design. Still, the main target is to improve the climatic and spatial performance of this existing house by a feasible solution while preserving its identity.

A special effort was made in order to preserve the electrical design of the house in Honselersdijk. Under normal circumstances, the skin would be applied over the existing house which can be translated into keeping the electrical design intact. This would be in line with the Pret-a-Loger moto “Improve your house, preserve your home”. Of course, the domotica system would still be installed over the existing installation since it strongly contributes into the sustainability of the renovated house.

3.4.2 Design Criteria

However, since a new prototype house needs to be built for demonstration purposes into the competition, the electrical altered the existing design. Still, the power and the light plan try to simulate the ones of the existing house but there are a couple of design criteria that lead to the alteration mentioned. First of all, this prototype house that will be used in Versailles is smaller and prefabricated. Apart that, the pavilion is going to be demountable since it will be deconstructed after the competition in Versailles and constructed back into The Netherlands. The addition of the domotica system is another aspect that lead to the variation of this electrical design compared to the original one. The final (and most important) design criteria that the electrical team had to face though was to make everything as simple as possible.

In order for the previously mentioned criteria to be fulfilled, a plug and play electrical installation will be used and the cables will be integrated into the skirting board mentioned in the structural design. This simplifies not only the installation but also the maintenance that may be needed since this skirting board can be removed and the cables (or any other elements) can be easily replaced.

3.4.3 Domotica System

In order to increase comfort of the residents as well as the energy efficiency of the house, a home automation system will be used. The name of this Domotica system is “Comfilux”. It will take inputs from temperature, lighting, moisture and CO2 sensors and send commands to receivers, motors, and valves, controlling this way the shading, lighting, heating - cooling and ventilation systems (HVAC) of the house.

In particular, lights will switch on/off depending on existing light intensity and whether there is movement in that specific area. Temperature readings from the inside and the outside of the house will determine whether cooling or heating is needed and open the corresponding systems to achieve the required level of comfort. The ventilation in the house will work likewise by using moisture and CO2 sensors as inputs.

Furthermore the system will be interactive with the user through applications on the cell

phone or the tablet, informing him on the current state of the house as well as giving him the freedom to make adjustments if he wants. It needs to be noted that the design of this system is only at the beginning and thus further details will need to be determined along the way.

3.4.4 Maintenance Plan

The maintenance model of the Pret-a-Loger pavilion is relatively simple due to the plug and play electrical installation. Starting by the replacement of the switches, the correspondent circuit breaker has to be switched off before replacing the switch or the wireless transmitter integrated onto it. Further actions may be required in the comfilux but it not relevant to the electrical maintenance plan.

If a light (or an RF receiver) has to be replaced, the corresponding circuit breaker has to be tripped off first in order to avoid electric shock during the replacement. It has to be noted here that in the unfortunate event of an electric shock actually happening due to poor preparation, the shock will not be lethal thanks to the 30mA RCD installed in the electrical box.

If a socket has to be replaced, the procedure is similar to the one required for the lights. The correspondent circuit breaker has to be tripped off before replacing the defective plug.

In case that an electrical appliance connected to a plug has to be replaced, the tripping off of the correspondent circuit breaker is not mandatory. Still, it can be performed as an additional security measure. The same applies for the comfilux system since it is going to be connected to a plug inside the electrical room, it will not have a dedicated power line for it. In case that the appliance is directly connected to the electrical box (such as oven, hot plates and boiler) then the tripping of the MCB before replacement is obligatory because the risk of an electric shock is very high in this case. Motors and pumps are included in this part as well.

If a part of the cables or a junction is defective, then its replacement is relatively easy thanks to the plug and play skirting board. The procedure is as follows: First, the corresponding MCB has to be tripped off. Then, the skirting board can be opened, the cable can be replaced. The skirting board is then closed and the MCB can be turned back on. In case the defective cable or junction is inside the shaft, it is suggested the new cable to be added from the first floor since it will easier for it to cross the shaft thanks to gravity. The opposite (insert the cable through the ground floor) will be more difficult.

Finally, if there is a defective element on the electrical box, the central isolator can be switched off, allowing replacement of the defective element (RCD, MCB etc) without worrying about electric shock. It is also suggested that additional MCB's RCD's and surge arresters are provided inside the monitoring room near the electrical box in order to minimize the replacement time.

3.4.5 System Design

Connection to the grid

The first part of the electrical design that is going to be presented is the grid interconnection, as it can be seen in the AC circuit. The main cable of 3G16mm^2 will be connected to the main electrical box provided by the competition. Its total length will be 20 meters, which is something reasonable dealing with the fact that the total distance is calculated

to be approximately 12 meters. This cable is also connected to the electrical box of the Pret-a-Loger pavilion. A central isolator switch will be used for two main reasons. The first one is the connection and disconnection of the house onto the grid, the second one is the maintenance that may be need by any of the components installed inside the electrical box (circuit breakers, RCD etc.). Additionally, a central miniature circuit breaker (MCB) and a residual current device (RCD) are going to be installed for protection reasons of our entire installation. Since the cable has a cross section of 16mm^2 the nominal power of the circuit breaker installed there has to be 63A. It has to be noted here that all the circuit breakers used in the AC side are 2-pole in order to cut off both the phase and the neutral in case that they trip.

The devices used are:

Isolator: **ABB E202/63R**. It has the following ratings: 3 Poles, rated operational current at 230 / 400 V AC (single pole): 63 A

MCB: **ABB S 201 NA-C63**. It has the following ratings: 2 Poles, 63A, 230VAC, Icu=10kA.

RCD: **ABB F202AS-63/0.3.** It has the following ratings: 2 Poles, 230 VAC, 63A, 300mA, type AS.

The residual current device (RCD) is used for protection of the house residents by leakage currents. This RCD is type AS which means it is both for DC and AC current while it has a slower response rate compared to the normal type A RCD.

As it can be seen here, the MCB used has is C type instead of the normal B type. The reason for that is that another 63A MCB is going to be installed at the start of the correspondent electrical line for the house load. If both of them were type B, they would both trip off in case that the current needed by the load exceeded 63A. This means that not only the house would not have electricity but the PV modules would be disconnected from the grid as well, leading to a loss of power flow to the grid without any defect taking place on the PV installation.

After that part, the installation is divided into two main sections. The first section is dedicated to the consumption of the pavilion (the electrical installation) while the second one is the PV installation for the production of the house. The PV installation includes both an AC and DC side.

Electrical Installation

The electrical installation is going to be presented here, it would be useful for someone to have the single line drawing while reading this part since it would be easier to understand that way. First, the central installation of the house includes a surge arrester, a RCD and a MCB. The surge arrester is used in order to protect the electrical installation from large transient overcurrents coming from the grid.
The selected device is **ABB OVR T1+2 25 255 TS**. It has the following ratings: 2 Poles, rated operational current at 230V AC.

The MCB is used for the magnetothermic protection of the installation. In case a higher current is been detected, the MCB trips, keeping the line and the elements connected to it safe from destruction.
The selected device is **ABB S 200 M-B**. It has the following ratings: 2 Poles, 63A, 230VAC.

The calculations for each of the lines of the electrical installation are going to be shown. The calculations are for the voltage drop of each separate line inside the house. Since

the electrical installation is a single phase one. The voltage drop is going to be calculated through the following equation:

$$\Delta V=(2*I*\rho*L)/S$$

Where:
ρ is the special resistivity of copper (0.0175 $\Omega mm^2/m$)
S is the cross section of the cable in mm^2
L is the length of the cable to the most distant element of the line in m.
I is the current flowing through the line.

For the current flowing, three different calculations are made according to the nature of the line:
If the line contains plugs, the current is 3A for each of the first 3 plugs and 0,5A for each additional (for example, if the line has 5 plugs the current is 3x3+2x0,5= 10A).
If the line contains lights, the current is 0,5A for each light included.
If the line contains an appliance or a pump, the current is equal to the power of the appliance divided by voltage and the result is multiplied by a safety factor 1,25 (I=1,25*P/V). Info regarding each appliance can be found in its corresponding chapter.

For the cables and circuit breakers used, the following rules are applied:
For a line that includes plugs, 3x2,5mm^2 cable and 16A MCB is used.
For a line that includes lights, 3x1,5mm^2 cable and 10A MCB is used.
For a line that includes appliances or pumps, 3x2,5mm^2 cable and 16A MCB is used.
For the oven line, 3x4mm^2 cable and 20A MCB is used.
For the line that includes the hot plates, 3x6mm^2 cable and a 25A MCB and is used.
For the cables that go to the window and shading motors, 4G1.5 cables are going to be used, the reason for that is to be able for the motors to turn both ways, something essential for the windows to open and close and for the shading system to go up or down through the roof.

Table 3.7 — *Voltage drop on each line*

The results are presented in the following table:

Line Name	I (A)	A (mm2)	p (Ωm-m2/m)	Most distant element (m)	Total line length (m)	DV (V)	Circuit Breaker
Sockets ground floor L	6,5	2,5	0,0175	15,05	17,45	1,36955	ABB S 200 M-B 2p 16A
Sockets ground floor R	7	2,5	0,0175	9,01	11,71	0,88298	ABB SN201 M-B 2p 16A
Sockets 1st floor	7,5	2,5	0,0175	14,9	25,25	1,5645	ABB SN201 M-B 2p 16A
Sockets electronics	6	2,5	0,0175	8,8	8,8	0,7392	ABB SN201 M-B 2p 16A
Lights ground floor	4	1,5	0,0175	8,8	28,45	0,7934	ABB SN201 M-B 2p 10A
Lights 1st floor	3	1,5	0,0175	13,6	30,59	0,952	ABB SN201 M-B 2p 10A
Lights external+2 kitchen spots	2,5	1,5	0,0175	14,6	28,39	0,8516	ABB SN201 M-B 2p 10A

Motors	0,9364	2,5	0,0175	10,54	14,76	0,14847	ABB S 200 M-D 2p 6A
Motors 2	10,265	2,5	0,0175	15,2	35,85	1,0922	ABB SN201 M-D 2p 16A
Boiler	13,58696	2,5	0,0175	2	2	0,38032	ABB SN201 M-B 2p 16A
Kitchen Hobs	20,1087	6	0,0175	7,44	7,44	0,87272	ABB S 200 M-B 2p 25A
Oven	19,83696	4	0,0175	7,44	7,44	1,29138	ABB S 200 M-B 2p 20A
Washing Machine	12,5	2,5	0,0175	1,67	1,67	0,29225	ABB SN201 M-B 2p 16A
Dryer	5,434783	2,5	0,0175	1,22	1,22	0,09283	ABB SN201 M-B 2p 16A
Dishwasher	13,04348	2,5	0,0175	11,24	11,24	2,05252	ABB SN201 M-B 2p 16A

Table 3.8 — *Motors line analysis*

A special remark has to be made at this part regarding the RCDs installed in the electrical system. As it can be seen in the single line drawing, instead of installing just one RCD, a total of four RCD's are going to be installed after the main load meters. In each RCD, three or four lines are going to be connected. This is a typical Dutch implementation that ensures maximum security while maintaining partial house functionality in case one of the RCD's trips. The RCD's used are: **ABB GS250S,** 2 pole, type A, 40A/30mA or 63A/30mA.
The current in the lines that include the pumps for the ventilation and water system, the motors for the shading system and the windows and finally, the electrical valves are calculated in the following table.

In the following tables it can be seen what electrical components are on each line and which MCB has to be used.
Only 6A MCB is used here, its type D MCB in order to avoid tripping when the pumps start consuming:

Table 3.9 — *Motors 2 line analysis*

Device	Power	Volt	Safety Factor	I
PCM Pump	11,1	230	1,25	0,060326087
Heat Exhanger (2 pumps)	22,2	230	1,25	0,120652174
Kitchen Hood	139	230	1,25	0,755434783
Valve motors (data to be acquired)				3x1=3
			SUM	3,936413041

It has to be noted here that since the data of the valve motors is not yet known, 1A current is chosen for each of them just for safety reasons since the current that such devices will need will be in the range of mA probably.
For the second line, a 16A D MCB is going to be used according to the following calculations:

Device	I
Fresh Water Pump	2,7
Window motors (2x)	1,2x2=2,4
Shading motors (3x)	1x3=3

SUM (with 1,25 safety factor)	10,265

By looking at the voltage drop table, it is noticeable that the voltage drop on each line is acceptable since it is less by 1% (2,3V). Thus, the cables chosen for those lines are the proper ones. Also the circuit breakers chosen are higher than the maximum current on each line.

All the installed circuit breakers are from the series **ABB S 200 M-B** with the exception of the motors MCB's which are **ABB S 200 M-D**. All of them are having breaking capacity of 10kA. They are both 2poles, 230 VAC while the rated current can be 10A, 16A, 20A and 25A depending on the line that they are installed as can be seen in the previous tables.

Table 3.10 — *cables used*

The total current of the installation is equal to 132,72A. Assuming a maximum of 45% use of the house's electrical installations, the current needed in that case is 0,45*132,72=59,724A. The 63A central MCB ABB S 200 M-B installed in this case is considered sufficient.

As can be seen in the single line drawing, there are two meters installed, one for the electrical appliances and one for the electronics inside the house. Before each of these meters, an additional circuit breaker is going to be installed, the reason is to be able to remove and install those meters without having to shut down the whole electrical installation. For the first meter (the appliance meter) a circuit breaker similar to the central MCB ABB S 200 M-B is used. For the electronics meter, a circuit breaker such the one used in this line is going to be installed as well. Apart the meters installed from the organization though, two meters will be installed by Pret-a-Loger in order to monitor the total consumption and the total production of the house and present them on the domotica monitor. The meters used are the ABB B21 112 100.

Additionally, a table regarding the tables used in the electrical installation is presented as well. The table is the following:

A (mm2)	Cable type
1,5	Draka NWPK Rubber Cable 4G1.5
1,5	Draka NWPK Rubber Cable 3G1.5
2,5	Draka NWPK Rubber cable 3G2.5
4	TKF YMvKmb 3G4
6	TKF YMvKmb 3G6
16	TKF Instalflex 3G16

Each cable has 3 wires in it: phase neutral and grounding (this is why it has 3G in its name). All the cables are having nominal voltage 450/750V. Its specific insulation resistance is greater than 20 GOhm x cm and it is made of copper. The total cable length for the AC electrical installation (including the 1,5m 3G6 cable that connects the inverter with the electrical box as can be seen in the PV design) is calculated equal to 233,76m. Those cables are placed throughout the house via 19mm2 channelings. All the conductors are drawn into conduits in that way. Those channelings are placed at the bottom of each wall near the floor. Exception are the wires that go to the kitchen hobs and the oven, those cables will be drawn across the living room under the floor. via bigger (32mm2) channelings The reason for that is that those cables are difficult to be drawn across the smaller channelings due to their big diameter.

Info is provided regarding the sucko sockets installed in the Pret-a-Loger pavilion. Busch

Jaeger USB socket outlets are the ones used. In order to provide children protection, baby proofing plastics can be used. A different socket is installed in the bathroom. This socket is a Gira which has an integrated children protection and residual current protection. It is also having IP 44 code which is compliant to the French standards. Also, its distance from the shower is 1,71 m, greater than the minimal distance of 60cm that is required as can be seen in the EL-301 drawing. Apart that, external sockets are also being installed in te Pret-a-Loger pavilion. The sockets installed in the front are of the house are used as bike chargers.

Regarding the distance of the bathroom switches from the shower, as can be seen in the EL-401 drawing it is sufficient. The distance is required to be greater than 60cm while the distance of the switches 11 and 12 from the shower is greater than 140cm.

A small note here is that one VOC and one CO2 meter are going to be installed. Those meters are placed upon two of the socket lines. They are not going to provide any negative effect upon those lines since the current required by them is a few mA.

A very important part of the installation is the grounding. As can be seen in the single line drawings, there is an equipotential bar where all the grounding cables from each line are connected. This central equipotential bar will be connected to the grounding provided by the competition. Apart that, metallic parts of the house like the radiators, the whole plumping system and the greenhouse are connected there as well. Additionally, an extra equipotential bar will be installed in the bathroom as well in order for the plumping and the radiator of that room to be grounded. This extra equipotential bar will be connected to the main equipotential bar through a 4mm2 copper wire.

Copper wires are going to be used for the grounding connection to the equipotential bar as can be seen in the EL-501 drawing. The choice of those copper wires is made based on standards. The following table include the diameter of the copper wires.

Table 3.11 — *copper wire diameter for grounding*

Grounding	Copper wire diameter [mm2]
Greenhouse	16
Plumping (including water supplies and shower)	4
Radiators	4
Electrical box	16
Connection between bathroom equipotential bar and the main equipotential bar	4

Datasheets for cables, MCB's, RCD's, surge arrester, isolator and sockets are included in the appendix XXX.

3.5 Photovoltaic systems design

3.5.1 Solar Photovoltaic System

General Description and Design Criteria

We, at Prêt-à-Loger, have embarked on the idea of using Building Integrated Photovoltaic (BIPV) system to power the house. The main criteria for selection of such a system is the fact that BIPVs combine efficiency, aesthetics and integration into an affordable package. The decision to utilize the BIPV is done in order to oversee installation on the house with requisite transparency, with the use of glass-glass modules, and optimum Watt-peaks (Wp) to ensure that the structure is at least energy neutral for domestic usage. Also, there is an incorporated cooling system attached below the modules to utilize some of the modules for heating water and in parallel improve their performance.

Since the theme of the design is to adapt to a Dutch row house, it would be desirable to customize the photovoltaic cells atop the glasshouse. The PV system installed ameliorates the natural lighting of the house as a factor of transparency is added to the modules as compared to conventional modules that have an almost opaque layer. Through this design, the preservation of the identity of the existing house but also the beautiful appearance of the new one is achieved.

Monocrystalline Silicon (mono c-Si) PV cells are used in the modules to ensure high efficiency, compact size and ease of integration into the skin. The panels are of two types on the solar roof. Transparency factors of the modules on the window and roof differ. Our system is integrated to the skin and not just added up as a layer on another layer. This will conclude to materials saving except from the improvement of aesthetics.

The PV modules are all connected with a 4mm2 to power optimizers to ensure Maximum Power Point Tracking (MPPT) and to obtain maximum yield from the panels. The Power Optimizers have a tracking and monitoring mechanism to ensure that the system can indicate the fault, error and condition of the panels connected on the rooftop. The power optimizers are connected in series with a 6mm2 cable to the inverter of the system.

The heart of the system is the inverter that is used to convert the DC output of the PV Strings to AC (230V, 50Hz, Single phase). The decision to choose the inverter has solely been based on a few important parameters like islanding protection, efficiency, reliability, monitoring, data-logging options and certifications.

The protection devices chosen are for the purpose of protecting the Personnel and Devices from Faults and surges of electrical parameters. The devices chosen are compliant to certifications mentioned by the competition dossiers. To ensure optimum protection for our devices like inverter and modules, it is necessary to position them at appropriate points in the single line diagram. The grounding system used is TT configuration. The specifics of the advantages of the topology are discussed in further sections.

As our concept represents the existing situation in Honselersdijk, Holland, our orientation is the original orientation of the house, with 138 degrees azimuth (42 from the south) and 21 degrees inclination (window PV modules - 23 degrees).

3.5.2 Photovoltaic System Design

Photovoltaic Modules

The Photovoltaic (PV) modules of the system are customized because flexibility in design The Photovoltaic (PV) modules of the system are customized because flexibility in design and mounting is desired. There are two different types of glass-glass modules, the roof module and the window module. The roof module consists of 48 mono c-Si solar cells and the window module of 42 mono c-Si silicon solar cells. On the roof there are 20 modules, while on the window there are 5 modules. Therefore, in the system 25 modules and namely 1170 cells are used in total. The PV modules are provided from DMEGC and they will be customized, suitable for our skin design. The edge boxes would have as an output, cable of 4mm2 cross section with an MC4 connector. The table below shows these values and it is significant to mention that the installed power will be equal to 4.875 kWp.

	P(Wp)	Imp(A)	Vmp(V)	Isc(A)	Voc(V)	Dim(mm)	A(m2)
Roof panel	200	8.14	24.6	8.61	30.3	1497 x 1183 x 8.8	1.771
Window panel	175	8.14	21.5	8.61	26.5	1388 x 1183 x 8.8	1.642

It is also important to note that modules are selected to be translucent in order to allow lighting to the house during the sunny hours of the day. The roof modules have 35% transparency with the window modules to have 38%. In addition, the PV system is integrated into the original design of the house for aesthetic reasons. Furthermore, the strategy of the PV system design is focused on increasing the energy efficiency. That is why, the cells present 19.2% efficiency, while the modules approximately 16.5%. Another important criterion, which was taken into account, was the compliance to the international standards. The selected modules have been constructed according to the required certificate EN 61215.

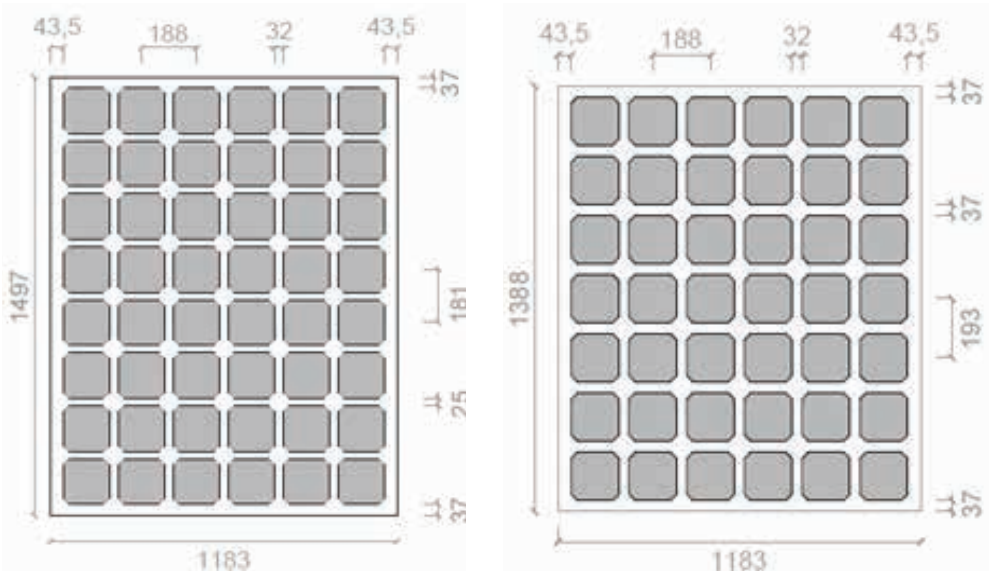


Figure 3.51 — *Different pv modules: roof module (left) and window module (right).*

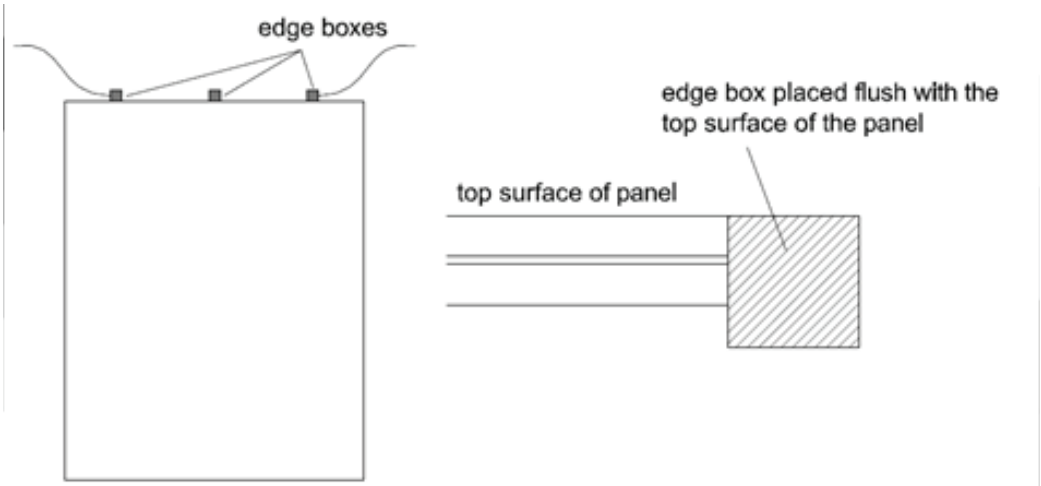


Figure 3.52 — *Edge boxes on both pv modules*

Power Optimizers

In order to optimize the performance of each module and to gain the maximum power available, a power optimizer is going to be installed in parallel to each PV module. So, in total 25 power optimizers connected in series are used. They are provided from the company Solaredge and the model is OP250. This type is compatible with c-Si modules. The power optimizer is a DC/DC converter which replaces the traditional solar junction box

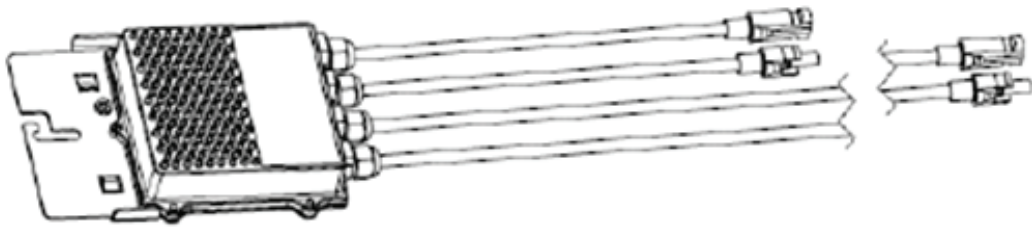


Figure 3.53 — *Sketch of a power optimizer.*

Another important advantage of the power optimizers is the fact that they enable the inverter to automatically maintain a fixed string voltage, at the optimal point for DC-AC conversion by the inverter, regardless of string length and individual module performance. Therefore, in the system it is possible to have 25 PV panels that produce Vmp = 599.5V and simultaneously an inverter with nominal DC input voltage 350V and maximum input voltage 500V. In other words, the power optimizers lower the module's output voltage and increase the current (up to a 15A limit). In the end, the string voltage will always be fixed at 350V. Another area of concern is safety, and power optimizers contribute significantly in this field as well. They start up in "safety 1V output" mode until the power optimizers are connected to a functioning Solaredge inverter. Additionally, in the event of a grid power shutdown, the modules immediately stop producing power and revert to this mode.

For the requirements of the PV system, one single-phase inverter of Solaredge, model SE5000, is selected. The DC power input of the inverter is 5,500 W and the rated AC power output is at the levels of 5,000W. The inverter is getting as nominal DC input voltage 350 V (maximum 500V) and as maximum input current 19.5 A. According to the compliance standards, the selected inverter complies with all the standards requested (DIN VDE 0126-1-1 and IEC 62109).

This type of inverter is specifically designed to work with power optimizers and it combines digital control technology with efficient power conversion architecture. In this way, it manages to achieve superior solar power harvesting and best-in-class reliability. The solar inverter, with the help of power optimizers, is maintained constantly at a fixed-voltage, as you can observe in the graph of simulation of competition days. This technology ensures that the inverter is always working at its optimal input voltage, regardless of the number of modules in a string or environmental conditions.

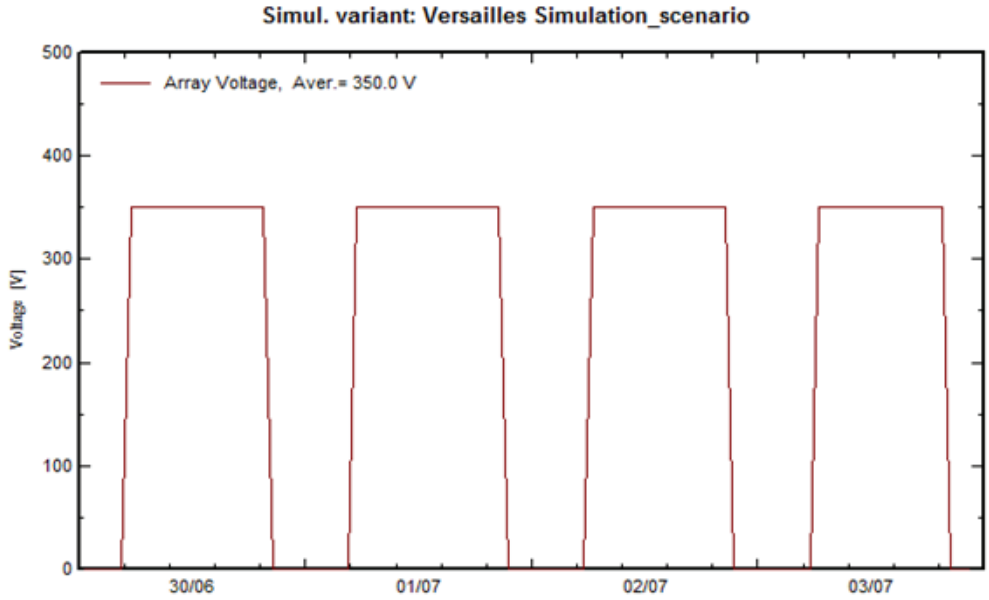


Fig. 87

Figure 3.54 — *FIxed voltage operation of inverter.*

Into the single phase solar inverter, a data monitoring receiver has been integrated in order to aggregate the power optimizer performance data from each PV module. This data can be used for performance analysis, fault detection and troubleshooting of PV system.

The selected inverter is lightweight, small and easy to install. These characteristics are important in order to simplify the installation process. The inverter is going to be located in the installation control room on the ground floor of the house. Finally, it is important to mention that it presents superior efficiency, higher than 97%.

Overview of PV system parameters and design

As it was mentioned above, the PV modules would be connected to the power optimizers, the power optimizers all in series with the inverter and then with an AC cable to the grid. The current that will flow from the modules to the optimizers according to PV modules table would be 8.5A and the current from the power optimizers to the inverter would be 4875W/350V = 13.92A. Under STC conditions inverter will provide us with 230V and 21.19A.

On the DC side, the PV modules are connected with 4mm2 cables to the power optimizers and then with 6mm2 to the inverter. The cables will be directed through the south-chimney to the monitoring room where there are the protection devices and the inverter. Furthermore, five grounding cables of 6mm2 will be connected from the inverter and the four surge arresters to the equipotential bar.

The total area of the PV modules on the skin is 43.63m2 where 35.42 m2 is the area of the roof modules and 8.21m2 is the area of the window modules.

Protection Devices

DC Side

Miniature Circuit Breaker

Using Miniature Circuit Breakers is a method of protecting the photovoltaic string as it detects fault conditions and interrupts the flow of current. It is always difficult to break DC as compared to AC as Alternating Current crosses the zero value two times in each cycle. DC as always assumed constant, will seldom drop to zero until full disconnection of the supply. An Arc is created when breaking DC under loaded conditions. Arc will break once sufficient resistance builds up which is vital. One way to achieve this is the series connection of contacts which will increase the air gap and suppress the arc without damages to the contacts. Switching capacity, contact life and higher operating voltages are obtained by this mechanism.

Selection of a circuit breaker with appropriate circuit protection includes consideration of:

- Circuit Voltage
- Circuit Frequency
- Available Short Circuit Current
- Continuous Current Rating
- Application Considerations

In order to select the device, following considerations are necessary:

- The cable from power optimizers to the inverter is 6mm2
- The maximum output current from the power optimizer is 15A and the power optimizers are connected in series.
- The maximum continuous current that can be supplied to the inverter SE5000 (SolarEdge) is 19.5A.
- According to the Manufacturer, Solaredge, from which the inverter and the power optimizers are provided, the Miniature Circuit Breaker should be rated at 20A.
- According to these requirements, the selected device is ABB S802PV-S16. It has the following ratings: 2 Poles, 16A, 800VDC

This device is necessary because it protects our system from overvoltage generated by lightning and varying atmospheric conditions.
Surge Arrester rating most appropriate for a particular application is calculated using system stresses to which the arrester is expected to be exposed, relative to its capability in each of the following categories:

- Continuous system voltage
- Temporary overvoltage
- Switching surges
- Lightning surges

The arrester is selected with sufficient capability to endure the anticipated requirements in all categories. In order to select the device for our purpose, the following considerations are necessary:

- The maximum continuous operating voltage (Vc) has to be larger than the product of 1.25 x Voc, where Voc is the open circuit voltage of the photovoltaic string. In our case Voc = 738.5 V, so by calculation it should be Vc > 923.12 V.

- The rated flashover current should be greater than 5kA.

According to these requirements, the selected device is *ABB OVR PV 40-1000 P.* It has the following ratings: 3 Poles, maximum continuous operating voltage: 1000V, nominal flashover current: 20kA.

Isolator

This device is used in order to de-energise the electrical circuit completely for service or maintenance. In order to select the device, we had to satisfy the same requirements as that of the circuit breaker.

The significant factors that are looked up to for selecting the DC Side Isolator.

- Current ratings

Maximum continuous current of the switch should be greater than the product of Isc (Short Circuit current) and a correction factor of 1.25. In our case, the current is 13.92A. Hence, after the multiplying with the factor, it is around 17.4A.

- Voltage ratings

Maximum continuous voltage of the switch should be greater than the product of Voc (Open circuit voltages) of the panel, Number of panels and a correction factors of 1.

- Average ambient temperature at positions where the switch-disconnec

tor are going to be positioned.

- Size of the cables

The selected device is *ABB OTDC16F3*. It has the following ratings: 3 Poles, rated operational current at 1000V: 16 A

AC Side

Isolator

AC Side Isolators functions as a switch with the establishment of a protection device (MCB) and are therefore used for breaking load currents up to their rated normal current.The design rules for selection of an AC isolator are similar to that of a DC isolator, but it is an AC power supply we are dealing with. However, breaking AC current is much easier.
The criteria considered for selection of our devices are:

- Current ratings

Maximum continuous current of the switch should be greater than the product of Isc (Short Circuit current) and a correction factor of 1.5. In our case, the current is 21.19A. Hence, after the multiplying with the factor, it is around 31.785A.

- Voltage ratings

Maximum continuous voltage of the switch should be greater than the open circuit voltage of the inverter.

- Average ambient temperature

At positions where the switch-disconnector are going to be positioned.

The selected device is *ABB E202/63R*. It has the following ratings: 3 Poles, rated operational current at 230 / 400 V AC (single pole): 63 A.

Surge Arrester

We use the surge arrester for Impulse withstand voltage of 2.5 kV that is type 2 standard for all domestic appliances. The selection of the surge arrester is dependent upon the maximum phase-to-ground voltage at the point of connection. In our case, it is 230V Ac.

The selected device is *ABB OVR T1+2 25 255 TS*. It has a nominal voltage of 230 V AC.

Miniature Circuit Breaker

The maximum continuous current that can be supplied from the inverter SE5000 (SolarEdge) is 27A. Therefore, it is important to choose the MCB with a value less than 27A AC. According to these requirements, the selected device is ABB S 200 M-B. It has the following ratings: 2 Poles, 25A, 230VAC.

Residual Current Detectors

Residual current devices are installed for the protection of personnel and the electrical installations from fault current to earth and fire hazards. The selected device is ABB GS252S - C63. It has the following ratings: 2 Poles, rated current 63 A, rated voltage 230/400 V and a residual current rating of 30mA.

Electrical cables in the system can be divided into 4 different sections:

- Connection between the modules and the power optimizers (DC)
- Interconnection of all power optimizers and their series connection to the in verter (DC)
- Connection from the inverter to the grid (AC)
- Grounding cables

Selection criteria for cables for wiring our system are:

- Application
- Nominal voltage and Current
- Environment of usage
- Way of laying
- Standards and approbations

DC part

Connection between the modules and the power optimizers

The MC4 connector in the PV Modules enables us to connect to the power optimizers with a 4mm2 cable. The current rating of the cable is limited such that the amperage of the cables is not exceeded. The cables selected for the purpose are TKF YMvKmb 3G6. These cables are selected for the following reasons:

- Small outer diameters
- Less flame propagation and Toxic combustion gases during conditions of fire.
- Robustness against mechanical impacts and external shocks;
- Reverse polarity protection during installation

The maximum input ratings of the power optimizer are 250W and a current of 10A. Hence a 4mm2 cable is connected from the Module to the power optimizer.

Interconnection between the power optimizers and connection to the inverter

All the power optimizers connected to individual panels are connected in series through a 6mm2 cable and the current through the cable is around 13.92A (fixed 350V). The MC4 connectors of the end PV modules of the string are connected to a MC4 connector and then connected to the inverter. The idea behind this connection is to ensure the wire losses are reduced by the installation of the 6mm2 cable as it has lesser losses and resistance as compared to 4mm2.

The estimated cable voltage drop of the cables on the DC Side before connecting to the Inverter is around 1.8V and the length of the cable calculated is around 44.8m.

AC Side

Connection between the Inverter and the grid

On the AC side, we use TKF YMvKmb 3G6 cables, selected by the same criteria as that done for the DC side. However, these cables are available with an option for ground connection which makes the installation much simpler.

The inverter outputs are usually Phase, Neutral and Ground, as we are feeding a single phase grid. The current rating of the Inverter output is around 21.19A (AC). The cable length is around m and the cable is chosen to be 6mm2. Electrical conduits are used to provide protection to enclosed conductors from impact, moisture, and chemical vapors.

Grounding cables

For grounding cables that are going to be connected to the equipotential bar, the cross section is 6mm2. For the grounding of the DC side surge arresters the same cable (6mm2) as that one which is used for the connection of power optimizers with the inverter. On AC side, the three cables (inverter – surge arresters) would be identical.

Lengths of the cables

The cables chosen are made of copper and the resistivity factor ρ is 0.0225 In the following table you can find information about the cable lengths from the modules until the power optimizers (both output 4mm2 cables).

Each R for roof modules and W for window modules:

R1/R4/R7/ R10	R/R5/R8/ R11	R3/R6/R9/ R12	W1/ W5	R13/R15/R17/ R19	R14/R16/ R18/R20
4.1m	2.42m	3.14m	1m	2.47m	1.76m

The length of the DC cables that connect the power optimizers with the inverter and the AC side are presented to the table below (6mm2 on both sides), total DC side length 43.3m.

DC - 6mm2 until chimney	DC - 6mm2 chimney until monitoring room	AC – 6mm2 to the grid
18.6m	24.7m	1.5m

Calculation of Voltage drop

For the calculation of the Voltage Drop on the cables we have used the specific formulas:

$$R = \rho * (L/A)$$
$$\Delta V = IR$$

where,
R is the resistance of the cable
ρ is the electrical resistivity factor
L is the total length of the cable
A is the cross section in mm2

The voltage drop on DC side will be calculated between the power optimizers and the inverter. The total resistance of the 6mm2 cable on DC side is 0.13Ω and the voltage is 350V fixed with the current under STC to be 13.92A. On the AC side the current is 21.19A and the voltage is 230V.

Voltage Drop on DC side	Voltage drop on AC side
2.26%	0.11%

In details A and B you can find the way that the 4mm2 to 6mm2 cables are going to be connected with the power optimizer via MC4 connector. Below is also presented the scheme of how the connection of the cables on the roof will take place. The brown cables are 6mm2, the red is the positive and the black is the negative cable, both 4mm2.

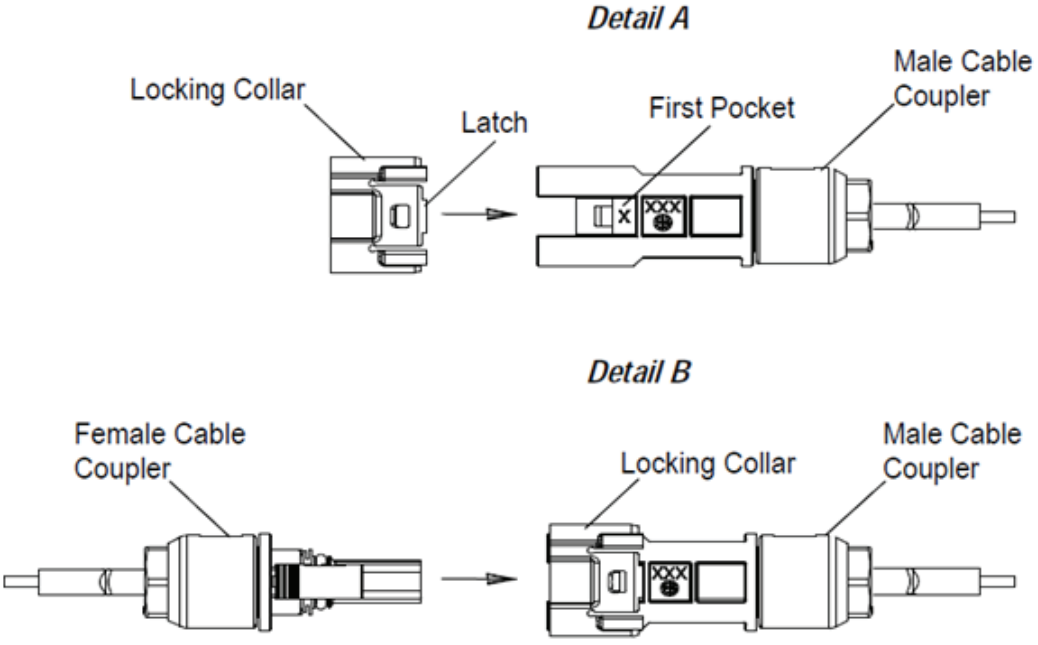


Fig. 88

Figure 3.55 — *MC4 connectors*

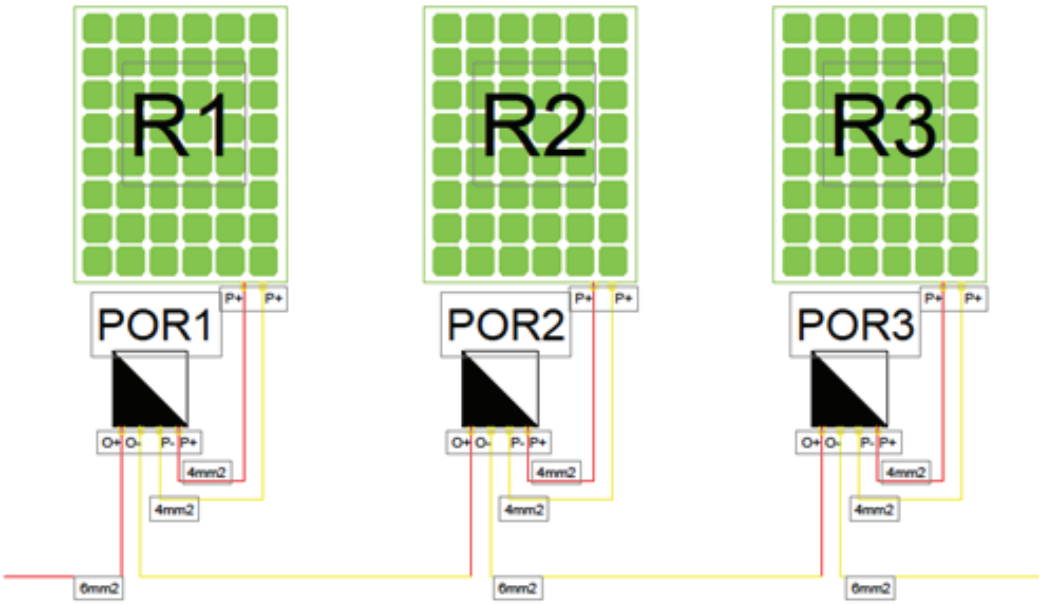


Fig. 89

Figure 3.56 — *Connection of pv modules with power optimizers*

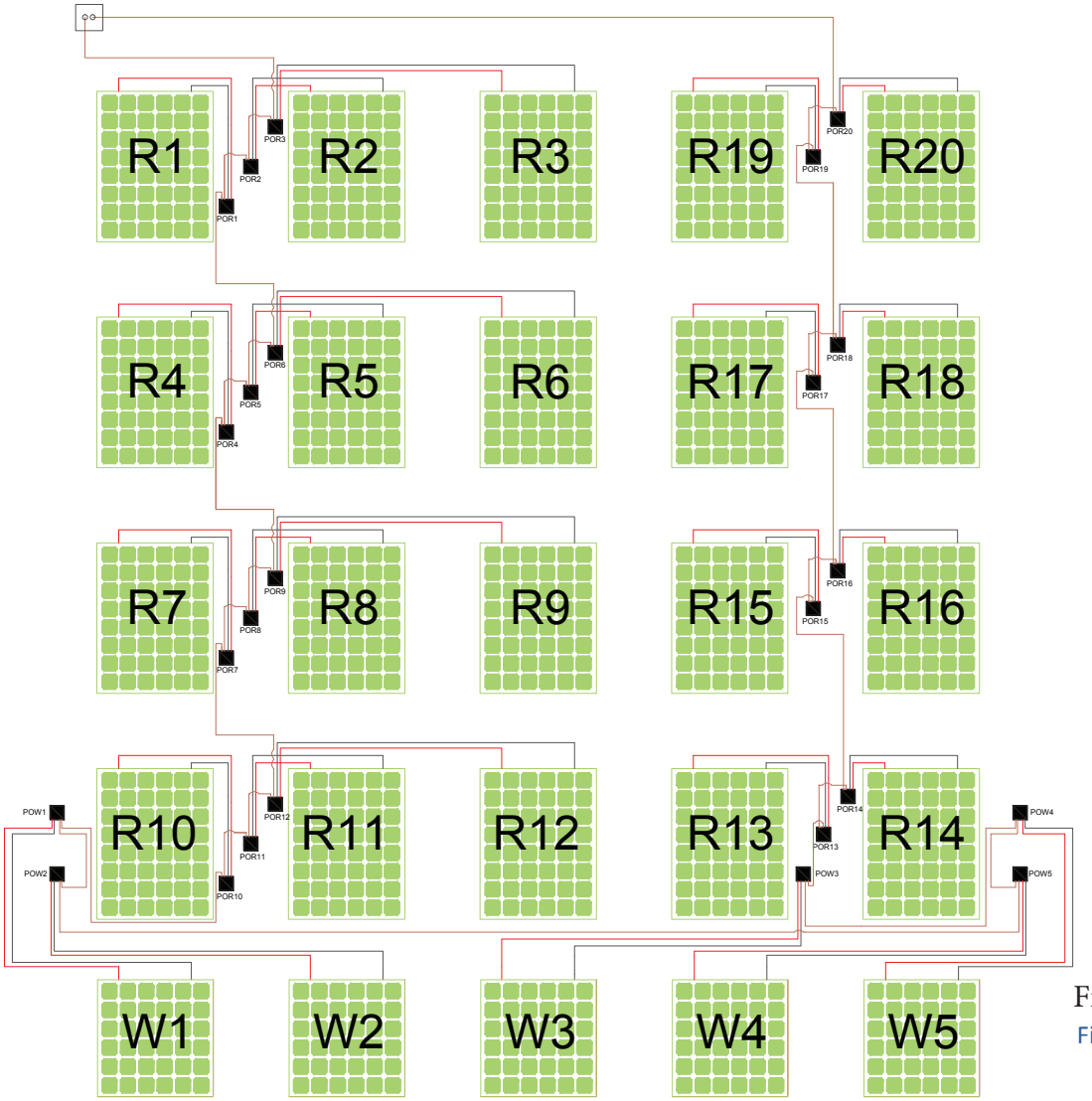


Fig. 90

Figure 3.57 — *Roof cables connections.*

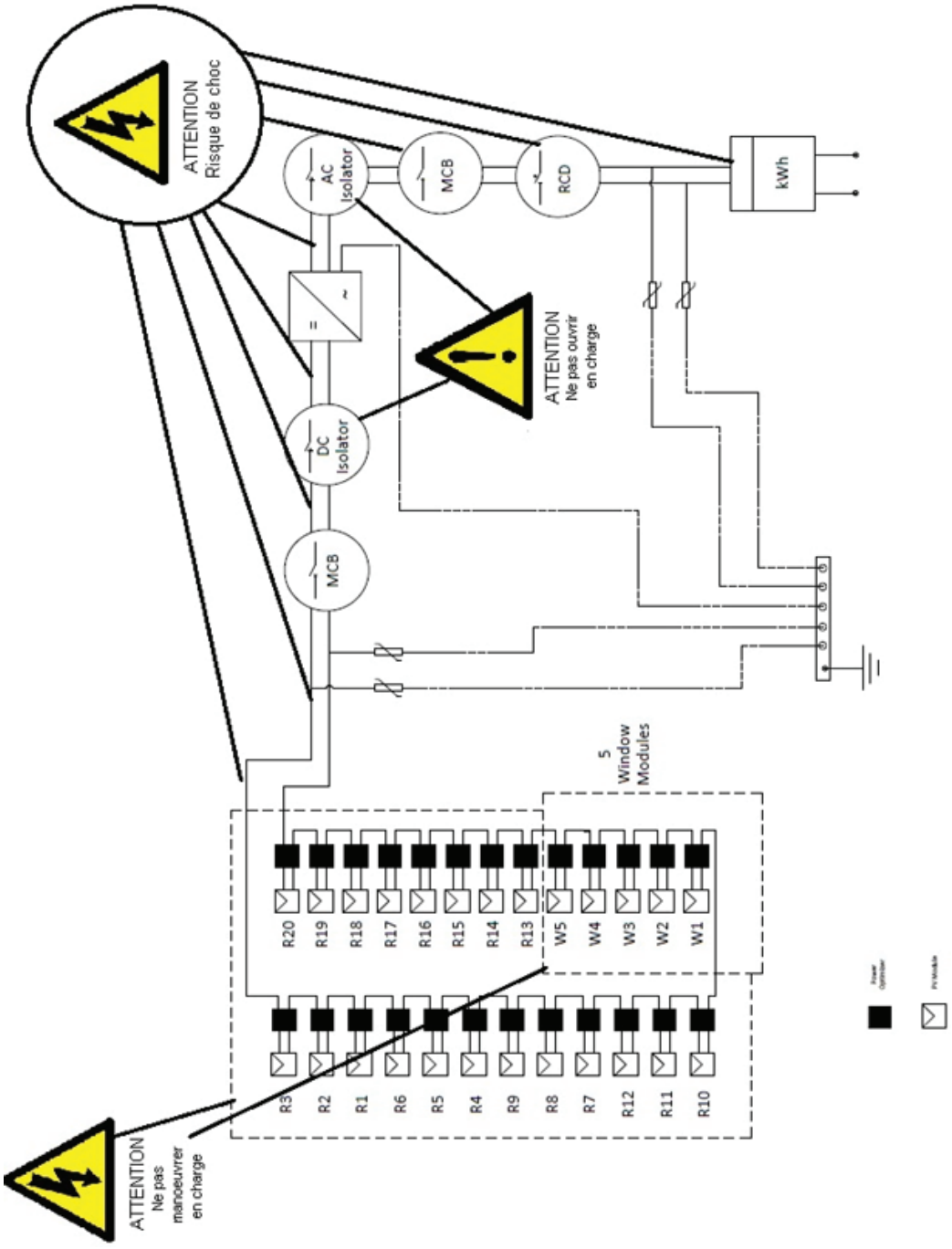


Fig. 91

Figure 3.58 — *Collocation of pictograms*

Payback time analysis

Photovoltaics produce electricity without emitting pollution and greenhouse gasses. That is why they are considered to be a sustainable solution for energy production. However, this does not mean that they do not need some energy in order to be produced. In the production of monocrystalline silicon cells, large wafers of purified silicon are used. The most energy intensive part is the process of purifying and crystallizing the silicon. In addition, other aspects of producing the modules need an amount of energy as well. A PV system has to operate a particular period of time in order to recover this total amount of energy. This period of time is called energy payback time and it depends on the geographical location. PV systems in Northern Europe, and so also in the Netherlands, need around 2.5 years to balance the energy that was used for their production [1].

It is not possible to know the exact amount of energy that the production of the modules requires, because the modules will be manufactured handmade and the company has not completed their production yet. Therefore, the energy payback time analysis is not possible to be carried out.

Monitoring

It is important to monitor the whole system so as to be able to detect any defects and to apply a quick solution. That is why the selected power optimizers and the selected inverter provide this possibility. There are 25 power optimizers, each of them responsible for one module, and they monitor the performance of each module. This performance data is available through the Solaredge monitoring portal. Furthermore, in case of abnormal conditions (inverter or grid power is shut down) each power optimizer shuts down modules' DC voltage, providing high level of security.

In addition, a data monitoring receiver has been integrated into the selected Solaredge inverter and gathers the power optimizer performance data from each PV module. This data is also transmitted to the web and is available via the Solaredge monitoring portal. In this way, it is possible to acquire all the necessary data for performance analysis, fault detection and troubleshooting of the PV system. Therefore, the efficiency of the whole system can be constantly evaluated. Finally, this integrated monitoring system offers an increased security for people and for the equipment as well.

Figure 3.59 — *[1]: "Fraunhofer institute for solar energy systems ISE" (2013) Retrieved on (02/03/2014) from (http://www.ise.fraunhofer.de/de/downloads/pdf-files/aktuelles/photovoltaics-report-in-englischer-sprache.pdf)*

3.5.3 Maintenance

The PV modules have the strong advantage that they do not need extended maintenance. Wiping, brushing or spraying the module with water is simple and enough. So, the main task is to maintain the PV panels clean. Dust, dirt, pollen, leaves and other debris might be collected on the surface of the module and this can lead to low performance. In the design, the gutters that exist on the top of the skin lead the water away, and as a result we have less concentration of these substances on modules. Furthermore, snow or ice should not cover the surface of the modules for a long time.

The modules in the system can be cleaned easily with water and a brush. For this reason, a steady ladder is needed. In addition, attention should be paid regarding the time when the modules are cleaned. They should be cleaned when they are not very hot, so early in the morning is a good choice. Natural cleaning by rain water is also possible, because of the high raining frequency in the Netherlands. Therefore cleaning is mainly necessary during long dry periods. However, a yearly cleaning in the spring is desirable and sufficient. After the cleaning, a visual inspection, under conditions of high safety, can be carried out in order to detect any defects of the modules such as broken glass.
Solaredge inverter gives us the possibility to replace a faulty module with a new one with different characteristics without disturbing the balance of the system. As mentioned before, the power optimizers monitor the performance of each module separately and track possible fault conditions. In this way enhanced and cost-effective module-level maintenance can be achieved. Furthermore, it is significant to note that the Solaredge ensures 25 year warranty for the power optimizers and 12 year warranty for the inverter (extendable to 20 or 25 years).

It is also important to have spare protection devices such as circuit breakers in the control box. In this way, if after the inspection, a device has to be replaced, then this can be done quickly. So you minimize the system's downtime.

3.5.4 Certificates and Data Sheets (more details at Appendix 14.2.2)

Power Optimizers Data Sheets and Compliance with Standards

SolarEdge Power Optimizer Module Add-On

OP250-LV / OP300-MV / OP400-MV / OP400-EV

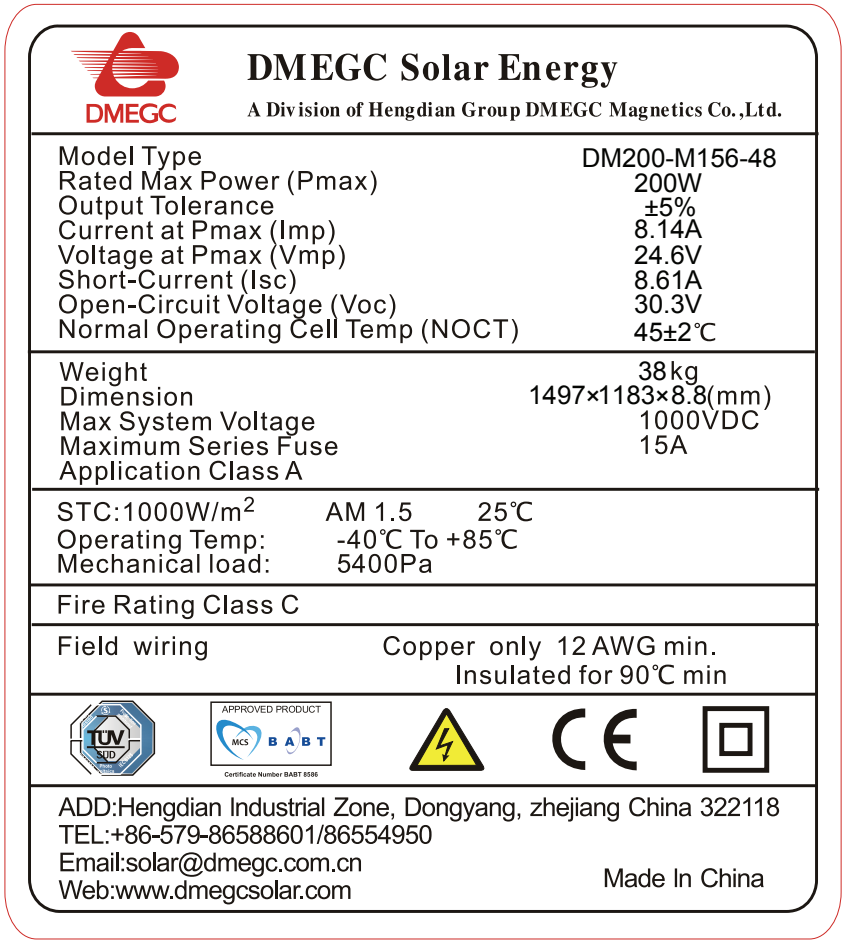
	OP250-LV	OP300-MV	OP400-MV	OP400-EV	
INPUT					
Rated Input DC Power*	250	300	400	400	W
Absolute Maximum Input Voltage (Voc)	55	75	75	125	Vdc
MPPT Operating Range	5 - 55	5 - 75	5 - 75	15 - 125	Vdc
Maximum Continuous Input Current (Isc)	10	10	10	7	Adc
Maximum Efficiency	99.5				%
Weighted Efficiency	98.8				%
Overvoltage Category	II				
OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING INVERTER)					
Maximum Output Current	15				Adc
Operating Output Voltage	5 - 60				Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM INVERTER OR INVERTER OFF)					
Safety Output Voltage per Power Optimizer	1				Vdc
STANDARD COMPLIANCE					
EMC	FCC Part15 Class B, IEC61000-6-2, IEC61000-6-3				
Safety	IEC62109-1 (class II safety), UL1741				
Material	UL-94 (5-VA), UV Resistant				
RoHS	Yes				
INSTALLATION SPECIFICATIONS					
Maximum Allowed System Voltage	1000				Vdc
Dimensions (W x L x H)	143 x 210 x 45 / 5.63 x 8.26 x 1.75				mm / in
Weight	450 / 1.0				gr / lb
Input Connector	MC4 / Tyco / H+S / Amphenol				
Output Wire Type	6mm²; MC4				
Output Wire Length	0.95 / 3.0		1.2 / 3.9	1.6 / 5.25	m / ft
Operating Temperature Range	-40 - +65 / -40 - +150				˚C / ˚F
Protection Rating	IP65 / NEMA4				
Relative Humidity	0 - 100				%

* Rated STC power of the module. Module of up to +5% power tolerance allowed.

PV SYSTEM DESIGN USING A SOLAREDGE INVERTER	SINGLE PHASE	THREE PHASE	
Minimum String Length (Power Optimizers)	8	16	
Maximum String Length (Power Optimizers)	25	50	
Maximum Power per String	5250	11250	W
Parallel Strings of Different Lengths or Orientations	Yes		

CE

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DMEGC Solar Energy

A Division of Hengdian Group DMEGC Magnetics Co.,Ltd.

Model Type	DM200-M156-48
Rated Max Power (Pmax)	200W
Output Tolerance	±5%
Current at Pmax (Imp)	8.14A
Voltage at Pmax (Vmp)	24.6V
Short-Current (Isc)	8.61A
Open-Circuit Voltage (Voc)	30.3V
Normal Operating Cell Temp (NOCT)	45±2℃
Weight	38kg
Dimension	1497×1183×8.8(mm)
Max System Voltage	1000VDC
Maximum Series Fuse	15A
Application Class A	

STC:1000W/m^2 AM 1.5 25℃
Operating Temp: -40℃ To +85℃
Mechanical load: 5400Pa

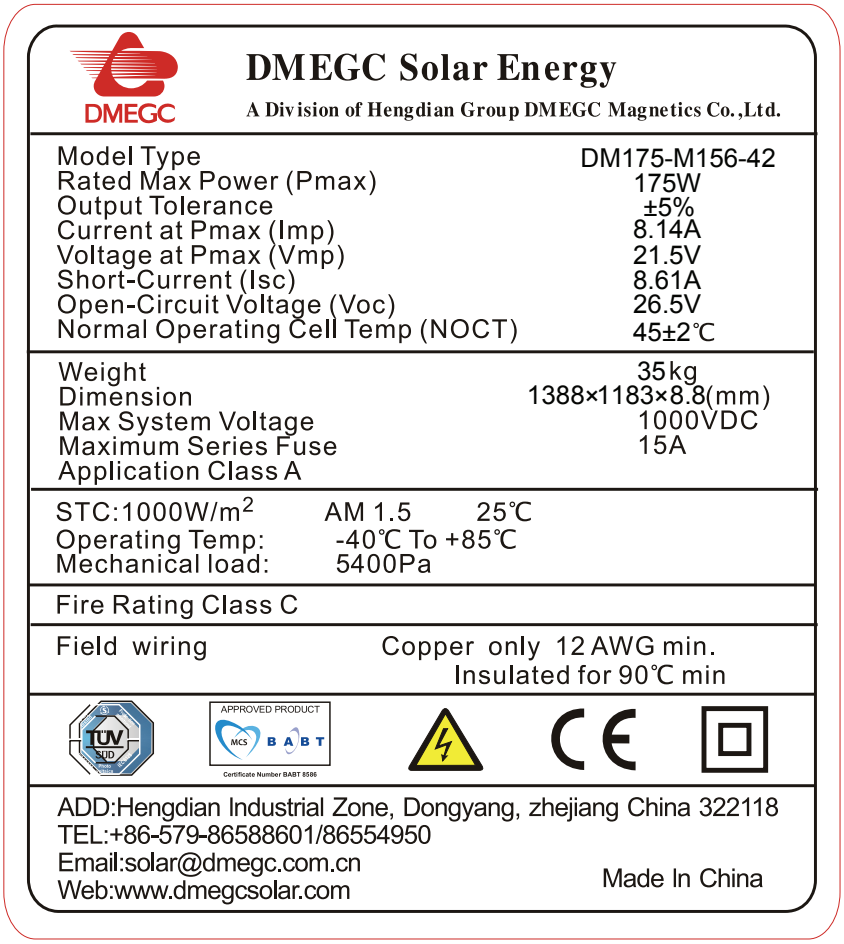
Fire Rating Class C

Field wiring: Copper only 12 AWG min. Insulated for 90℃ min

APPROVED PRODUCT MCS BABT Certificate Number BABT 8586

ADD:Hengdian Industrial Zone, Dongyang, zhejiang China 322118
TEL:+86-579-86588601/86554950
Email:solar@dmegc.com.cn
Web:www.dmegcsolar.com

Made In China



DMEGC Solar Energy

A Division of Hengdian Group DMEGC Magnetics Co.,Ltd.

Model Type	DM175-M156-42
Rated Max Power (Pmax)	175W
Output Tolerance	±5%
Current at Pmax (Imp)	8.14A
Voltage at Pmax (Vmp)	21.5V
Short-Current (Isc)	8.61A
Open-Circuit Voltage (Voc)	26.5V
Normal Operating Cell Temp (NOCT)	45±2℃
Weight	35kg
Dimension	1388×1183×8.8(mm)
Max System Voltage	1000VDC
Maximum Series Fuse	15A
Application Class A	

STC:1000W/m^2 AM 1.5 25℃
Operating Temp: -40℃ To +85℃
Mechanical load: 5400Pa

Fire Rating Class C

Field wiring: Copper only 12 AWG min. Insulated for 90℃ min

APPROVED PRODUCT MCS BABT Certificate Number BABT 8586

ADD:Hengdian Industrial Zone, Dongyang, zhejiang China 322118
TEL:+86-579-86588601/86554950
Email:solar@dmegc.com.cn
Web:www.dmegcsolar.com

Made In China

Hengdian Group DMEGC Magnetics Co., Ltd

Hengdian Industrial Area

Dongyang，Zhejiang 322118

P. R. China

TEL: +86 579 8658 8825

FAX: +86 579 8655 4845

Date: Mar.03, 2014

Subject: Declaration of Conformity

To whom it may concern,

As the manufacturer of the Photovoltaic modules, We Hengdian Group DMEGC Magnetics Co., Ltd hereby declare that our below produced Photovoltaic modules:

Double Glass Module M156-48
Double Glass Module M156-42

are complying with EN 61215: 2005.

Should you have any questions, pls. let us know.

Yours faithfully,

Hengdian Group DMEGC Magnetics Co., Ltd

ABB

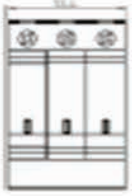
Surge Protective Device
Parafoudre

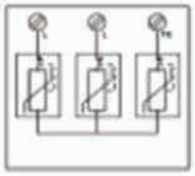
Type : **OVR PV 40-1000 P**
Part : 2CTB803953R6400
EAN : 3 600 308 516534
FR : 395384

Pluggable Unit
Produit débrochable









Electrical characteristics
Caractéristiques électriques

Type of networks *Régime de réseau*		
Type / test class *type / classe*		
Number of poles / type of current *nombre de pôles / type de courant*		
Protection mode *type de protection*		
Short circuit current backup *courant de court circuit associé*	A	
Maximal continuous operating voltage Uc(pv) *tension maximale permanente Uc (pv)*	V	
Voltage protection level Up at In (L1 / L+) ± 5% *niveau de protection en tension Up à In (L1 / L+)*	kV	
Nominal discharge current In (8/20) *courant nominal de décharge In (8/20)*	kA	
Maximal discharge current Imax (8/20) *courant maximal de décharge Imax (8/20)*	kA	
Operating current Ic *courant de fonctionnement Ic*	mA	
Response time *temps de réponse*	ns	
Follow current If *courant de suite*	A	
Integrated thermal disconnector *déconnecteur thermique intégré*		
State indicator *indicateur d'état*		
Safety sealing *scellement sécurité*		
TS remote indicator *télésignalisation à distance*		
Disconnector* *Protection contre les surintensités à monter en amont**		
Curve B or C Circuit breaker *disjoncteur courbe B ou C*	A	
gG - gL fuse *fusible gG - gL*	A	

*Including a 10kA, disconnector rated at 10kA or

Mechanical characteristics
Caractéristiques mécaniques

Wire range (L/+) : Solid wire *section des conducteurs (L/+) : rigide*	mm²	
Wire range (L/+) : Stranded wire *section des conducteurs (L/+) : souple*	mm²	
Stripping length (L/+) *longueur de dénudage des conducteurs (L/+)*	mm	
Tightening torque (L/+) *couple de serrage des cornes (L/+)*	Nm	
Wire range (PE) : Solid wire *section des conducteurs (PE) : rigide*	mm²	
Wire range (PE) : Stranded wire *section des conducteurs (PE) : souple*	mm²	
Stripping length (PE) *longueur de dénudage des conducteurs (PE)*	mm	
Tightening torque (PE) *couple de serrage des cornes (PE)*	Nm	
Degree of pole-door *indice de protection*		

TS remote indicator
télésignalisation (TS)

Contact complement *type de contact*		
Minimal load *charge mini*		
Maximal load *charge maxi*		
Connection cross section *section des connexions*	mm²	

Miscellaneous characteristics
Caractéristiques diverses

Stocking temperature / Operating temperature *température de stockage / température de fonctionnement*	°C	
Maximal altitude *Altitude max*	m	
Weight *poids*	g	
Compliance to *conforme à*		
Reference standards *normes de référence*		

Replacement cartridges
Cartouches de remplacement

Phase / Product ID *Phase / code produit*	
Neutral / Product ID *Neutre / code produit*	

Miniature circuit-breakers
S800 PV-S



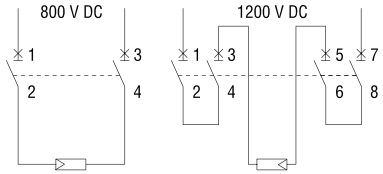
S800 PV-S miniature circuit-breakers can be used in networks up to 1200 V d.c. (four-pole version). These products and their vast range of accessories (auxiliary contacts, release coils) can be used to create countless system configurations. The main features of S800 PV-S circuit-breakers are:

- interchangeable terminals
- fault signalling lever in the central position
- contact status displayed for each individual pole
- no restrictions as to polarity or power direction in the wiring
- use of the rotary door operating handle

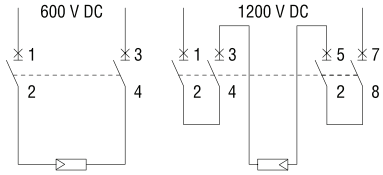
Main technical specifications		S800 PV-S	
Reference Standards		IEC EN 60947-2	
Rated current In	[A]	10…80	100, 125
Number of poles		2, 4	
Rated voltage Ue			
(d.c.) 2 poles*	[V]	800	1200
(d.c.) 4 poles*	[V]	600	1200
Ultimate rated short-circuit breaking capacity Icu			
(d.c.) 600/800 V (2 poles) *	[kA]	5	5
(d.c.) 1200 V (4 poles) *	[kA]	5	5
Thermomagnetic release characteristic		4 In ≤ Im ≤ 7 In	
Class of use		A	
Operating temperature	[°C]	-25…+60	
Mounting		on EN 60715 channel (35 mm) with a quick coupling device	

Please refer to wiring diagrams*

≥ 80A



≥ 100, 125A

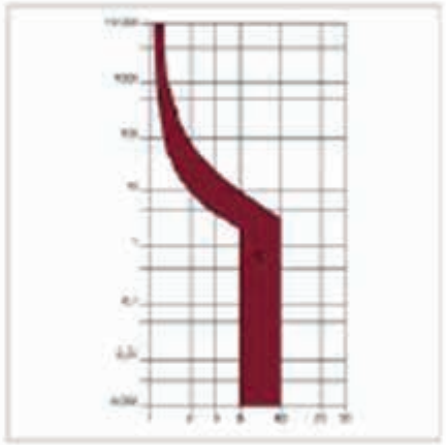


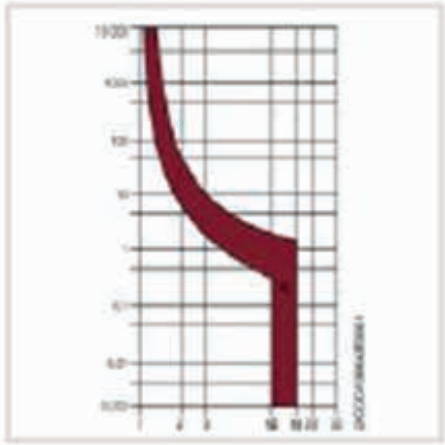
Connection
Photovoltaic panel network
in earth-insulated systems

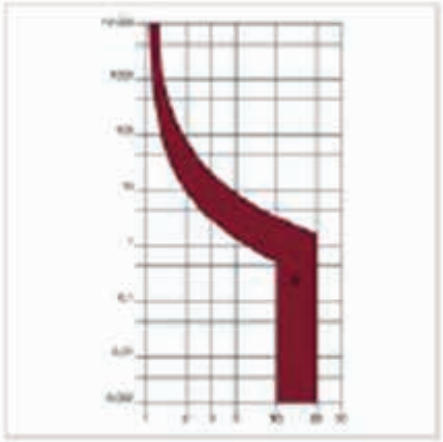
Poles	Rated current In [A]	Description Type	Order code
2	10	S802PV-S10	2CCP842001R1109
2	13	S802PV-S13	2CCP842001R1139
2	16	S802PV-S16	2CCP842001R1169
2	20	S802PV-S20	2CCP842001R1209
2	25	S802PV-S25	2CCP842001R1259
2	32	S802PV-S32	2CCP842001R1329
2	40	S802PV-S40	2CCP842001R1409
2	50	S802PV-S50	2CCP842001R1509
2	63	S802PV-S63	2CCP842001R1639
2	80	S802PV-S80	2CCP842001R1809
2	100	S802PV-S100	2CCP842001R1829
2	125	S802PV-S125	2CCP842001R1849
4	10	S804PV-S10	2CCP844001R1109
4	13	S804PV-S13	2CCP844001R1139
4	16	S804PV-S16	2CCP844001R1169
4	20	S804PV-S20	2CCP844001R1209
4	25	S804PV-S25	2CCP844001R1259
4	32	S804PV-S32	2CCP844001R1329
4	40	S804PV-S40	2CCP844001R1409
4	50	S804PV-S50	2CCP844001R1509
4	63	S804PV-S63	2CCP844001R1639
4	80	S804PV-S80	2CCP844001R1809
4	100	S804PV-S100	2CCP844001R1829
4	125	S804PV-S125	2CCP844001R1849

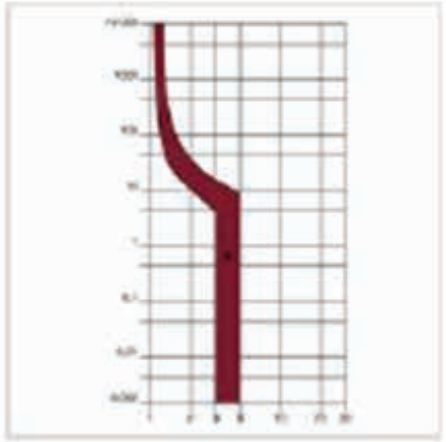
Declaration of Conformity - CE: 2CCC413009D0201













OTDC16F3

General Information

Extended Product Type:	OTDC16F3
Product ID:	1SCA121457R1001
EAN:	6417019526126
Catalog Description:	OTDC16F3 Switch-disconnector
Long Description:	Types OTDC16...32 include protected terminal clamps, IP 20. Shafts and handles need to be ordered separately. The type and the ordering numbers are for one piece.

Categories

Products » Low Voltage Products and Systems » Switches » Switch Disconnectors

Ordering

EAN:	6417019526126
Minimum Order Quantity:	1 piece
Customs Tariff Number:	85365080

Dimensions

Product Net Width:	52.5 mm
Product Net Height:	89 mm
Product Net Depth:	78 mm
Product Net Weight:	0.18 kg

Container Information

Package Level 1 Units:	1 piece
Package Level 1 Width:	64 mm
Package Level 1 Height:	100 mm
Package Level 1 Length:	100 mm
Package Level 1 Gross Weight:	0.2 kg

Environmental

RoHS Status:	Planned to follow EU Directive 2002/95/EC August 18, 2005 and amendment after 2009 Q3

Additional Information

Cable Cross-Section:	2.5...16 mm²
Conventional Free-air Thermal Current (I_{th}):	θ=40°C 25 A
Conventional Thermal Current (I_{the}):	Fully Enclosed 25 A
IIT Publishing Status:	Level 0 - Information enabled
Number of Poles:	3
Operating Mechanism:	Mechanism on top of the switch
Pollution Degree:	2
Position of Line Terminals:	Top in - bottom out
Power Loss:	Per Pole 0.15 W
Product Main Type:	OT16E_16F
Product Name:	Switch-disconnector
Rated Impulse Withstand Voltage (U_{imp}):	8 kV
Rated Insulation Voltage (Ui):	1250 V
Rated Operational Current DC-21B (I_e):	(1000V) 16 A
Rated Operational Voltage (U_e):	1000 V
Rated Short-time Withstand Current (I_{cw}):	for 1.0s 0.4 kiloampere rms

Certificates and Declarations (Document Number)

Declaration of Conformity - CE:	1SCC340047D0201;

Classifications

E-number:	3134017
ETIM 5.0:	EC000216 - Switch-disconnector
Object Classification Code:	Q

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Single Phase Inverters

SE2200 - SE6000

	SE2200	SE3000	SE3500	SE4000	SE5000	SE6000	
OUTPUT							
Rated AC Power Output	2200	3000	3500	4000	5000	6000	VA
Maximum AC Power Output	2200	3000	3500	4000	5000	6000	VA
AC Output Voltage (Nominal)	220 /230						Vac
AC Output Voltage Range	184 - 264.5						Vac
AC Frequency (Nominal)	50 / 60 ± 5						Hz
Maximum Continuous Output Current	12	16.5*	19.5*	22*	27	27	A
Residual Current Detector / Residual Current Step Detector	300 / 30						mA
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes						
INPUT							
Recommended Maximum DC Power** (Module STC)	2400	3300	3900	4400	5500	6600	W
Transformer-less, Ungrounded	Yes						
Maximum Input Voltage	500						Vdc
Nominal DC Input Voltage	350						Vdc
Maximum Input Current	8.5	11.5	13.5	15.5	19.5	23	Adc
Reverse-Polarity Protection	Yes						
Ground-Fault Isolation Detection	600kΩ Sensitivity						
Maximum Inverter Efficiency	97.6						%
European Weighted Efficiency	97.6	97.6	97.5	97.5	97.4	97.4	%
Nighttime Power Consumption	< 2.5						W
ADDITIONAL FEATURES							
Supported Communication Interfaces	RS485, RS232, Ethernet, Zigbee (optional)						
STANDARD COMPLIANCE							
Safety	IEC-62103 (EN50178), IEC-62109						
Grid Connection Standards	VDE 0126-1-1, VDE-AR-N-4105, AS-4777, RD-1663 , DK 5940						
Emissions	IEC61000-6-2, IEC61000-6-3, IEC61000-3-11, IEC61000-3-12, FCC part15 class B						
RoHS	Yes						
INSTALLATION SPECIFICATIONS							
AC Output	Cable Gland - diameter 9-16						mm
DC Input	1 MC4 pair			2 MC4 pairs			
Dimensions (HxWxD)	540 x 315 x 172			540 x 315 x 191			mm
Weight	20.2			21.7			kg
Cooling	Natural Convection						
Noise	< 50						dBA
Operating Temperature Range	-20 - +50 (M40 version -40 - +50)						°C
Protection Rating	IP65 - Outdoor and Indoor						
Bracket Mounted (Bracket Provided)							

* For inverters with an AC current limit of 16A please refer to the "SE6000-4000-16A Inverter" datasheet.
** Higher input DC power may be installed, enabling yearly AC performance.

CE

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primara
Test- und Zertifizier-GmbH

Certificate of Conformity

Applicant: SolarEdge Technologies
6 HeHarash St.
Hod Hasharon, 45240
Israel

Product type: PV Inverter

Model:	SE2200	SE3000	SE3300	SE3500	SE4000 -16A	SE4000	SE4600	SE5000	SE6000
Output power:	2200W	3000W	3300W	3500W	3680W	4000W	4600W	5000W	6000W

A representative test sample of above stated models passed the tests according to:

Standard: IEC 62109-1:2010
IEC 62109-2:2011

Report no: 13KFS011-01
13KFS011-02

Certificate no: 13-106-00

Date of issue: 2013-06-25

Horst Haug
Certification

CERTIFICATION primara Test- und Zertifizier-GmbH

Primara Test- und Zertifizier-GmbH | Gewerbestraße 28 | 87600 Kaufbeuren | Germany | T +49 (0) 8341 955 48 93 | T +49 (0) 8341 955 48 94

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CE Declaration of conformity

This is to declare that the following products including the required accessories have been manufactured according to the

EU low-voltage directive 2006/95/EG

and

EU EMC directive 2004/108/EG.

Product:	Solar Inverter
Manufacturer:	**SolarEdge Technologies Ltd.** Abba Eban 1° Hertzlia 46725 **Israel**
Type:	SE2200,SE3000, SE3300, SE3500, SE4000, SE5000, SE6000

The following standards had been applied according to the low-voltage directive 2006/95/EG:

EN 50178:1997
DIN EN 50178:1998

The following standards had been applied according to the EMC directive 2004/108/EG:

EN 61000-6-2:2005
EN 61000-6-3:2007
EN-61000-3-11:2000
EN-61000-3-12:2005

Hod Hasharon, Israel	19/7/2012	סולראדג' טכנולוגיות בע"מ ח.פ. 513865329 (Meir Adest)
(Place)	(Date)	

SolarEdge Technologies

US: 2225 East Bayshore Rd., Suite 200, Palo Alto, CA 94303

Germany: Königstr. 5, 01097 Dresden

Japan: B-9 Ariake Frontier Building, 3-7-26 Ariake, Koto-Ku, Tokyo, 135-0063

Israel: 6 Ha'Harash St., P.O.Box 7349, Neve Ne'eman, Hod Hasharon 45240



Bureau Veritas Consumer Products Services Germany GmbH
Businesspark A96
86842 Türkheim
Germany
+ 49 (0) 4074041-0
cps-tuerkheim@de.bureauveritas.com

Certificate of compliance

Applicant: SolarEdge Technologies Ltd.
6 HeHarash St.
Hod Hasharon 45240
Israel

Product: Automatic disconnection device between a generator and the public low-voltage grid

Model: SE5K; SE7K; SE8K; SE9K; SE10K; SE10,5K; SE12K; SE12,5K; SE15K; SE16K; SE17K

Use in accordance with regulations:

Automatic disconnection device with three-phase mains surveillance in accordance with DIN V VDE V 0126-1-1:2006-02 for photovoltaic systems with a three-phase parallel coupling via an inverter in the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverter. This serves as a replacement for the disconnection device with insulating function which the distribution network provider can access at any time.

Applied rules and standards:

DIN V VDE V 0126-1-1 (VDE V 0126-1-1):2006-02 and „Generator at the public low-voltage grid, 4th edition 2001, guideline for connection and parallel operation of generators in the public low-voltage grid" with VDN additions (2005) from the German Electricity Association (VDEW) and Association of network operator (VDN).

The safety concept of an aforementioned representative product corresponds at the time of issue of this certificate to the valid safety specifications for the specified use in accordance with regulations.

Report number: 10TH0222-VDE0126
Certificate number: U12-0976
Date of issue: 2012-11-06 **Valid until:** 2015-05-07

Achim Hänchen

E202/63R

Print View..
Print to Pdf..

General Information

Extended Product Type:	E202/63R
Product ID:	2CDE282001R0063
EAN:	4016779645904
Catalog Description:	Isolator E202/63r
Long Description:	These devices are suitable for commanding loads and they are realized according EN 60947-3 and EN 60669-1 respectively. Fast removal without dismantling of the busbar. Captive screws with recessed/slotted head. Pozidrive size 2. Add-on of up to 3 auxiliary contact S2C-H6R possible integrated lay-on edge for labeling system ILS. Locking device as accessories for unauthorized ON/OFF. Approval: VDE, CCC, KEMA



< 1 2 3 >

Categories

Products » Low Voltage Products and Systems » Modular DIN Rail Products » Modular DIN Rail Components MDRCs » Command Devices

Ordering

EAN:	4016779645904
Minimum Order Quantity:	1 piece
Customs Tariff Number:	85365080

Dimensions

Product Net Width:	35.0 mm
Product Net Height:	85.0 mm
Product Net Depth:	69.0 mm
Product Net Weight:	0.190 kg

Container Information

Package Level 1 Units:	5 piece
Package Level 1 Width:	92.0 mm
Package Level 1 Height:	80.0 mm
Package Level 1 Length:	183.0 mm
Package Level 1 Gross Weight:	0.995 kg
Package Level 1 EAN:	4016779668828
Package Level 2 Units:	60 piece
Package Level 2 Width:	275.0 mm
Package Level 2 Height:	210.0 mm
Package Level 2 Length:	395.0 mm
Package Level 2 Gross Weight:	12.340 kg

Package Level 2 EAN:	4016779865708

Environmental

RoHS Status:	Following EU Directive 2002/95/EC August 18, 2005 and amendment

Additional Information

Product Main Type:	E200
Product Name:	Switch Disconnector
Product Range:	Switch-disconnector E202
RoHS Date:	0016
Standards:	IEC/EN 60947-3

Certificates and Declarations (Document Number)

Declaration of Conformity - CE:	2CDK441011D0401

Classifications

ETIM 4.0:	EC000216 - Switch disconnector
ETIM 5.0:	EC000216 - Switch disconnector
Object Classification Code:	Q

Miniature Circuit Breaker S 200/S 200 M
Technical data

	S 200	S 200 M
General Data		
Standards	IEC/EN 60898-1, IEC/EN 60947-2 UL 1077	IEC/EN 60898-1, IEC/EN 60947-2 UL 1077, CSA 22.2 No. 235
Poles	1P, 2P, 3P, 4P, 1P+N, 3P+N	
Tripping Characteristics	B, C, D, K, Z	
Rated current I_n	0.5 up to 63 A	
Rated frequency	50/60 Hz	
Rated insulation voltage U_i	250 V AC (phase to ground), 500 V AC (phase to phase)	
Overvoltage Category	III	
Pollution Degree	3	
IEC/EN 60898-1		
Rated operational voltage U_e	1P: 230/400 V AC; 1P+N: 230 V AC; 2P, 3P, 4P: 400 V AC; 3P+N: 400 V AC	
Max. power frequency recovery voltage U_{rec}	1P: 253 V AC; 1P+N: 253 V AC; 2P, 3P, 4P: 440 V AC; 3P+N: 440 V AC; 1P: 72 V DC; 2P: 125 V DC	
Min. operating voltage	12 V AC, 12 V DC	
Rated short-circuit capacity I_{cn}	6 kA	10 kA
Energy limiting class (B, C up to 40 A)	3	
Rated impulse withstand voltage U_{imp} (1.2/50 µs)	4 kV (test voltage 6.2 kV at sea level, 5 kV at 2,000 m)	
Dielectric test voltage	2.0 kV (50/60 Hz, 1 min)	
Reference temperature for tripping characteristics	B, C, D: 30 °C	
Electrical endurance	I_n < 32 A: 20,000 ops. (AC), 1,000 ops. (DC); one cycle 2 s - ON, 13 s - OFF I_n ≥ 32 A: 10,000 ops. (AC), 1,000 ops. (DC); one cycle 2 s - ON, 28 s - OFF	
IEC/EN 60947-2		
Rated operational voltage U_e	1P: 230 V AC; 1P+N: 230 V AC; 2P, 3P, 4P: 440 V AC; 3P+N: 440 V AC	
Max. power frequency recovery voltage U_{rec}	1P: 253 V AC; 1P+N: 253 V AC; 2P, 3P, 4P: 482 V AC; 3P+N: 482 V AC; 1P: 72 V DC; 2P: 125 V DC	
Min. operating voltage	12 V AC, 12 V DC	
Rated ultimate short-circuit breaking capacity I_{cu}	10 kA	15 kA
Rated service short-circuit breaking capacity I_{cs}	7.5 kA	≤ 40 A: 11.25 kA 50, 63 A: 7.5 kA
Rated impulse withstand voltage U_{imp} (1.2/50 µs)	4 kV (test voltage 6.2 kV at sea level, 5 kV at 2,000 m)	
Dielectric test voltage	2.0 kV (50/60 Hz, 1 min)	
Reference temperature for tripping characteristics	B, C, D: 55 °C; K, Z: 20 °C	
Electrical endurance	I_n < 32 A: 20,000 ops. (AC), 1,000 ops. (DC); one cycle 2 s - ON, 13 s - OFF I_n ≥ 32 A: 10,000 ops. (AC), 1,000 ops. (DC); one cycle 2 s - ON, 28 s - OFF	
UL/CSA		
Rated voltage	1P: 277 V AC, 60 V DC 2...4P: 480 Y/277 V AC, 110 V DC	1P: 277 V AC, 60 V DC 2...4P: 480 Y/277 V AC, 125 V DC
Rated interrupting capacity	6 kA (AC), 10 kA (DC)	
Application	Suppl. prot. for general use. Application Codes: TC2, OL0, SC: U1	
Reference temperature for tripping characteristic	B, C, D, K, Z: 25 °C	
Electrical endurance	6,000 ops. (AC), 6,000 ops. (DC); one cycle 1 s - ON, 9 s - OFF	
Mechanical data		
Housing	Insulation group II, RAL 7035	Insulation group I, RAL 7035
Toggle	Insulation group II, black, sealable	
Contact position indication	Marking on toggle (ON/O OFF), Real CPI (red ON/green OFF)	
Protection degree acc. to EN 60529	IP20[1], IP40 in enclosure with cover	
Mechanical endurance	20,000 ops.	
Shock resistance acc. to IEC/EN 60068-2-27	25 g, 2 shocks, 13 ms	
Vibration resistance acc. to IEC/EN 60068-2-6	5 g, 20 cycles at 5...150...5 Hz with load 0.81 I_n	
Environmental conditions acc. to IEC/EN 60068-2-30	28 cycles with 55 °C/90-96 % and 25 °C/95-100 %	
Ambient temperature	-25 ... +55 °C	
Storage temperature	-40 ... +70 °C	

[1] Also fulfilling the requirements acc. to the protection degree IPXXB

2CDC002157D0202

System pro *M* compact®

Technical features

OVR Surge Protective Devices - Type 1 & Type 1+2

SPDs



TECHNICAL FEATURES		Type 1 OVR T1 □ 25 □ TS				
Technology		Triggered spark-gap				
Electrical features						
Standard		IEC 61643-1 / EN 61643-11				
Type / test class		1 / I				
Poles		1P □	1P □ 2P □	3P □	4P □	1P+N □	3P+N □
Types of networks		IT - TT	TT*-TNS-TNC	TNC	TNS	TT - TNS	TT - TNS
Type of current		A.C.					
Nominal voltage Un (L-N/L-L)	V	400	230	230/400		230	230/400
Max. cont. operating voltage Uc	V	440	255			-	-
Max. cont. operating voltage Uc (L-N / N-⏚)	V	-	-			255 / 255	255 / 255
Impulse current Iimp (10/350) per pole	kA	25	25			-	-
Impulse current Iimp (10/350) (L-N / N-⏚)	kA	-	-			25 / 50	25 / 100
Imax discharge current (8/20) per pole (Imax)	kA	-	-			-	-
Imax discharge current (8/20) (L-N/N-terre) (Imax)	kA	-	-			-	-
Nominal discharge current In (8/20) per pole	kA	25	25			-	-
Nominal discharge current In (8/20 (L-N / N-⏚)	kA		-			25 / 50	25 / 100
Voltage protection level Up	kV	2	2.5			-	-
Voltage protection level Up (L-N / N-⏚)	kV	-	-			2.5 / 2	2.5 / 2
Follow current interrupting rating Ifi	kArms	50	50			-	-
Follow current interrupting rating Ifi (L-N / N-⏚)	kArms	-	-			50 / 0.1	50 / 0.1
TOV (temporary overvoltage) withstand U_T (5s.)	V	690	400			-	-
TOV (temporary overvoltage) withstand U_T (L-N: 5s. / N-⏚ : 200ms.)	V	-	-			400 / 1200	400 / 1200
Continuous operating current Ic	mA	None					
Short-circuit withstand capability	kArms	50					
Load current I_{max} (for V-wiring)	A	125					
Maximum back-up fuse gG/gL		-					
Parallel Connection	A	≤125					
Serial Connection (V-wiring)	A	≤125					
Mechanical features							
Stocking and operating temperature	°C	-40 to +80					
Degree of protection		IP 20					
Fire resistance according to UL 94		V0					
Colour of Housing		Polyarylamide grey RAL 7035					
State indicator		Option (with TS)					
TS remote indicator		Option (TS)					
Installation							
Wire range (L, N, ⏚)							
solid wire	mm²	2.5 ... 50					
stranded wire	mm²	2.5 ... 35					
Stripping length (L, N, ⏚)	mm	15					
Tightening torque (L, N, ⏚)	Nm	3.5					

TECHNICAL FEATURES OF THE INTEGRATED AUXILIARY CONTACT (TS)		
Electrical features		
Contact complement		1NO (1 normally open contact), +1NC (1 normally closed contact)
Min. load		6 V D.C. - 10 mA
Max. load		250 V A.C. - 5 A
Continuous operating current	mA	10
Installation		
Connection cross-section	mm²	1.5

TT* : in TT network for L/N protection only

Technical features

OVR Surge Protective Devices - Type 1 & Type 1+2






Type 1 OVR T1 ☐ 25 255-7 Triggered spark-gap		Type1+2 OVR T1+2 25 255 TS Triggered spark-gap/varistor	Type 1+2 OVR T1+2 ☐ 15 255-7 Triggered spark-gap		Type 1+2 OVR T1+2 ☐ 7 275 s P Varistor				
IEC 61643-1 / EN 61643-11 1 / I		IEC 61643-1 / EN 61643-11 I / I	IEC 61643-1 / EN 61643-11 1 / I		IEC 61643-1 / EN 61643-11 1 / I				
1P ☐ TT*-TNS-TNC	3P+N ☐ TT - TNS	TT* - TNS - TNC	1P ☐ TT*-TNS-TNC	3P+N ☐ TT - TNS	1P ☐ TT-TNS-TNC	3P ☐ TNC	4P ☐ TNS	1P+N ☐ TT - TNS	3P+N ☐ TT - TNS
A.C.		A.C.	A.C.		A.C.				
230	230/400	230	230	230/400	230	230/400		230	230/400
255	-	255	255	-	275			275	275 / 255
-	255 / 255	-	-	255 / 255					
25	-	25	15	-	7			-	-
-	25 / 100	-	-	15 / 50	-			7 / 12	7 / 12
-	-	40	60	-	70			-	-
-	-	-	-	60/60	-			70/70	70/70
25	-	25	15	-	6			-	-
-	25 / 100	-	-	15 / 50	-			6	6
2.5	-	1.5	1.5	-	0.9			-	-
-	2.5 / 1.5	-	-	1.5 / 1.5	-			0.9 / 1.4	0.9 / 1.5
7	-	15	7	-	NA			-	-
-	7 / 0.1	-	-	7 / 0.1	-			NA / 0.1	NA / 0.1
650	-	334	650	-	334			-	-
-	650 / 1200	-	-	650 / 1200	-			334 / 1200	
< 2 (LED)		< 1 (Varistor leakage)	< 2 (LED)		< 1				
50		50	50		50				
-		125	-		-				
≤125		≤125	≤125		≤50				
NA		125	NA		NA				
-40 to +80		-40 to +80	-40 to +80		-40 to +80				
IP 20		IP 20	IP 20		IP 20				
V0		V0	V0		V0				
Polyarylamide grey RAL 7035		Polyarylamide grey RAL 7035	Polyarylamide grey RAL 7035		PC grey RAL 7035				
Yes		Yes	Yes		Yes				
No		No	No		No				
2.5 ... 50		2.5 ... 50	2.5 ... 50		2.5 ... 25				
2.5 ... 35		2.5 ... 35	2.5 ... 35		2.5 ... 16				
15		15	15		12.5				
3.5		3.5	3.5		2.8				
-		1NO (1 normally open contact),	-		-				
-		+ 1NC (1 normally closed contact)							
-		12V D.C. - 10 mA	-		-				
-		250V A.C. - 1 A	-		-				
-		None	-		-				
-		1.5	-		-				

TT* : in TT network for L/N protection only

Residual Current Devices (RCD)

Technical Data



Type	GS250S		DS251	DS271	DS9	FH200 / F200
Standards	IEC61009		IEC61009, BSEN 61009-2-2		IEC61009	IEC61009
Pole	1 + NA	2, 3, 4	1 + NA	1 + NA	1 + NA	2, 4
Tripping Characteristics	C	C - D	C	B - C	C	-
Tripping Type	Electronic Type				Electro-Magnetic Type	
Rated breaking capacity Icu	6kA	6kA (I=40A) 4,5kA (53, 63A)	6kA	10kA	10kA (DS971) 6kA (DS951) 4,5kA (DS941)	-
Rated current In	6 - 40A	6 - 63A	6 - 32A	6 - 32A	6 - 40A	25 - 63A (FH200) 80 - 100A (F200)
Rated voltage Un / AC	230V	230 / 400V	230 / 240V	230 / 240V	230V	230 / 400V
Type	AC	AC, A	AC	AC	AC	AC
Rated sensitivity	0,01, 0,03	0,01, 0,03, 0,3	0,03	0,01, 0,03, 0,1	0,03	0,03, 0,1, 0,3
Frequency Hz	50 - 60					
Mechanical Life no. of operation	20,000					
Protection degree Terminals Housing	IP20 IP40					
Ambient temperature Operating Temperature °C Storage Temperature °C	-25...+55 -40...+70		-25...+55 -25...+70		-25...+55 -35...+70	
Tropicalization (IEC 60068-2) constant climatic conditions (°C/RH) variable climatic conditions (°C/RH)	23/93, 40/93, 55/20 25/95, 40/93					
Terminal Size mm²	0,75 - 16		1 - 25 (Line side) 1 - 10 (Load side)		1 - 16	1 - 25
Tightening Torque Nm	2		2 (Line side) 1,2 (Load side)		2	

Laagspanningskabels
YMvKmb 0,6/1 kV

10415



De Twenkaplus kabels YMvKmb 0,6/1kV kunnen in laagspannings-installaties worden toegepast waar hoge eisen worden gesteld aan de brandveiligheid.

Handelsinformatie	Specificaties	Eenheid
Productgroep	Installatiekabel	
Serie	Twenkaplus installatiekabel	
Type	YMvKmb 0,6/1 kV	
Omschrijving	3 X 6 rm	
Netto Gewicht	321	kg/Km
Mantelstempeling	{Length} TKF YMvKmb 0,6/1kV 3X6rm TWENKAPLUS KEMA-KEUR {Batch}	

Artikelnummer per handelslengte	EAN nummer	Specificaties	Eenheid
10415	8713182070267	Haspel à 1	m
10415H X 500/20	8713182070243	Haspel à 500	m

Constructie	Specificaties	Eenheid
Normering	K42C-1-4-D / HD 604-4-D / NEN 3617	
Norm geleidermateriaal	IEC 60228	
Aantal aders	3	
Nominale geleiderdoorsnede	6	mm²
Geleidermateriaal	Cu	
Geleidervorm	Rond	
Samenstelling geleider	Klasse 1 = massief	
Aderisolatie	XLPE	
Adercodering	HD 308 S2	
Aderkleuren	Br-zw-gr	
Geel/Groene ader	Neen	
Samenslag	Geslagen met een vaste spoed + vulling	
Materiaal buitenmantel	PVC	
Mantelkleur	Grijs	

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BV Twentsche Kabelfabriek
Spinnerstraat 15 - Postbus 6 - 7480 AA Haaksbergen - Nederland
Tel: +31 (0)53 573 22 55 - Fax: +31 (0)53 573 21 85 - info@TKF.nl - www.tkf.nl

BV TWENTSCHE KABELFABRIEK
Kies bewust voor beter!

Laagspanningskabels
YMvKmb 0,6/1 kV

10415

Gebruikseigenschappen	Specificaties	Eenheid
Brandvertraging	IEC 60332-3-24 Cat. C	
Nominale geleiderdiameter	2.73	mm
Isolatiedikte	0.7	mm
Diameter over isolatie (bij sector: sector hoogte)	4.1	mm
Dikte buitenmantel	1.8	mm
Buitendiameter circa	13.1	mm
Buigstraal geïnstalleerd	52	mm
Buigstraal tijdens verlegging	91	mm
Trekkracht met kop	900	N
Trekkracht met kous	510	N

Technische eigenschappen	Specificaties	Eenheid
Nominale spanning U0	0.6	kV
Nominale spanning U	1	kV
Testspanning	3.5	kV
Geleider DC weerstand @ 20 °C	3.08	Ohm/km
Inductie	0.28	mH/km
Bedrijfscapaciteit (nom.)	72	nF/km
Kortsluitstroom geleider (5 sec)	0.4	kA
Max. toelaatbare geleidertemperatuur	90	°C
Minimale installatietemperatuur	0	°C
Min/max bedrijfstemperatuur	-40 / 70	°C

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3.5.5 Building Integrated Solar Active Systems

Daylight

One of the important aspects from an architectural point of view is the amount of daylight in the glasshouse And because the PV modules are a major element of this glasshouse, these also needed to be designed taking daylight into account. This is one of the reasons that we have chosen for mono crystalline cells integrated in glazing. Tis way, the transparency factor of the modules could be determined, leaving space in between the cells to let the daylight in (fig.4.45).

Aesthetic value

Another important design criteria for the building integrated solar active system, is the aesthetic value, for the skin needs to provide extra value in terms of space and climate to the existing house. The common approach for applying PV-panels is to put them on top of the roof: putting layer on top of layer. With 'Home with a Skin' however we choose to really apply an integrated system: making the PV modules an essential part of the greenhouse, without reducing it's aesthetic value. By using the mono crystalline cells integrated in glazing, the modules become a direct part of the greenhouse: preserving the architectural essence.

Reduction of amount of materials

Another important aspects of 'Home with a Skin' is, as mentioned before, finding the balance between sustainability, affordability, climate performance and quality. This also means, that it is not just about putting all the elements to achieve the highest climate performance. It is about putting the right amount in the right way. The commonly used approach for applying PV modules, is putting separate panels on top of a roof. However by using the integrated PV modules, the previously mentioned balance is respected, for the panels function as glazing of the greenhouse and PV modules the same time: reducing the amount of materials needed.

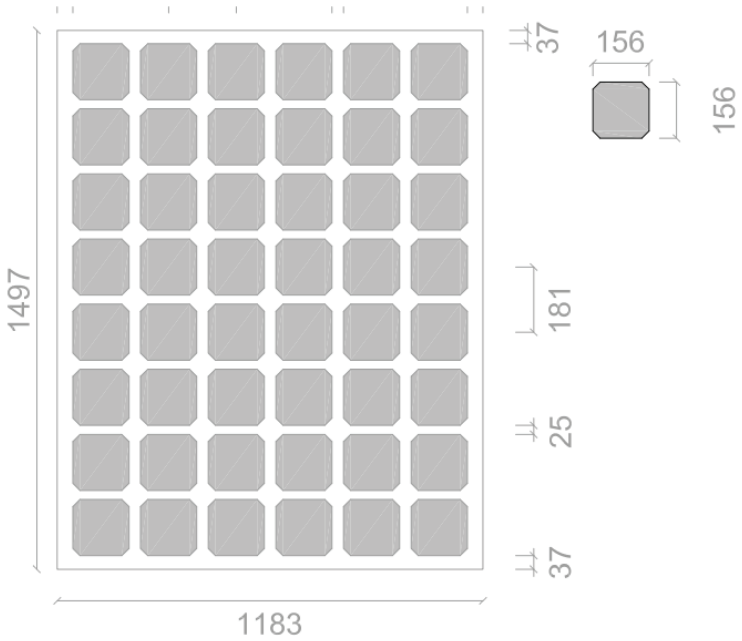


Figure 3.60 — *The space between the cells guarantees transparency*

Optimizing amount of area

The roof area of the greenhouse is larger than the area of the existing house. By using integrated PV modules, relatively more roof area on the sun-side can be used to produce energy. (Fig.4.46)

Optimizing efficiency of the PV modules

Finally, by making the PV modules a direct part of the greenhouse, the efficiency can be optimized by making use of the natural ventilation of the greenhouse., cooling down the modules in a passive way. (fig.4.47)

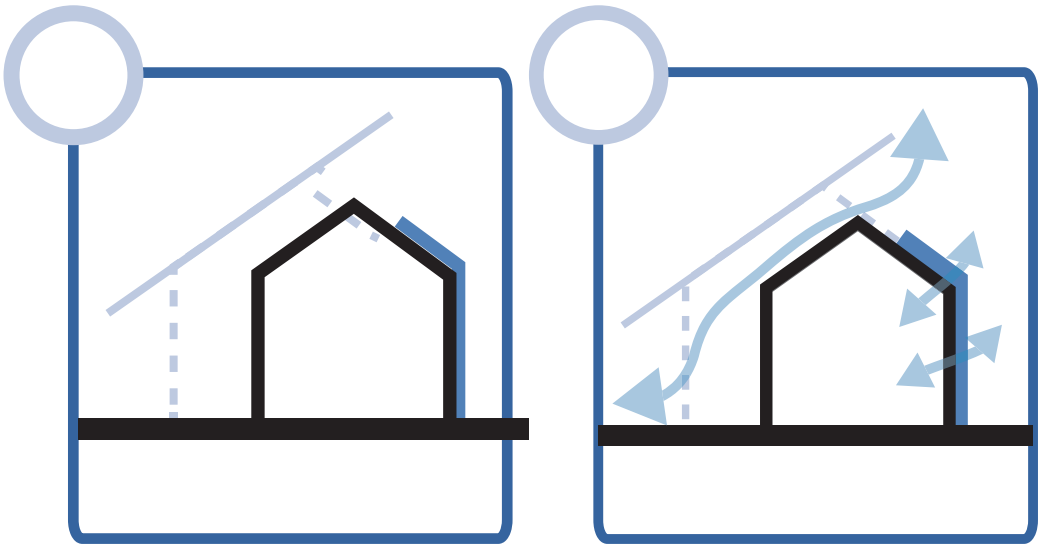


Figure 3.61 — *The total amount of area of the greenhouse is bigger than the area of the existing roof*

Figure 3.62 — *Using the integrated modules, these can be cooled using the natural ventilation of the greenhouse*

Construction Solution

The first step of the PV system installation is the placement of the Power Optimizers. All the 25 Power Optimizers are installed and connect each other. Only then, the PV modules installation starts.

The BIPVs modules are integrated in the Aluminium gables of the glasshouse. The mounting of the different modules can be started when the main Aluminum gables frame is already applied to the steel frame. The only aluminum elements that will be mounted after the BIPVs modules are the final coverings (Figure 4.48, element number 7), needed in order to fix the modules to the Aluminium gables and to prevent water infiltration.

For the BIPVs modules placed on the roof, every panel is inserted among the horizontal and vertical aluminum frame elements (number 3 and 4). Once the modules are inserted in the right position, the covering elements (number 7) can be placed vertically and screwed to the vertical aluminum frame under it (number 3).

For the BIPV modules placed on the operable windows, the panels will be inserted among the horizontal frame at the top and the bottom of the operable windows (element number 5 and 6) and the vertical frame elements (number 3). Once the modules are placed the covering frame (number 7) can be screwed to the vertical frame (number 3).

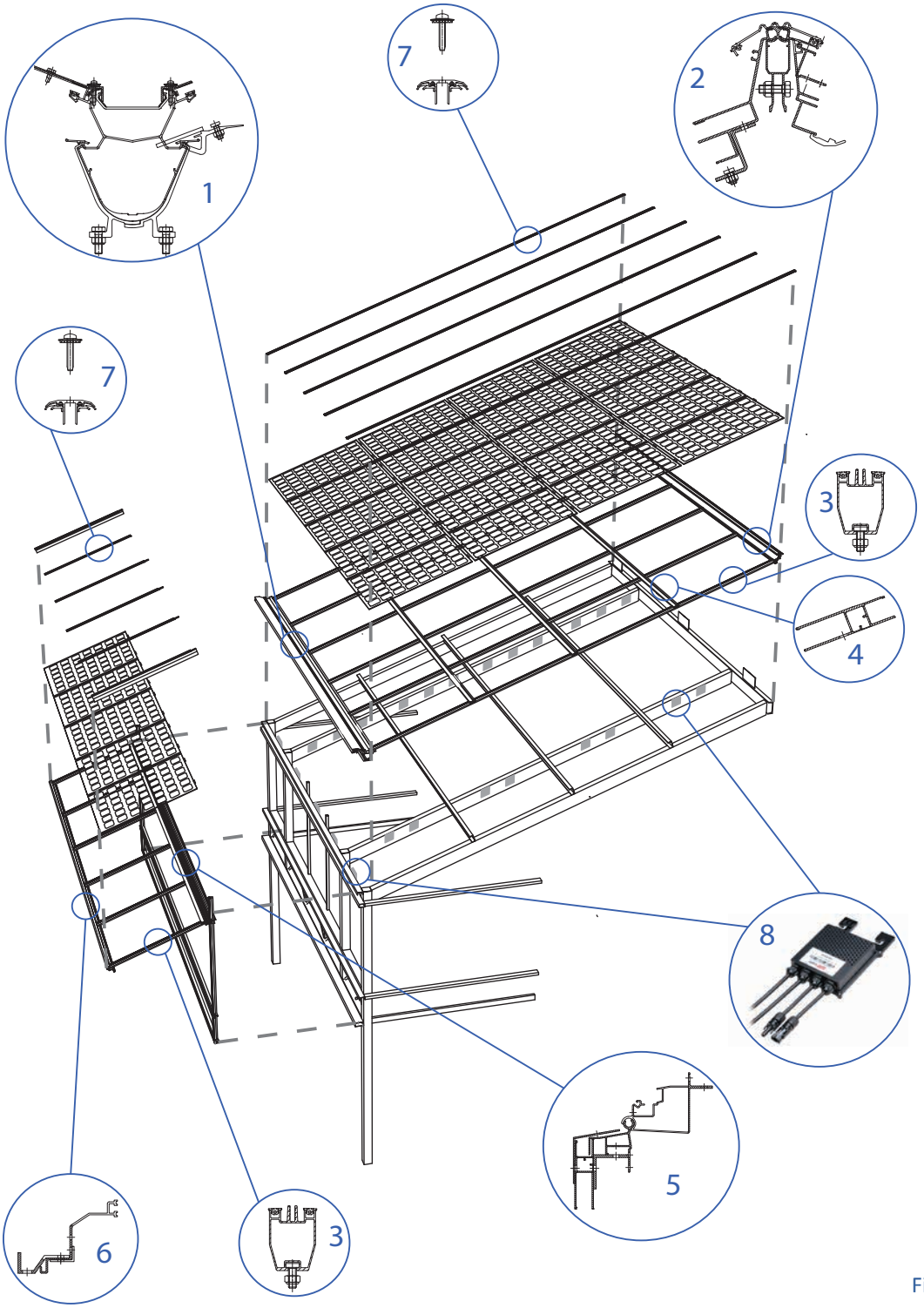


Figure 3.63 — *Construction Solution*

Cost of BIPV system

As our BIPV system is customized in order to meet our design, the total cost is high, at the levels of 19.800 euros. The BIPVs cost 16.200 euros (roof modules 12.000 euros and window modules 4.200 euros) , inverter and power optimizers 2.500 euros, cables and MC4 200 euros and labour cost 900 euros. By analysing the cost in Wp of installation, the cost is of around 4 euros / Wp.

Maintenance

The PV modules have the strong advantage that they do not need extended maintenance. Wiping, brushing or spraying the module with water is simple and enough. So, the main task is to maintain the PV panels clean. Dust, dirt, pollen, leaves and other debris might be collected on the surface of the module and this can lead to low performance.

Electric Loads

Household Appliances

For the calculation of the energy consumption of the appliances and the lighting equipment during the competition it was taken into consideration the calendar of the competition and the available time periods that can the tasks be completed. It was also calculated the load of the appliances and their energy consumption per half hour at full load, since the timetable of the calendar is divided in half hours. Moreover some assumptions were made for the energy consumption calculation.

Assumptions:

- Each appliance works at full load, except for the oven that is assumed that it does not work at full load (instead of 3650Watt full load it works at 2650Watt).
- Each appliance works for one hour for the completion of each task unless it is given differently by the organization (e.g. home electronics, fridge, refrigerator). As an exemption the oven is assumed that it works for half an hour in order to reach the required temperature
- All the appliances it is assumed that they work in “normal” or “standard” programs (the characterization of these programs depends on the manufacturer) the consumption of which is used for the calculation of the loads of the appliances.
- The formula that is used to calculate the consumption of an appliance is:

$$E_{appliance\ i} = P\ (Watt) * t\ (hours)$$

The time of completion of the different tasks was chosen in that way so as to avoid overloading the electrical system at any time of the day. Moreover the team tried to use more energy efficient appliances and lighting equipment in order to reduce as much as possible the energy consumption of the appliances.

Finally all the relevant scenarios showing the exact hours of the day that each appliance is used are found in the corresponding excel file.

Calculation of the load of the appliances

The appliances that were used are the followings. Their technical characteristics and their manuals can be found in the Appendix.

Appliance	Brand	Model
Fridge	Bosch Koel-diepvriescombinatie	KIS86AD40
Washing Machine	Bosch	WAY28770NL

Dryer	Bosch	WTY88782NL
Dishwasher	Bosch	SBV99T10NL
Hot plates	Bosch	PIA611F18E
Kitchen Hood	Bosch	DWB097A51 & DSZ6240
Oven	Bosch	HBG36B650
TV	Samsung	UE28H4000
Laptop	Apple	MacBook Pro 17-inch

Fridge and Refrigerator

Bosch Koel-diepvriescombinatie KIS86AD40

The fridge/refrigerator that is used has an annual energy consumption equal to 152 kWh. Since the fridge operates all day, its load can be calculated by dividing the consumption by the total number of hours per year (365days/year*24hours/day). Thus, the average load of the fridge is:

$$P_{fridge/refrigeraator} = \frac{152000Wh}{365 * 24hours} \cong 17.35Watt$$

Its energy consumption per half hour at full load is:

$$E_{half\ hour} = 17.35Watt * \frac{1}{2} = 8.675Wh$$

Washing Machine

Bosch WAY28770NL

The energy consumption of the standard program at 60°C for cotton at full load is 0.59kWh as provided by the manufacturer. The duration of that program is 299minutes=4.9hours, so the load of the washing machine is:

$$P_{washing\ machine} = \frac{590Wh}{4.9h} = 120.41Watt$$

Its energy consumption per half hour at full load is:

$$E_{half\ hour} = 120.41Watt * \frac{1}{2} = 60.205Wh$$

Dryer

Bosch WTY88782NL

The energy consumption of the standard program (standaard katoenprogramma) for cotton is according to the manufacturer 1.41kWh. the duration of the program is 187minutes=3.12hours, so the load of the dryer for this program is:

$$P_{dryer} = \frac{1140Wh}{3.12hours} = 365.38Watt$$

Its energy consumption per half hour at full load is:

$$E_{half\ hour} = 365.38Watt * \frac{1}{2} = 182.692Wh$$

Dishwasher

Bosch SBV99T10NL

The energy consumption of program 2 (45°C-65°C) is 0.65kWh-1.25kWh and the duration of the program is90-160minutes. The average consumption of this program is 0.95kWh and the average duration of this program according to the manufacturer is 125 minutes=2.08hours, hence the load of the dishwasher is:

$$P_{dishwasher} = \frac{950Wh}{2.08} = 456.73Watt$$

Its energy consumption per half hour at full load is:

$$E_{half\ hour} = 456.73Watt * \frac{1}{2} = 228.36Wh$$

Oven

Bosch HBG36B650

For the oven, the average power consumption equals to the nominal load of the appliance, which is 3650 Watt. It should be mentioned there that the average consumption of the oven varies with the load. For the calculation of the consumption of the oven it is assumed that it does not work at its full load of 3650Watt but at a load of 2650Watt in order to reach the required temperature.

Its energy consumption per half hour at load of 2000Watt is:

$$E_{half\ hour} = 2650Watt * \frac{1}{2} = 1325Wh$$

Kitchen Hobs

Bosch PIA611F18E

For the calculation of the load of the kitchen hobs it is used the average load of the 4 hobs.

$$P_{hobs} = \frac{1400Watt + 1400Watt + 1800Watt + 1800Watt}{4} = 1600Watt$$

Its energy consumption per half hour at full load is:

$$E_{half\ hour} = 1600Watt * \frac{1}{2} = 800Wh$$

Extraction System

Bosch DWB097A51 & DSZ6240

The connected load of the extraction system as provided by the manufacturer is 139Watt.

Its energy consumption per half hour at full load is:

$$E_{half\ hour} = 139Watt * \frac{1}{2} = 100Wh$$

TV

Samsung UE28H4000AW

For the average load of the TV as provided by the manufacturer is 21Watt.

Its energy consumption per half hour at full load is:

$$E_{half\ hour} = 21Watt * \frac{1}{2} = 10.5Wh$$

Laptop

MacBook Pro 17-inch

According to the manufacturer (http://support.apple.com/kb/sp546), the load of the laptop is 85Watt.

Its energy consumption per half hour at full load is:

$$E_{half\ hour} = 85Watt * \frac{1}{2} = 37.5Wh$$

Energy Consumption during contest

30 June

Refrigerator/Freezer

Usage: 24hours

Consumption: $E_{refrigerator-freezer} = 416.4Wh$

TV

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{TV} = 126Wh$

Laptop

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{laptop} = 510Wh$

Washing machine

Usage: 08:00-09:00

Consumption: $E_{washing\ machine} = 120.41Wh$

Dryer

Usage: 09:00-10:00

Consumption: $E_{dryer} = 365.384Wh$

Dishwasher

Usage: 10:00-11:00

Consumption: $E_{dishwasher} = 456.72Wh$

Oven

Usage: 14:30-15:00

Consumption: $E_{oven} = 1325Wh$

Kitchen hobs

Usage: 15:00-16:00

Consumption: $E_{kitchen\ hobs} = 1600Wh$

Extraction System

Usage: 15:00-16:00

Consumption: $E_{extraction\ system} = 139Wh$

Total consumption

$$\boldsymbol{E_{30\ June}} = E_{refrigerator-freezer} + E_{TV} + E_{laptop} + E_{washing\ machine} + E_{dryer} + E_{dishwasher} + E_{oven} + E_{kitchen\ hobs} + E_{extraction\ system} = 5058.914Wh$$

1 July

Refrigerator/Freezer

Usage: 24hours

Consumption: $E_{refrigerator-freezer} = 416.4Wh$

TV

Usage: 08:00-10:00, 14:30-16:30

Consumption: $E_{TV} = 84Wh$

Laptop

Usage: 08:00-10:00, 14:30-16:30

Consumption: $E_{laptop} = 340Wh$

Washing machine

Usage: 08:00-09:00

Consumption: $E_{washing\ machine} = 120.41Wh$

Dryer

Usage: 09:00-10:00

Consumption: $E_{dryer} = 365.284Wh$

Usage: 10:00-11:00

Consumption: $E_{dishwasher} = 456.72Wh$

Oven

Usage: 14:30-15:00, 20:30-20:45 (dinner party)

Consumption: $E_{oven} = 1987.5Wh$

Kitchen hobs

Usage: 15:00-16:00, 19:300-20:38 (dinner party)

Consumption: $E_{kitchen\ hobs} = 3412.8Wh$

Extraction System

Usage: 15:00-16:00, 19:300-20:38 (dinner party)

Consumption: $E_{extraction\ system} = 296.487Wh$

Total consumption

$$\boldsymbol{E_{1\ July}} = E_{refrigerator-freezer} + E_{TV} + E_{laptop} + \\ + E_{dishwasher} + E_{oven} + E_{kitchen\ ho} \\ = 7479.701Wh$$

2 July

Refrigerator/Freezer

Usage: 24hours

Consumption: $E_{refrigerator-freezer} = 416.4Wh$

TV

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{TV} = 126Wh$

Laptop

Consumption: $E_{laptop} = 510Wh$

Washing machine

Usage: 08:00-09:00

Consumption: $E_{washing\ machine} = 120.41Wh$

Dryer

Usage: 09:00-10:00

Consumption: $E_{dryer} = 365.384Wh$

Dishwasher

Usage: 10:00-11:00

Consumption: $E_{dishwasher} = 456.72Wh$

Oven

Usage: 14:30-15:00

Consumption: $E_{oven} = 1325Wh$

Kitchen hobs

Usage: 15:00-16:00

Consumption: $E_{kitchen\ hobs} = 1600Wh$

Extraction System

Usage: 15:00-16:00

Consumption: $E_{extraction\ system} = 139Wh$

Total consumption

$$\begin{aligned} \boldsymbol{E_{2\ July}} &= E_{refrigerator-freezer} + E_{TV} + E_{laptop} + E_{washing\ machine} + E_{dryer} \\ &\quad + E_{dishwasher} + E_{oven} + E_{kitchen\ hobs} + E_{extraction\ system} \\ &= 5058.914Wh \end{aligned}$$

3 July

Refrigerator/Freezer

Usage: 24hours

Consumption: $E_{refrigerator-freezer} = 416.4Wh$

TV

Usage: 08:00-10:00, 14:30-16:30

Consumption: $E_{TV} = 84Wh$

Laptop

Usage: 08:00-10:00, 14:30-16:30

Consumption: $E_{laptop} = 340Wh$

Washing machine

Usage: 08:00-09:00

Consumption: $E_{washing\ machine} = 120.41Wh$

Dryer

Usage: 09:00-10:00

Consumption: $E_{dryer} = 365.384Wh$

Dishwasher

Usage: 10:00-11:00

Consumption: $E_{dishwasher} = 456.72Wh$

Oven

Usage: 14:30-15:00, 20:30-20:45 (dinner party)

Consumption: $E_{oven} = 1987.5Wh$

Kitchen hobs

Usage: 15:00-16:00, 19:300-20:38 (dinner party)

Consumption: $E_{kitchen\ hobs} = 3412.8Wh$

Extraction System

Usage: 15:00-16:00, 19:300-20:38 (dinner party)

Consumption: $E_{extraction\ system} = 296.487Wh$

Total consumption

$$\boldsymbol{E_{3\ July}} = E_{refrigerator-freezer} + E_{TV} + E_{laptop} + E_{washing\ machine} + E_{dryer} + E_{dishwasher} + E_{oven} + E_{kitchen\ hobs} + E_{extraction\ system} = 7479.701Wh$$

4 July

Refrigerator/Freezer

Usage: 24hours

Consumption: $E_{refrigerator-freezer} = 416.4Wh$

TV

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{TV} = 126Wh$

Laptop

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{laptop} = 510Wh$

Washing machine

Usage: 08:00-09:00

Consumption: $E_{washing\ machine} = 120.41Wh$

Dryer

Usage: 09:00-10:00

Consumption: $E_{dryer} = 365.384Wh$

Dishwasher

Usage: 14:30-15:30

Consumption: $E_{dishwasher} = 456.72Wh$

Total consumption

$$\boldsymbol{E_{4\,July}} = E_{refrigerator-freezer} + E_{TV} + E_{laptop} + E_{washing\,machine} + E_{dryer} + E_{dishwasher} = 1994.914Wh$$

5 July

Refrigerator/Freezer

Usage: 24hours

Consumption: $E_{refrigerator-freezer} = 416.4Wh$

Total consumption

$$\boldsymbol{E_{5\,July}} = E_{refrigerator-freezer} = 416.4Wh$$

6 July

Refrigerator/Freezer

Usage: 24hours

Consumption: $E_{refrigerator-freezer} = 416.4Wh$

Total consumption

$$\boldsymbol{E_{6\,July}} = E_{refrigerator-freezer} = 416.4Wh$$

7 July

Refrigerator/Freezer

Usage: 24hours

Consumption: $E_{refrigerator-freezer} = 416.4Wh$

TV

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{TV} = 126Wh$

Laptop

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{laptop} = 510Wh$

Washing machine

Usage: 08:00-09:00

Consumption: $E_{washing\ machine} = 120.41Wh$

Dryer

Usage: 09:00-10:00

Consumption: $E_{dryer} = 365.384Wh$

Dishwasher

Usage: 10:00-11:00

Consumption: $E_{dishwasher} = 456.72Wh$

Oven

Usage: 14:30-15:00

Consumption: $E_{oven} = 1325Wh$

Kitchen hobs

Usage: 15:00-16:00

Consumption: $E_{kitchen\ hobs} = 1600Wh$

Extraction System

Usage: 15:00-16:00

Consumption: $E_{extraction\ system} = 139Wh$

Total consumption

$$\begin{aligned} \boldsymbol{E_{7\ July}} = E_{refrigerator-freezer} + E_{TV} + E_{laptop} + E_{washing\ machine} \\ + E_{dishwasher} + E_{oven} + E_{kitchen\ hobs} + E_{extraction\ sy} \\ = 5058.914Wh \end{aligned}$$

8 July

Refrigerator/Freezer

Usage: 24hours

Consumption: $E_{refrigerator-freezer} = 416.4Wh$

TV

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{TV} = 126Wh$

Laptop

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{laptop} = 510Wh$

Washing machine

Usage: 08:00-09:00

Consumption: $E_{washing\ machine} = 120.41Wh$

Dryer

Usage: 09:00-10:00

Consumption: $E_{dryer} = 365.384Wh$

Dishwasher

Usage: 10:00-11:00

Consumption: $E_{dishwasher} = 456.72Wh$

Oven

Usage: 14:30-15:00

Consumption: $E_{oven} = 1325Wh$

Kitchen hobs

Usage: 15:00-16:00

Consumption: $E_{kitchen\ hobs} = 1600Wh$

Usage: 15:00-16:00

Consumption: $E_{extraction\ system} = 139Wh$

Total consumption

$$\boldsymbol{E_{8\ July}} = E_{refrigerator-freezer} + E_{TV} + E_{laptop} + E_{washing\ machine} + E_{dryer} + E_{dishwasher} + E_{oven} + E_{kitchen\ hobs} + E_{extraction\ system} = 5058.914Wh$$

9 July

Refrigerator/Freezer

Usage: 24hours

Consumption: $E_{refrigerator-freezer} = 416.4Wh$

TV

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{TV} = 126Wh$

Laptop

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{laptop} = 510Wh$

Washing machine

Usage: 08:00-09:00

Consumption: $E_{washing\ machine} = 120.41Wh$

Dryer

Usage: 09:00-10:00

Consumption: $E_{dryer} = 365.384Wh$

Dishwasher

Usage: 10:00-11:00

Consumption: $E_{dishwasher} = 456.72Wh$

Oven

Usage: 14:30-15:00

Consumption: $E_{oven} = 1325Wh$

Kitchen hobs

Usage: 15:00-16:00

Consumption: $E_{kitchen\ hobs} = 1600Wh$

Extraction System

Usage: 15:00-16:00

Consumption: $E_{extraction\ system} = 139Wh$

Total consumption

$$\boldsymbol{E_{9\ July}} = E_{refrigerator-freezer} + E_{TV} + E_{laptop} + E_{washing\ machine} + E_{dryer} + E_{dishwasher} + E_{oven} + E_{kitchen\ hobs} + E_{extraction\ system} = 5058.914Wh$$

10 July

Refrigerator/Freezer

Usage: 24hours

Consumption: $E_{refrigerator-freezer} = 416.4Wh$

TV

Usage: 08:00-10:00, 14:30-16:30

Consumption: $E_{TV} = 84Wh$

Laptop

Usage: 08:00-10:00, 14:30-16:30

Consumption: $E_{laptop} = 340Wh$

Washing machine

Usage: 08:00-09:00

Consumption: $E_{washing\ machine} = 120.41Wh$

Dryer

Usage: 09:00-10:00

Consumption: $E_{dryer} = 365.384Wh$

Dishwasher

Usage: 10:00-11:00

Consumption: $E_{dishwasher} = 456.72Wh$

Oven

Usage: 14:30-15:00, 20:30-20:45 (dinner party)

Consumption: $E_{oven} = 1987.5Wh$

Kitchen hobs

Usage: 15:00-16:00, 19:300-20:38 (dinner party)

Consumption: $E_{kitchen\ hobs} = 3412.8Wh$

Extraction System

Usage: 15:00-16:00, 19:300-20:38 (dinner party)

Consumption: $E_{extraction\ system} = 296.487Wh$

Total consumption

$$\begin{aligned} \boldsymbol{E_{10\ July}} &= E_{refrigerator-freezer} + E_{TV} + E_{laptop} + \\ &+ E_{dishwasher} + E_{oven} + E_{kitchen\ hob} \\ &= 7479.701Wh \end{aligned}$$

11 July

Refrigerator/Freezer

Usage: 24hours

Consumption: $E_{refrigerator-freezer} = 416.4Wh$

TV

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{TV} = 126Wh$

Laptop

Usage: 08:00-10:00, 14:30-16:30, 21:00-23:00

Consumption: $E_{laptop} = 510Wh$

Washing machine

Usage: 08:00-09:00

Consumption: $E_{washing\ machine} = 120.41Wh$

Dryer

Usage: 09:00-10:00

Consumption: $E_{dryer} = 365.384Wh$

Dishwasher

Usage: 14:30-15:30

Consumption: $E_{dishwasher} = 456.72Wh$

Total consumption

$$\boldsymbol{E_{11\,July}} = E_{refrigerator-freezer} + E_{TV} + E_{laptop} + E_{washing\ machine} + E_{dryer} + E_{dishwasher} = 1994.914Wh$$

According to the above analysis the daily consumption of the competition is:

Day	Consumption (Kwh)
30 June	5.058
1 July	7.479
2 July	5.058
3 July	7.479
4 July	1.994
5 July	0.416
6 July	0.416
7 July	5.058
8 July	5.058
9 July	5.058
10 July	7.479
11 July	1.994

Total consumption of the competition

$$\mathrm{E}_{\boldsymbol{total}} = 52556.3\mathrm{Wh} = 52.556\mathrm{kWh}$$

Weekly, monthly and annual Consumption

For the weekly consumption of the appliances of the house it was used the sum of the energy consumption of the seven first days of the competition (30 June- 6 July). This value was then used as constant for the calculation of the monthly and annual consumption.

$$E_{weekly} = E_{30\ June} + E_{1\ July} + E_{2\ July} + E_{3\ July} + E_{4\ July} + E_{5\ July} + E_{6\ July}$$
$$= 27904.944Wh = 27.904kWh$$

Then taking this weekly calculated value as constant and assuming that each month has 31 days and a year has$12\ \mathrm{months}$ the monthly and annual consumption was calculated as following:

$$E_{monthly} = E_{weekly} * 31/7 = 123.574kWh$$

$$\mathrm{E}_{\mathrm{annual}} = E_{monthly} * 52 = 1482.888\ \mathrm{kWh}$$

All the above calculations can be found in tables in the corresponding excel file.

Lighting equipment load

For the calculation of the energy consumption of the lighting equipment have been taken into consideration the load of every chosen light.it is also calculated their energy consumption per half hour as the timetable of the calendar is divided in half hours. These loads are summarized in the following matrix.

Number of light	Load (W)
Light 1 (outside front)	3.5
Light 2 (toilet)	4
Light 3 (hall)	4
Light 4 (kitchen: 3x2Watt)	6
Light 4 (living room 1: 2x4Watt)	8
Light 5 (back outside 1)(ceiling)	8
Light 5 (back outside 2)(ceiling)	8
Light 6 (back outside 3)(wall)	5.5
Light 7 (living room 2)	5
Light 8 (installation room)	5
Light 9 (child's bedroom/ model room)	8
Light 10 (stairs)	38
Light 11 (bathroom 1st floor)	30
Light 12 (bathroom spotlight: 5x4Watt)	20
Light 13 (parents' bedroom)	8

The detailed characteristics and specifications of the lighting equipment are already mentioned in the lighting design narrative.

As indicated by the organization all the lights are turned on every day from 21:00 until 23:00. Hence, their daily consumption is:

Light 1 (outside front): $E_{light\ 1} = P_{light\ 1} * 2hours = 3.5Watt * 2hours = 7Wh$

Light 2 (toilet): $E_{light\ 2} = P_{light\ 2} * 2hours = 4Watt * 2hours = 8Wh$

Light 3 (hall): $E_{light\ 3} = P_{light\ 3} * 2hours = 4Watt * 2hours = 8Wh$

Light 4 (kitchen): $E_{light\ 4} = P_{light\ 4} * 2hours = 6Watt * 2hours = 12Wh$

Light 4 (living room 1): $E_{light\ 4} = P_{light\ 4} * 2hours = 8Watt * 2hours = 16Wh$

Light 5 (back outside 1): $E_{light\ 5} = P_{light\ 5} * 2hours = 8Watt * 2hours = 16Wh$

Light 5 (back outside 2): $E_{light\ 5} = P_{light\ 5} * 2hours = 8Watt * 2hours = 16Wh$

Light 6 (back outside 3): $E_{light\ 6} = P_{light\ 6} * 2hours = 5.5Watt * 2hours = 11Wh$

Light 7 (living room 2): $E_{light\ 7} = P_{light\ 7} * 2hours = 5Watt * 2hours = 10Wh$

Light 8 (installation room): $E_{light\ 8} = P_{light\ 8} * 2hours = 5Watt * 2hours = 10Wh$

Light 9 (model room): $E_{light\ 9} = P_{light\ 9} * 2hours = 8Watt * 2hours = 16Wh$

Light 10 (stairs): $E_{light\ 10} = P_{light\ 10} * 2hours = 38Watt * 2hours = 76Wh$

Light 11 (bathroom 1st floor): $E_{light\ 11} = P_{light\ 11} * 2hours = 30Watt * 2hours = 60Wh$

Light 12 (bathroom spotlight): $E_{light\ 12} = P_{light\ 12} * 2hours = 20Watt * 2hours = 40Wh$

Light 13 (parents' bedroom): $E_{light\ 13} = P_{light\ 13} * 2hours = 8Watt * 2hours = 16Wh$

Total daily consumption

$$E_{daily} = E_{light\ 1} + E_{lgiht\ 2} + E_{lgiht\ 3} + E_{light\ 4} + E_{light\ 4} + E_{light\ 5} + E_{light\ 5} + E_{light\ 6} + E_{light\ 6} + E_{light\ 7} + E_{light\ 8} + E_{light\ 9} + E_{light\ 10} + E_{light\ 11} + E_{light\ 12} + E_{light\ 13} = 322Wh$$

Total consumption during the contest

$$E_{total\ contest} = 12 * E_{daily=} 12days * 331Wh = 3864Wh$$

Weekly, Monthly and annual consumption

	Weekly Consumption (Wh)	Monthly Consumption (Wh)	Annual Consumption (Wh)
Light 1 (outside front)	49	196	2352
Light 2 (toilet)	56	224	2688
Light 3 (hall)	56	224	2688
Light 4 (kitchen: 3x2Watt)	84	336	4032
Light 4 (living room 1: 2x4Watt)	112	448	5376
Light 5 (back outside 1)(ceiling)	112	448	5376
Light 5 (back outside	112	448	5376

2)(ceiling)			
Light 6 (back outside 3)(wall)	77	308	3696
Light 7 (living room 2)	70	280	3360
Light 8 (installation room)	70	280	3360
Light 9 (model room)	112	448	5376
Light 10 (stairs)	532	2128	25536
Light 11 (bathroom 1st floor)	420	1680	20160
Light 12 (bathroom spotlight: 5x4Watt)	280	1120	13440
Light 13 (parents' bedroom)	112	448	5376
Total Consumption (Wh)	**2254**	**9016**	108192

For the calculations of the weekly, monthly and annual consumption of the lights it was assumed that each week has 7 days so the weekly consumption of each lights is:

$$E_{weekly,light\ i} = E_{daily,light\ i} * 7$$

Then taking these weekly calculated values for each light as constant and assuming that each month has 4weeks and a year has $12\ \text{months}$ the monthly and annual consumption was calculated as following:

$$E_{monthly,light\ i} = E_{weekly,light\ i} * 4$$

$$E_{annual,light\ i} = E_{\text{monthly},light\ i} * 12$$

The sum of the above calculated values gave the total weekly, monthly and annual consumption of the lighting equipment.

Finally all the relevant scenarios showing the exact hours of the day that each appliance is used are found in the corresponding excel file.

Photovoltaic system description

The photovoltaic system consists of 25 glass-glass modules, 20 roof modules on the top of the skin and 5 window modules that are on the vertical side of the glass house. The total area is 43m^2 and the transparency factor 35% and 38% respectively. The installed power is 4.995kWp and the orientation of the system is south-east with 138° azimuth and 21° inclination. The PV modules are connected to the power optimizers which track the maximum power point and all in series are connected to the inverter of the system.

PV modules

For the PV modules you can refer to subchapter 5.3.5 for detailed analysis.

Inverter

For the inverter you can refer to subchapter 5.3.5 for detailed analysis.

Description simulation tools

Tools production simulation

For the calculation of the energy production of the photovoltaic system it was used the PVsyst 6.1.9 software. This software was used because it is considered one of the most reliable tool in the market. PVsyst also generates detailed analysis, which includes both graphs (e.g. production in relation with ambient temperature, extended loss diagram etc.) and numeric tables of the production of the photovoltaic system in hourly, daily, weekly, monthly and annual basis.

Tools consumption simulation

Lighting

The program that was used for the calculations of the consumption of the lighting equipment is the Microsoft Excel 2010 because it gives the chance to create tables of all the lights in relation to their hourly usage during each day and calculate via functions their consumption.

Appliances and devices

The program that was used for the calculations of the consumption of the appliances and devices is the Microsoft Excel 2010 because it gives the chance to create tables of all the appliances in relation to their hourly usage during each day and calculate via functions their consumption.

Cooling - Heating

The software that has been chosen for the energy modeling of the house, including the simulations for the cooling and heating design, is Design Builder.

This software was initially chosen because it provides many options concerning both the input and the output data that can be utilized by the user. In addition, there is the possibility to export dynamic results that offer a detailed overview over the cooling and heating design characteristics. More specifically, distribution curves are generated, so the outputs can be easily checked graphically, at the level of accuracy that is needed (hourly, daily, monthly or yearly). Comfort output, the operative temperature, the underheating and overheating hours are also illustrated. Moreover, the energy needed for cooling and heating are calculated automatically after any simulation. This tool is considered really useful, as one of the main objectives of the project is the lower possible energy consumption in the dating circumstances.

Ventilation

Ventilation calculations were carried out based on two factors:

- fresh air requirements(during summer and winter)

- cooling(during summer). These calculations were done on Excel.

Why it was used

The ventilation relations were customized and hence excel was chosen based on ease of use.

Domestic hot water

MS excel was used in order to estimate the energy required to heat the water from the storage temperature to 50 C.

The domestic hot water requirements were customized and hence excel was chosen based on ease of use.

Simulation results

Contest week simulations

Lighting equipment

The algorithms/functions that were used for the calculations are:

Daily consumption of light i:

$$E_{light\,i} = load * hours\ of\ use = P_{light\,i}(W) * t(hours)\ (1)$$

It should be mentioned that the calendar of the contest is divided in half hours and as a result the exact formula that it was used in the excel table was:

$$E_{light\,i} = energy\ consumed\ per\ half\ hour * half\ hours\ of\ use$$
$$= \left[P_{light\,i}(W) * \frac{30}{60} hours\right] * t(hours)$$

The total daily consumption of the lighting equipment was the sum of the consumption of all lights during the day:

$$E_{daily\ x} = \sum_{i=1}^{13} E_{light\ i}$$

Total consumption during the contest

The total consumption of the lighting equipment during the contest was calculated according to the following formula:

$$E_{contest/weekly} = \sum_{x=1}^{12} E_{daily\ x}$$

Appliances and Devices

The algorithms/functions that were used for the calculations are:

Daily consumption of appliance i:

$$E_{appliance\ i} = load * hours\ of\ use = P_{appliance\ i}(W) * t(hours)\ (1)$$

It should be mentioned that the calendar of the contest is divided in half hours and as a result the exact formula that it was used in the excel table was:

$$E_{appliance\ i} = energy\ consumed\ per\ half\ hour * half\ hours\ of\ use$$
$$= \left[P_{appliance\ i}(W) * \frac{30}{60} hours\right] * t(hours)$$

The total daily consumption of the lighting appliances was the sum of the consumptions of all appliances during the day:

$$E_{daily\ x} = \sum_{i=1}^{9} E_{appliance\ i}$$

Total consumption during the contest

The total consumption of the appliances during the contest was calculated according to the following formula:

$$E_{contest/weekly} = \sum_{x=1}^{12} E_{daily\ x}$$

Cooling - Heating

Most of the calculations were performed by the software (Design Builder) itself. Nevertheless, the basic equations that were used in order to define the energy demands for cooling and heating were the ones regarding the heat balance and are listed below:

Heating/Cooling capacity = Qinfiltration losses + Qventilation losses + Qsolar radiation + Qinternal heat gains

The internal heat gains are the total heat gains by the people and the appliances and are given by the following equation:

$$Qinternal = Qpeople + Qappliances$$

Ventilation

The CO2 limit inside the house was taken at 800 ppm. The ventilation requirements were calculated based on the number of people inside the house and their activity type.

Domestic hot water

The energy required to heat the water from storage tank temperature to a temperature of 50 C is calculated using the following relation.

$$E = \frac{V.\rho.C_p\Delta T}{3600}$$

Where, E is in kWh and V is in liter.

Annual simulation

Lighting

Monthly and annual consumption

For the monthly and annual consumption the average consumption of the contest week is considered as a constant consumption and is extended throughout the year. Hence, the formulas that were used are:

Monthly consumption:

Based on the thinking that in 12days the lighting equipment consumes in 31 days how much energy is going to consume the resulted formula is:

$$E_{monthly} = 31 * \frac{E_{contest/weekly}}{12}$$

Annual consumption:

Based on the thinking that in 12days the lighting equipment consumes in 365 days how much energy is going to consume the resulted formula is:

$$E_{annual} = 365 * \frac{E_{contest/weekly}}{12}$$

The results of the simulations are described in the Energy Balance Simulation narrative and the numeric results can be found in the appendix 14.4.2.

Appliances and devices

Monthly and annual consumption

For the monthly and annual consumption the average consumption of the contest week is considered as a constant consumption and is extended throughout the year. Hence, the formulas that were used are:

Monthly consumption:

Based on the thinking that in 12days the appliances consume in 31 days how much energy are they going to consume, the resulted formula is:

$$E_{monthly} = 31 * \frac{E_{contest/weekly}}{12}$$

Annual consumption:

Based on the thinking that in 12days the appliances consume in 365 days how much energy are they going to consume, the resulted formula is:

The results of the simulations are described in the Energy Balance Simulation narrative and the numeric results can be found in the appendix 14.4.2.

$$E_{annual} = 365 * \frac{E_{contest/weekly}}{12}$$

Heating

For the monthly and annual consumption the average consumption of the contest week is considered as a constant consumption and is extended throughout the year. Hence, the formulas that were used are:

Monthly consumption:

Based on the thinking that in 12days the heating system consumes in 31 days how much energy is it going to consume, the resulted formula is:

$$E_{monthly} = 31 * \frac{E_{contest/weekly}}{12}$$

Annual consumption:

Based on the thinking that in 12days the heating system consumes in 365 days how much energy is it going to consume, the resulted formula is:

$$E_{annual} = 365 * \frac{E_{contest/weekly}}{12}$$

The numeric results can be found in the appendix 14.4.2.

Cooling

For the monthly and annual consumption the average consumption of the contest week is considered as a constant consumption and is extended throughout the year. Hence, the formulas that were used are:

Monthly consumption:

Based on the thinking that in 12days the cooling system consumes in 31 days how much energy is it going to consume, the resulted formula is:

$$E_{monthly} = 31 * \frac{E_{contest/weekly}}{12}$$

Annual consumption:

Based on the thinking that in 12days the cooling system consumes in 365 days how much energy is it going to consume, the resulted formula is:

$$E_{annual} = 365 * \frac{E_{contest/weekly}}{12}$$

The numeric results can be found in the appendix 14.4.2.

Ventilation

For the monthly and annual consumption the average consumption of the contest week is considered as a constant consumption and is extended throughout the year. Hence, the formulas that were used are:

Monthly consumption:

Based on the thinking that in 12days the ventilation system consumes in 31 days how much energy is it going to consume, the resulted formula is:

$$E_{monthly} = 31 * \frac{E_{contest/weekly}}{12}$$

Annual consumption:

Based on the thinking that in 12days the ventilation system consumes in 365 days how much energy is it going to consume, the resulted formula is:

$$E_{annual} = 365 * \frac{E_{contest/weekly}}{12}$$

The numeric results can be found in the appendix 14.4.2.

Domestic hot water

For the monthly and annual consumption the average consumption of the contest week is considered as a constant consumption and is extended throughout the year. Hence, the formulas that were used are:

Monthly consumption:

Based on the thinking that in 12days the domestic hot water system consumes in 31 days how much energy is it going to consume, the resulted formula is:

$$E_{monthly} = 31 * \frac{E_{contest/weekly}}{12}$$

Annual consumption:

Based on the thinking that in 12days the domestic hot water system

consumes in 365 days how much energy is it going to consume, the resulted formula is:

$$E_{annual} = 365 * \frac{E_{contest/weekly}}{12}$$

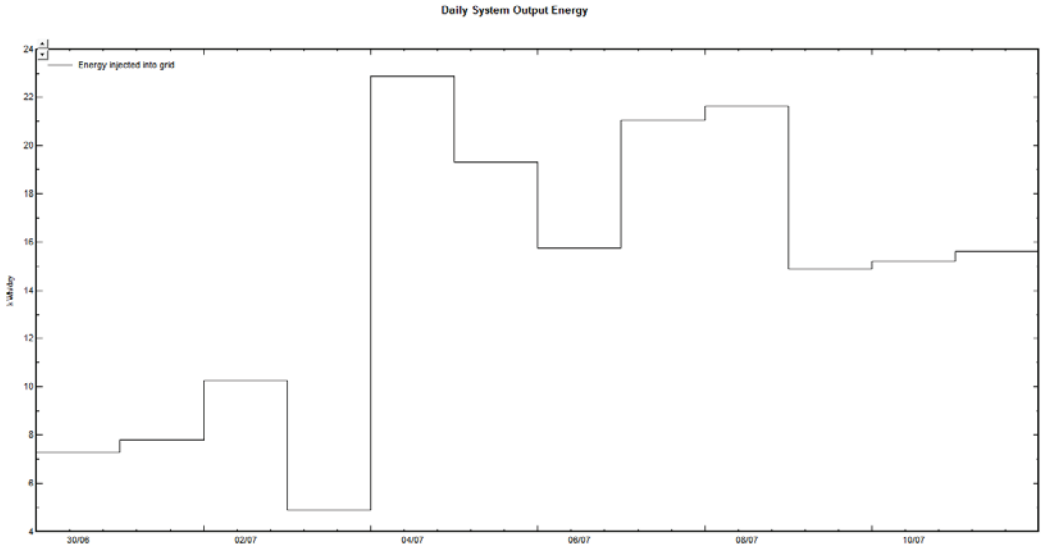
The numeric results can be found in the appendix 14.4.2.

Simulation results

In this section, the simulation results are going to be presented. First, the energy balance of the contest week is going to be calculated. After that, an annual consumption is going to be approximated by using the consumption of the contest week through the entire year. Regarding with the electricity production simulations, the PR of the system is at the levels of around 69% which means that our scenario is realistic.

Contest week simulation

First, the simulation of the contest week is going to be calculated. The electricity production during the days of the competition is simulated around 176.5 kWh total with PR of 69%. More details are presented in the graph below (also in the appendix 14.4.1):

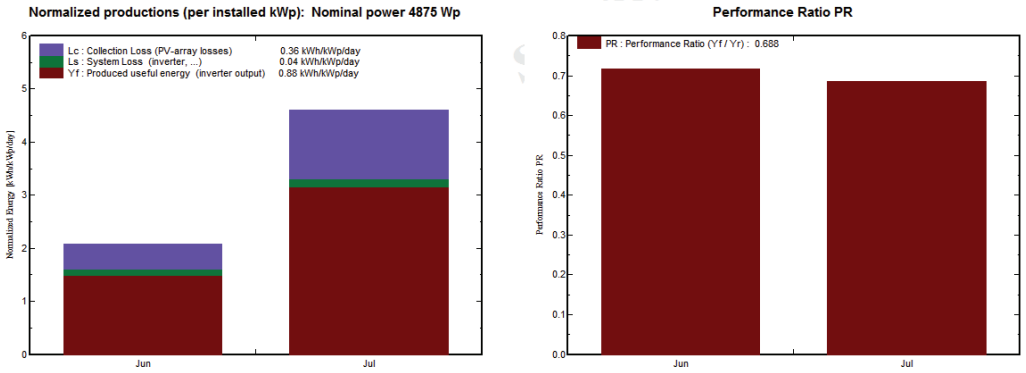


Main simulation results

System Production

Produced Energy **176.5 kWh** Specific prod. 36 kWh/kWp

Performance Ratio PR 68.8 %

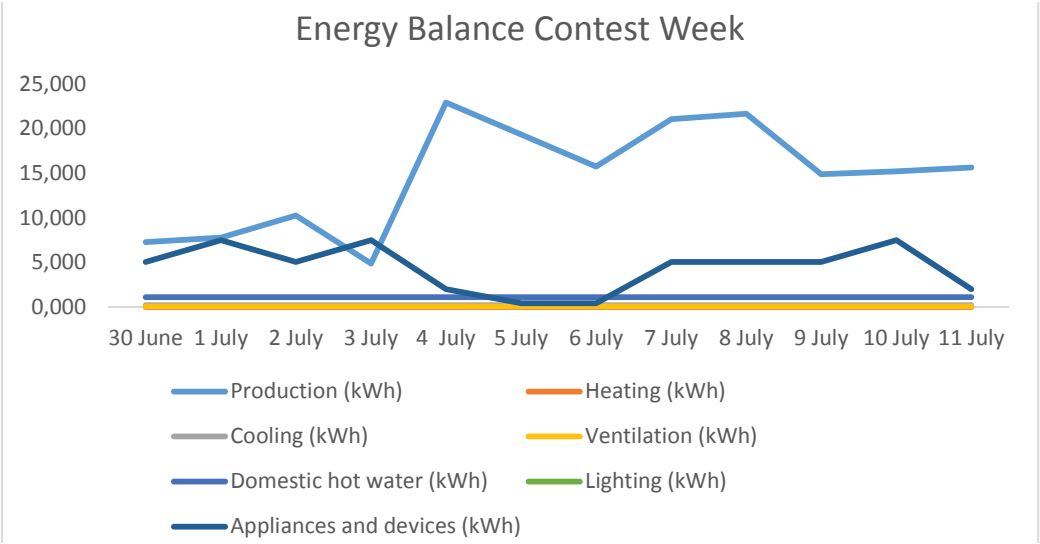


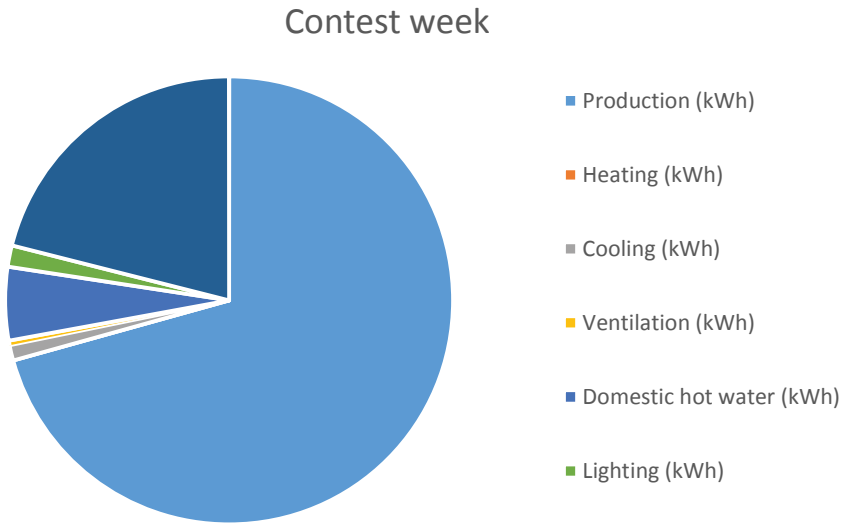
The results of the 12 days of the competition are presented in the following table (More info is included in 5.3.6.2):

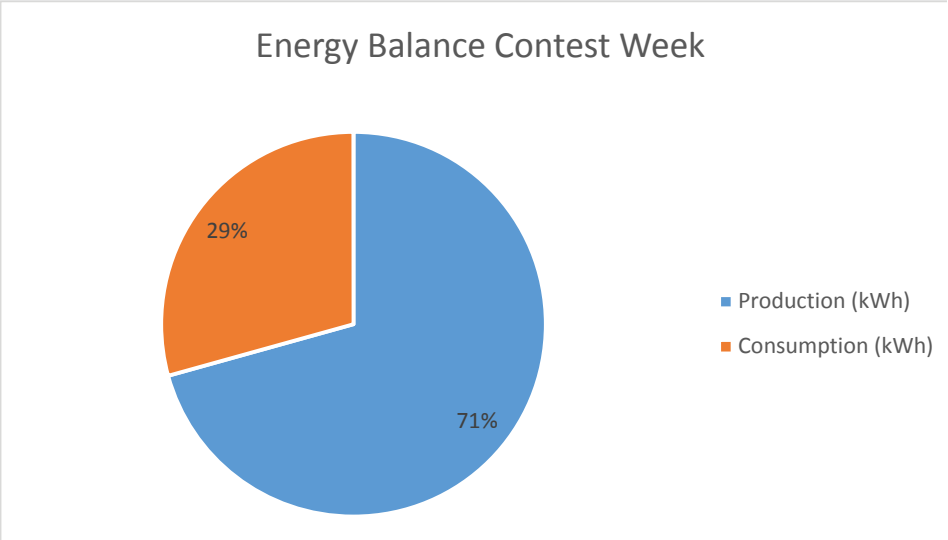
Day	30 June	1 July	2 July	3 July	4 July	5 July	6 July	7 July	8 July	9 July	10 July	11 July
Production (kWh)	7,264	7,788	10,25	4,876	22,89	19,31	15,75	21,05	21,63	14,89	15,2	15,63
Heating (kWh)	0	0	0	0	0	0	0	0	0	0	0	0
Cooling (kWh)	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23
Ventilation (kWh)	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07
Domestic hot water (kWh)	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1
Lighting (kWh)	0,322	0,322	0,322	0,322	0,322	0,322	0,322	0,322	0,322	0,322	0,322	0,322
Appliances and devices (kWh)	5,058	7,479	5,058	7,479	1,994	0,416	0,416	5,058	5,058	5,058	7,479	1,994
Balance	0,484	-1,413	3,470	-4,325	19,174	17,172	13,612	14,27	14,85	8,11	5,99	11,91

The total energy balance of the competition week is summed in the next table:

	Contest week (kWh)
Production (kWh)	176,528
Heating (kWh)	0
Cooling (kWh)	2,76
Ventilation (kWh)	0,84
Domestic hot water (kWh)	13,2
Lighting (kWh)	3,864
Appliances and devices (kWh)	52,547
Balance (kWh)	+103,317







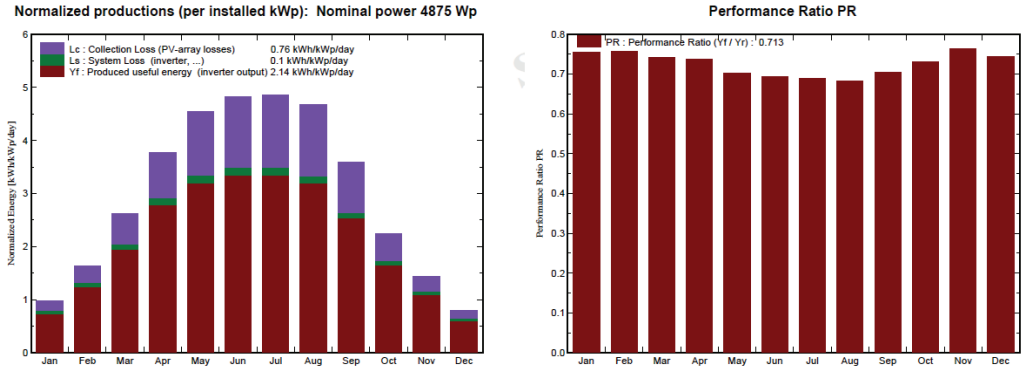
Annual simulation

The annual simulation consists of two parts, the annual consumption and the annual production. As stated earlier, the annual consumption will be generated by the consumption of the contest week (this is why there is only cooling throughout the year). The case is different for the energy production whose results were

generated throughout a year by the help of PVsyst. The results of the electricity production simulation are shown in the next image (also in the appendix 14.4.1):

Main simulation results
System Production

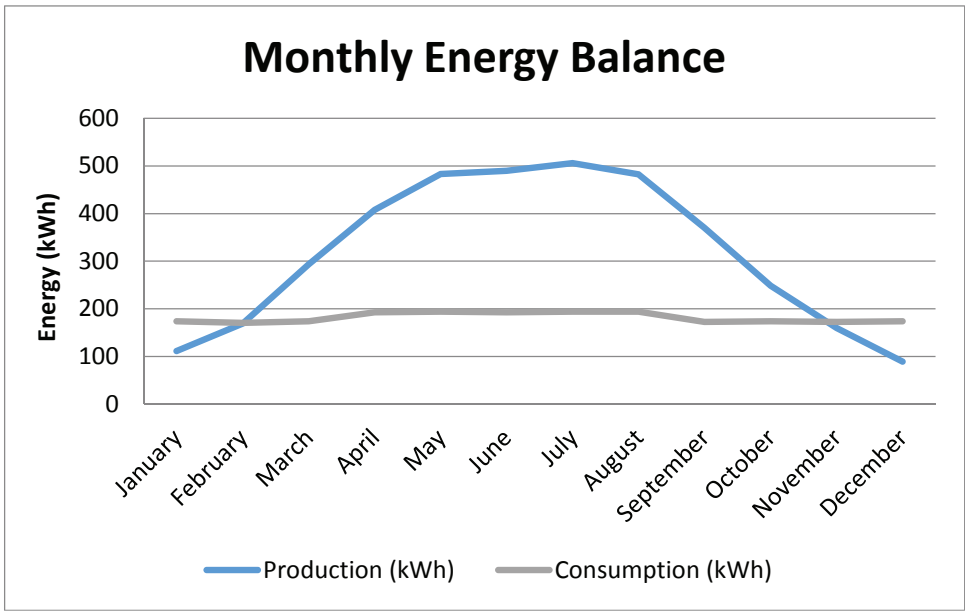
Produced Energy **3811 kWh/year** Specific prod. 782 kWh/kWp/year
Performance Ratio PR 71.3 %

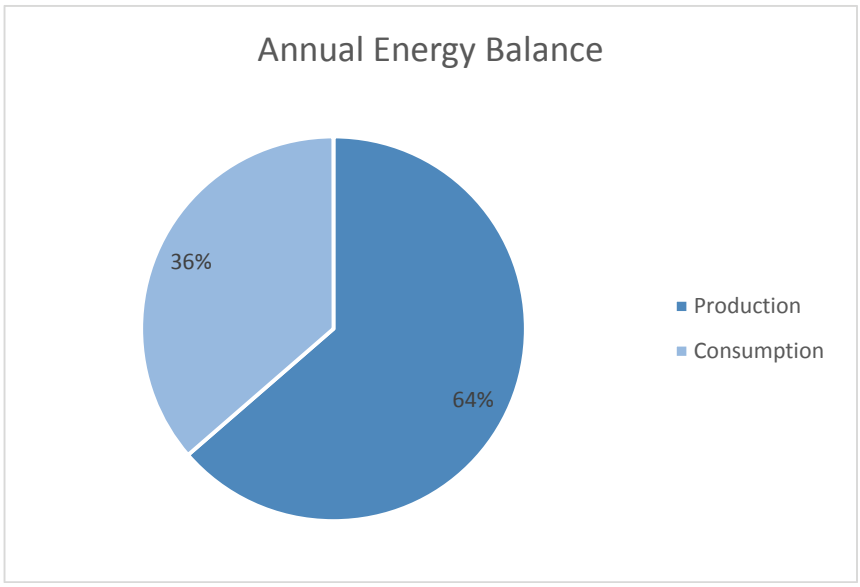


Additionally, the monthly consumption (along with the production) is presented in the following table. It is noted that due to the consumption rule 36.6 of the competition, the monthly consumption is considered the same during the whole year.

Montly Results	Production	Consumption	Balance (kWh)
January	111,3	173,79	-62,49
February	169,4	170,49	-1,09
March	293,5	173,79	119,71
April	407,6	192,69	214,91
May	483,3	193,79	289,51
June	489,4	192,69	296,71
July	505,9	193,79	312,11
August	482,5	193,79	288,71
September	370,4	172,69	197,71
October	248,4	173,79	74,61
November	159,9	172,69	-12,79
December	89,4	173,79	-84,39
Annual Result	3811,0	2177,78	1633,22

Finally, the two following charts show the results obtained by the annually energy balance.





By observing the annual energy balance pie chart, it becomes obvious that the prototype house is actually energy positive.

Energy Payback Time

As mentioned above, in order to calculate the energy payback time we need to know the specific amount of energy is needed for the production and the transportation of the PV modules. As referred in the chapter 3.5 Photovoltaic Design we do not know the specific amount of energy needed for the production of the PVs, as they are going to be manufactured handmade. Therefore, the energy payback time analysis is not possible to be carried out for this deliverable.

Critical analysis results

According to the results, the house throughout the year seems to be energy positive. The excess of energy is calculated to be approximately 1633kWh per year. Although this number is really good, it has to be pointed out that is is for the prototype house. For a real case scenario, more conservative assumptions will have to be made, leading to a house that is not energy positive but energy neutral instead, which was our main goal. Thus, we strongly believe that we achieved our targer, which was to make an existing house energy neutral.

Of course, there are real cases that the energy balance will be positive as well. For those specific cases, the excess of energy can be provided to the neighborhood's homes in order to supply them with "green" energy reducing at the same time their need for fossil fuels. Furthermore, in the future, the continuously increasing demand for energy could be covered by the aforementioned excess of energy. Such examples are the electric vehicles or even other house appliances that are still under development.

3.7 Solar Thermal Design

3.7.1 Context of Honselersdijk

Design criteria

The design creteria for the Solar Thermal Design is that is has a high efficiency, that it must be affordable, that it can be applicible in a renovation of Dutch row houses and that it can both function in all four seasons. Therefore te greenhouse is the most important design tool for Solar energy. The greenhouse functions as solar thermal energy harvester and uses this in a smart way. In winter it is used as pre-heated air for the house, in spring and autumn the greenhouse is an extra living space and in summer the greenhouse can open to lose its solar thermal heat.

It is very important that there is a smart controlling system behind this to make it function. If there is none, than the greenhouse will be way to hot in summer and makes the design not efficiently. Controlling the sunshading system and the opening of the windows is essential. Also to react on time, for example when there is a hot day forecasted, the controlling system already turns the sunshading down and the windows open in the morning in stead of waiting till the greenhouse has already become too hot.

A system that is both affordable and easily applied in the skin is found in the Solar Compleet system. The Solar Compleet system provides the house with the needed hot tap water during the whole year and heating for the radiators in winter.Thereby the energy panels from Solar Compleet extracts the heat from the PV panels and cools them down, which increases the efficiency of the greenhouse while generating hot water.

‘Solar compleet’ system

The serial THERMBOIL E is an innovative water heater, based on the system of heat The Solar Compleet syste Serial E is an innovative water heater, based on the system of heat pump which uses a solar panel as system of evaporation. Furthermore, the system is capable of absorbing the solar and ambient energy all year long, even during the cold period. The collected energy is passed on in the water via a condenser surrounding the outside of the tank.

3.7.2 Details solar thermal design

Detailed description

- The Energy panels underneath the solar voltaic panels have a double function:
- Cooling the PV panels to increase the efficiency
- A source of heat to let a heatpump run to obtain domestic hot water

The domestic hot water is storage in a 300 liter storage tank which has a heating spiral inside. The PV panels will be cooled at the warmest time of the day to get the best efficieny of the solar cells.
The stored hot water is sufficient to last a family of 4 for more than a day. The heatpump is controlled with sensors so that it get also cool when extra hot water is needed.
The hot water storage tank is the source of all the hot water including the hot water needed for the low temperature radiators.
The heatpump will require energy in order to work. The unit that is selected needs 1 [kW] to regenerate 4 [kW] of heating power.
There is also a back-up heat pump which can use the ambient air in the control room to still generate hot water. This back-up system will only be needed during the winter.
The heatpump can be installed in the attic of the existing house in Honselersdijk without much trouble. All the piping can be used and connected to the hot water reservoir.
The heating system in the original house is also done with hot water radiators. This makes the transfer to the new domestic hot water more achievable.

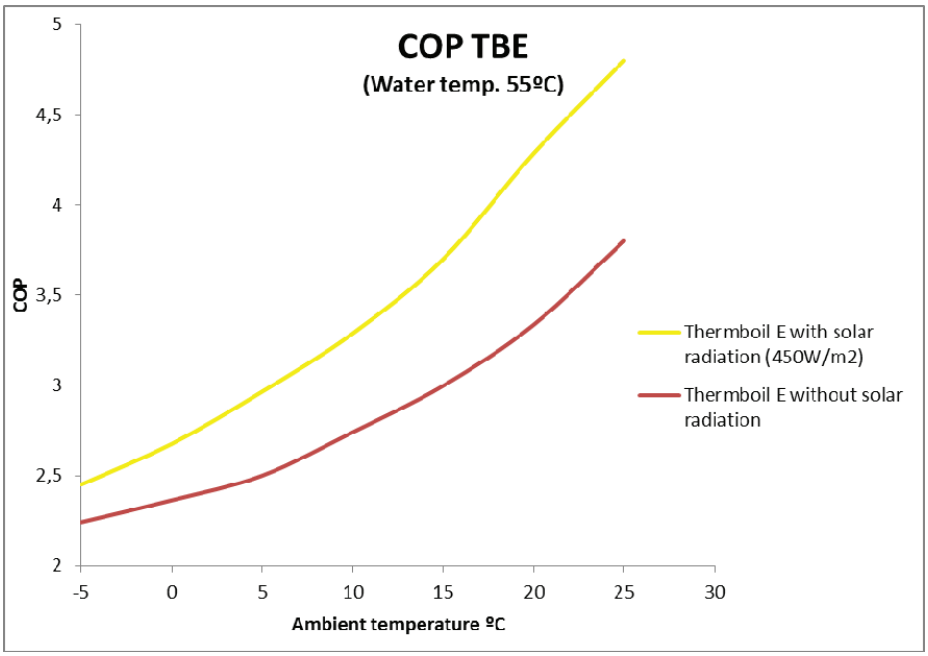
Thermodynamic solar equipment for domestic hot water

- Water heater for heat pump with thermodynamic panels integrated in the equipment.
- Stainless steel tank
- Compact unit, steel carcass lacquered.
- High-efficiency compressor
- Ecological cooling liquid R134 in.
- Stainless steel condenser.
- Isolating injected polyurethane 40 kg / cm.
- System of protection against high pressures and temperatures of functioning.
- Thermostatic expansion valve.
- Auxiliary electric system.
- All the equipments are tested in factory before sending.

Maintenance

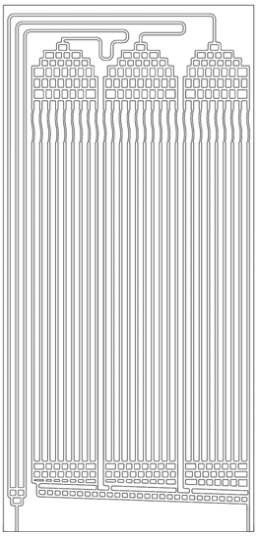
The maintenance of the Solar Compleet system can be divided in the Energy panels and the heatpumps with boiler. The Energy panels do not need much maintenance they have a long lifetime. The Energy panels are glued to the surface of the photovoltaic panels and are also hard to reach. The heatpumps with boiler are located in the technical room and are easy accessible. If there is a malfunctioning in the system it will be in the heatpump with boiler and is easy accessible to fix the problem.

PERFORMANCE DATA





THERMODINAMIC PANEL DIMENSIONS



1700 x 800x 25 mm

4 Energy Efficiency Design Narrative

4.1 Technical project summary

4.1.1 Technical summary Honselersdijk 'Home with a Skin'

Project Dimensions	Value	Reference
Gross area [m2]	148	
Gross Volume [m3]	302	Project Manual #5 Section III - Major changes for the house in Versailles
Surface area [m2]	121.4	
Net floor area [m2]	89.3	
Conditioned Volume [m3]	222.1	
House Envelope		
Walls area and Thermal transmitance - N [m2,W/m2K]	41, 0.117	Project Manual #5 Section II
Walls area and Thermal transmitance - S [m2,W/m2K]	41, 0.157	
Floor area and Thermal Transmittance [m2,W/m2K]	87.9, 2.93	
Roof area and Thermal Transmittance - N [m2,W/m2K]	28, 0.119	
Roof area and Thermal Transmittance - S [m2,W/m2K]	28, 0.151	
Glazing area and Thermal transmitance - N [m2,W/m2K]	2.441, 1.34	
Glazing area and Thermal transmitance - S [m2,W/m2K]	4.099, 1.96	
Glazing solar gain (SHGC) - N	0.474	
Glazing solar gain (SHGC) - S	0.635	
Glazing solar gain (SHGC) - Glasshouse	0.35	
HVAC systems		
Heating system		
Type	Solar Compleet	Appendix 4.1
Name	Energy Panel Thermboil 300 E	
Refrigerant	R134a	
Capacity [W]	4000	
COP	3,5-4,5	
Heat recovery Unit		
Type	HRU ECO-fan 3	Appendix 4.3
Efficiency	96%	
Power [W]	10-150	
Domestic Hot Water		
Type	Solar Compleet	
Name	Energy Panel Thermboil 300 E	
Refrigerant	R134a	
Capacity [W]	4000	
COP	3,5-4,5	
Solar thermal Panels area [m2]	5.44	
Storage Tank Volume [L]	300	

Electrical Energy Production	
	DMEGC mono c-Si glass-glass
PV Modules Type	customized
PvV panels area [m2]	43.61
Installed PV power [kWp]	4.875
Estimated energy production [kWh/year]	3753

Energy consumption	
Estimated energy consumption [kWh/year]	3185
Estimated energy consumption per conditioned area [kWh/year per m2]	34.26
Heating	19%
Cooling	0.00%
Ventilation	5.65%
Domestic Hot Water	27.4%
Lighting	4%
Appliances and Devices	44%

Energy balance	
Estimated energy balance [kWh/year]	568
Estimated CO2 emissions [Tn/year]	0

4.1.2 Technical summary Prototype house in Versailles

Project Dimensions	Value	Reference
Gross area [m2]	105.44	Project Manual #5 Section III - Major changes for the house in Versailles
Gross Volume [m3]	268.90	
Surface area [m2]	115.00	
Net floor area [m2]	85.00	
Conditioned Volume [m3]	216.80	
House Envelope		
Walls area and Thermal transmitance - N [m2,W/m2K]	27, 0.089	AR111
Walls area and Thermal transmitance - S [m2,W/m2K]	27, 0.114	AR113
Floor area and Thermal Transmittance [m2,W/m2K]	45.6, 0.236	
Roof area and Thermal Transmittance - N [m2,W/m2K]	28, 0.14	
Roof area and Thermal Transmittance - S [m2,W/m2K]	28, .189	Project Manual #5 Section III - Major changes for the house in Versailles
Glazing area and Thermal transmitance - N [m2,W/m2K]	4.53, .78	
Glazing area and Thermal transmitance - S [m2,W/m2K]	3.84, 1.69	
Glazing solar gain (SHGC) - N	0.474	
Glazing solar gain (SHGC) - S	0.635	
Glazing solar gain (SHGC) - Glasshouse	0.35	

HVAC systems		
Heating system		
Type	Solar Compleet	Appendix 4.1
Name	Energy Panel Thermboil 300 E	
Refrigerant	R134a	
Capacity [W]	4000	
COP	3,5-4,5	
Cooling		
Type	DCC-90 woningverkoeler (PCM 23)	Appendix 4.2
Flow rate [m3/h]	350	
Design temp [C]	23	
Cooling Capacity [Wh]	5530	
COP	-	
Heat recovery Unit		
Type	HRU ECO-fan 3	Appendix 4.3
Capacity [m3/h]	max. 325	
Efficiency	96%	
Power [W]	10-150	
Domestic Hot Water		
Type	Solar Compleet	Appendix 4.1
Name	Energy Panel Thermboil 300 E	
Refrigerant	R134a	
Capacity [W]	4000	
COP	3,5-4,5	
Solar thermal Panels area [m2]	5.44	
Storage Tank Volume [L]	300	

Electrical Energy Production		
PV Modules Type	DMEGC mono c-Si glass-glass customized	TEE SID sheet #6
PvV panels area [m2]	43.61	
Installed PV power [kWp]	4.875	
Estimated energy production [kWh/year]	3811	

Energy consumption		
Estimated energy consumption [kWh/year]	2354	
Estimated energy consumption per conditioned area [kWh/year per m2]	27.69	Project Manual #5 Section III - Major changes for the house in Versailles
Cooling	3.6%	
Ventilation	4.25%	
Domestic Hot Water	17.03%	
Lighting	13%	
Appliances and Devices	62%	

Energy balance	
Estimated energy balance [kWh/year]	1457
Estimated CO2 emissions [Tn/year]	0

4.2 Comprehensive Energy Analysis and Discussion Report

The aim of the competition is to get an energy positive house in the local context. However, there are multiple strings attached to this goal. Affordability, architectural integration and engineering limitations seek to make it difficult to achieve these targets. For Prêt-à-Loger, all three of them matter and the project is evolving as a perfect balance between these characteristics. Since the houses are being renovated, it becomes immediately important to consider the age of the house and it's structural strength. How will the addition of new insulation layers affect the structure? Will it be possible to completely remove the façades and install a new one? How long will it take to add the new installation in the house? Architecturally, will it please the house owner? Will they be able to afford it? All these questions have to be balanced against the level of energy performance they wish to achieve. Certain things like aesthetic quality, ease of renovation are constrained and thus it makes Prêt-à-Loger project unique. Engineering rises above these challenges and provides what people are really looking for – a 'Home with a Skin'.

In the early design phase Autodesk Ecotect was used to get initial estimates on the house heating demand. In later stages, Design Builder was used extensively for optimising the design. Various simulations were run by changing the wall compositions and schedules for openings and occupancy behaviour. These results were used to estimate the heating and cooling loads of the house. The glasshouse design was simulated in ANSYS Fluent to see the effect of solar radiation on temperatures inside the glasshouse.

4.2.1 SECTION I - Influence of Energy Analysis on House Design and Strategy

Energy analysis objectives and methodology

Most of the existing dwellings in Netherlands were built around 1960-1980s. Because of the age or the poor construction quality, these buildings perform very badly in terms of energy consumption, and definitely they are far from offering comfortable living conditions for their inhabitants.

The team's focus is on improving the existing conditions and make those buildings perform better and to assure that the people living in these buildings would enjoy every single moment of their lives. The main goal of the team is to transform the existing dwellings into 'Energy Positive Houses'. To begin with, ideas and concepts were developed which could decrease the energy loads. Moreover, it is important that besides the technical solutions of improving insulation values or reducing thermal losses, the inhabitants should also know that the main energy consumer in the habitat are they themselves, and try to convince them that they should reconsider their consumption habits.

Additionally development of passive strategies was emphasized, which would mean the use of natural conditions to control the climate environment inside the house, like natural ventilation, solar water heating etc. To maximiee the efficiency of energy delivery, energy generation on site and energy recovery systems are also employed. This



entails that the user receives maximum benefit from the solar energy and uses heat recovery installation in order to reduce the energy wastage. The team struggled in developing these concepts, and was always trying to be sure that the comfort conditions are satisfactory for the inhabitants, that their living environment is healthy and that the costs of these innovative solutions in terms of sustainability are low.

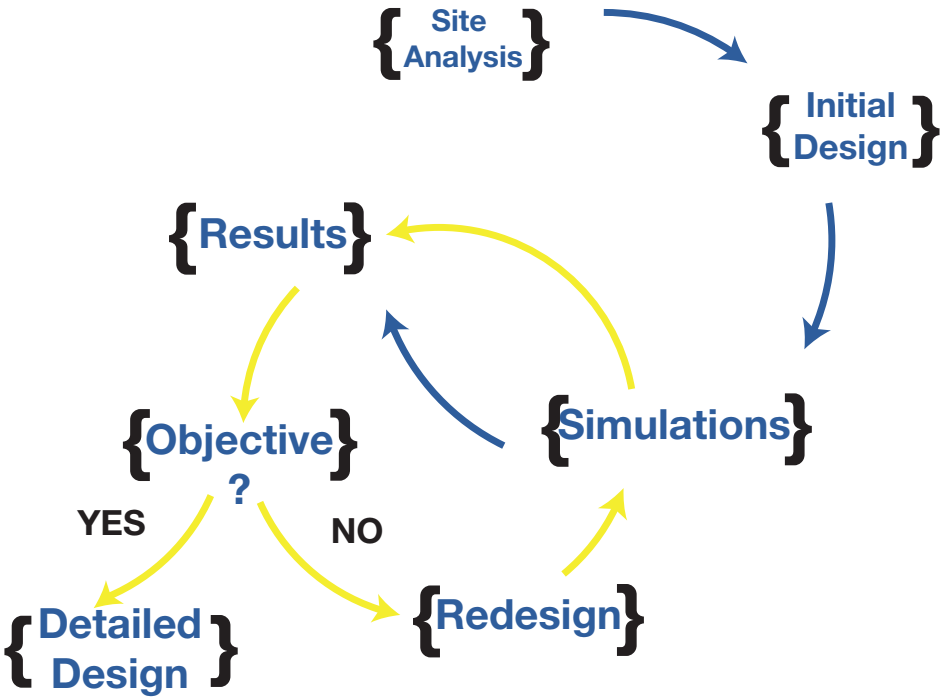


Figure 4.1 — *Design Methodology*

Methodology

Every conceptual idea we started to develop was based on the initial site analysis, in our case the site being represented by the Honselersdijk neighborhood conditions. After analyzing these local conditions preliminary design was performed, where the solutions were provided in a conceptual form, gathered together and analyzed. The analysis process was being performed by the use of simulation software, by which we could evaluate the proposed solutions in terms of efficiency and impact. If the results of the simulations were consider to satisfy entirely out team's objectives, than the solutions were considered to be valid, and the process continued with further deeper investigations and progressed into detailed designing. If the simulations were showing unsatisfactory results, than the solutions proposed would be redesigned and re-analyzed, until the simulations' results could meet our expectations.

Month of year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SUM
	01	02	03	04	05	06	07	08	09	10	11	12	1-12
Dominant Wind dir.	↗	↖	↗	↗	↖	↗	n/a	n/a	n/a	n/a	n/a	n/a	↗
Wind probability >= 4 Beaufort (%)	1	4	9	4	0	0	n/a	n/a	n/a	n/a	n/a	n/a	3
Average Wind speed (kts)	4	5	5	3	3	2	n/a	n/a	n/a	n/a	n/a	n/a	3
Average air temp. (°C)	3	3	5	10	13	17	n/a	n/a	n/a	n/a	n/a	n/a	8
Select month (Help)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year

Figure 4.2 — *Climate data for Honselersdijk*

Temperature of Honselersdijk shows moderate climate condition. The charts describe annual wind speed, wind direction and annual temperature relatively. Domestic wind direction is S.S.W. It also mainly blows north-west and north-east direction. During summer, average wind speed is 4~5 m/s and winter time the wind speed is almost twice of that of summer with 6~8m/s. the range of annual average temperature is from 3°c (Winter) to 17°c (Summer). Otherwise, the temperature for Spring and Autumn is normally, 12°c. In terms of direction of sunlight, facing to south can get strong sunlight.

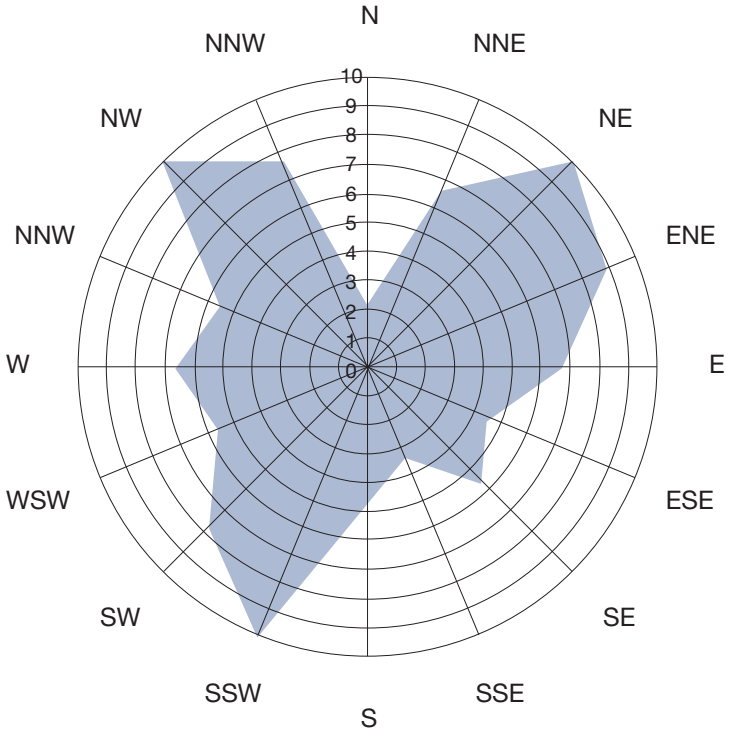


Figure 4.3 — *Wind speed & wind direction(year) for Honselersdijk*

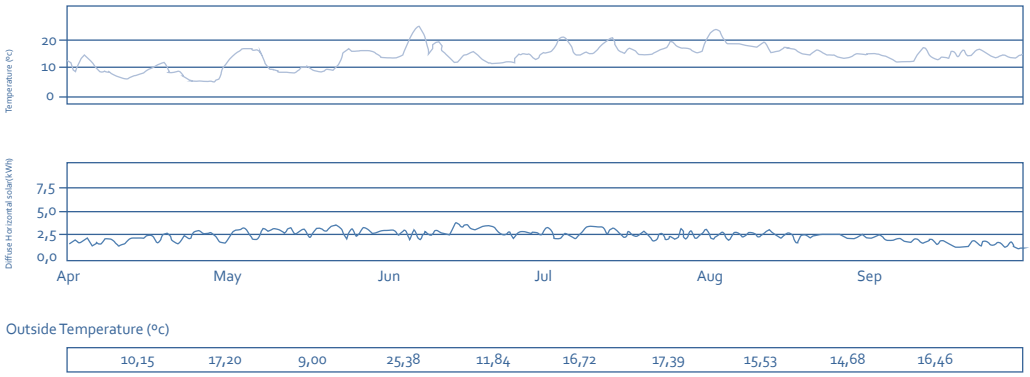


Figure 4.4 — *Outside temperature profile*

Outside Temperature (°c)

10,15	17,20	9,00	25,38	11,84	16,72	17,39	15,53	14,68	16,46

Team Energy Strategy

The energy strategy is closely related to the team's product philosophy which is to preserve the original characteristics of the house as far as possible and at that same time improve its energy performance. The basis for team's energy strategy is 'Trias Energetica' a concept formuylated at TU Delft in 1979.

Central to this concept is the idea to reduce the wastage of energy in the house, which is mainly due to energy leaking through the house envelope and out of the air ventilation system. Also, use of passive systems can largely reduce reliance on power. Therefore, minimizing(or eliminating) unnecessary use of energy. The next step is to generate as much energy as possible through renewable sources like solar radiation or wind. Finally, if the demands are not being met, the strategy suggests to make use of fossil fuels as efficiently as possible. While implementing this 3 step strategy, great care has been taken to not compromise the comfort levels inside the house.

In the end the proposed solutions have to be affordable and have market potetntial. Thus the idea of using a toolbox of solutions becomes all important. Certain parts of the envelope the 'skin' can be substituted for attaining better comfort levels or achieve a more environmentally friendly lifestyle. These solutions of course come at increased prices. Thus, during the process of designing an energy efficient house, it is crucial to consider the ability to easily fit in multiple solutions from the toolbox.

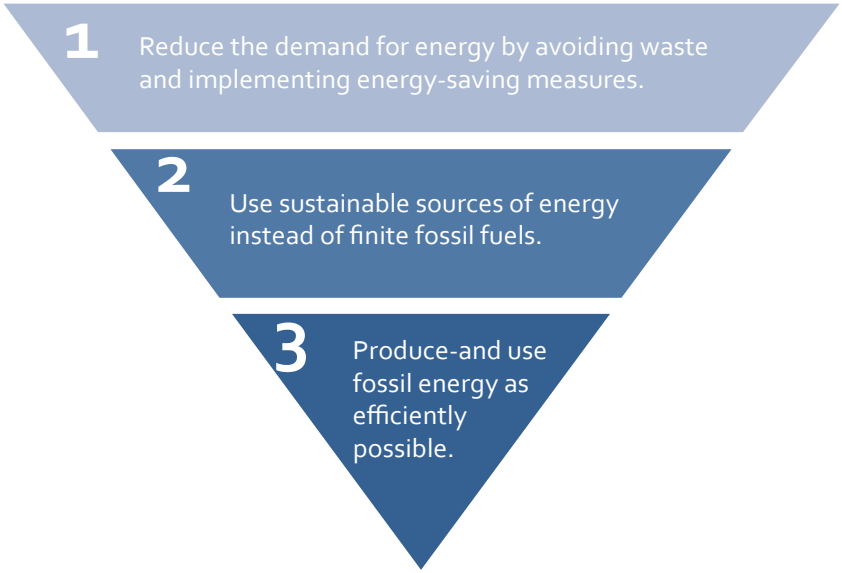


Figure 4.5 — *Trias Energetica, the team's energy strategy.*

Influence of the energy analysis in the project design

selersdijk was chosen and its energy consumption was analysed. To get an accurate estimate of the house's heating and cooling demands, a block model was created which has 3 houses. The house's heating capacity is analysed as shown:

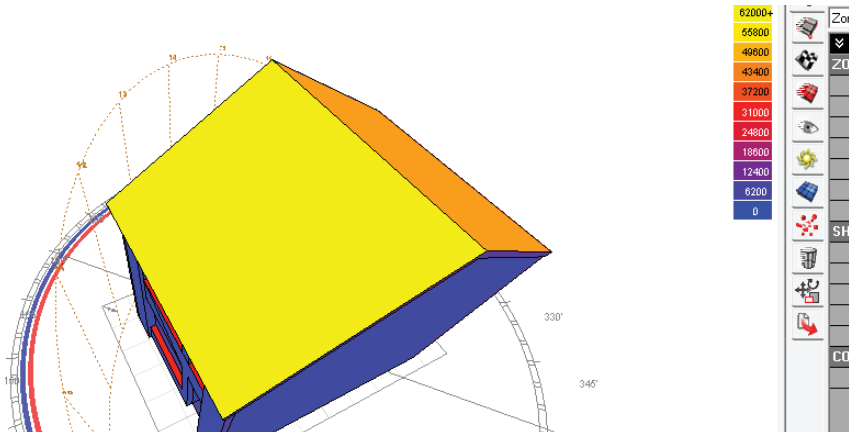


Figure 4.6 — *Solar radiation as recieved by different surfaces on the Honselersdijk house*

Solar radiation study show that the south east facade of the house recieves the major share of solar radiation. The gasshouse is thus added on the south facade to maximize the heat retention during winters. This addition results in significant reudction in heating loads. Analysis also shows that adding a glasshouse on the north facade doesnot make a lot of sense as amount of solar radiation falling on that side is less (by 30%).

Hence it makes more sense to install hot water generation devices on the southern facade. The goal at this stage is to provide all the heating required by the house using hot water radiators. Energy analysis provides interesting insights into the possibility of using hot water radiators system for heating the house.

In order to further improve the team's understanding of the existing house in Honselersdijk, its energy consumption was analysed. To get an accurate estimate of the house's heating and cooling demands, a block model was created which has 3 houses.

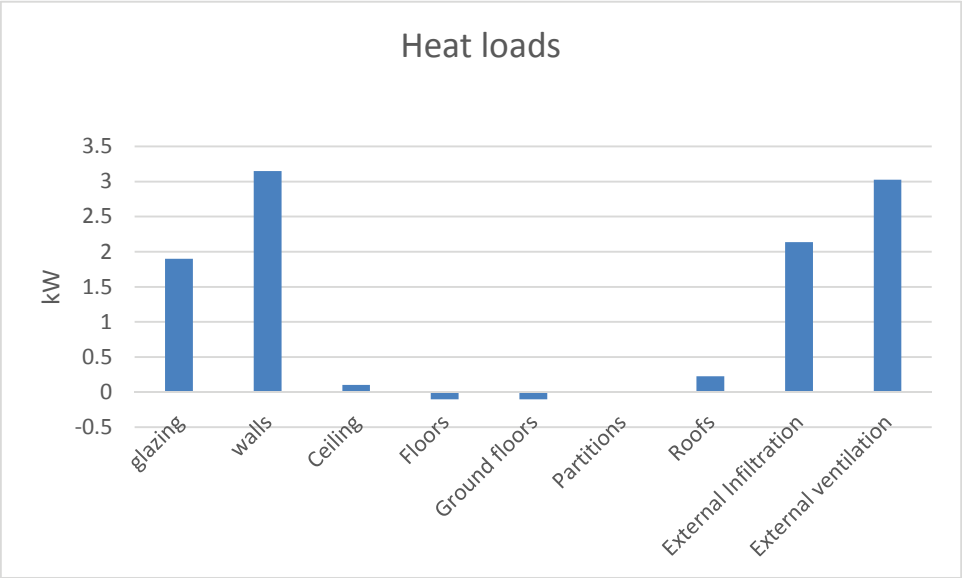


Figure 4.7 — *Break up of heat losses from the House in Honselersdijk*

As can be seen from the figure above that the major heat losses come from the walls,external ventilation, external infiltration and glazing. It can be concluded that a major saving in energy design can be achieved by reducing the losses mentioned above.

In order to reduce these loads it is important to identify passive interventions. Addition of a glasshouse plays a significant role as it creates a buufer thermal zone which due to its higher internal zonal temperature results lesser heat losses. The benefit is that this intervention is completely passive. External infiltration losses are also reduced as the glasshouse zone (when closed) has a stagnant air volume.

Based on initial site analysis, it can be concluded that indoor climate is unfavourable and at the current situation does not provide the required comfort without a high-energy consumption. The damage registered to the inner finishing proves the high humidity within the walls. This can be due to water capillary action form the ground but also to a lack of water tightness of the façade and the roof. Better insulation, water tightness and different energy sources (such as PV cells) can considerably improve the existing situation achieving a sustainable house, at least from the energy point of view. With this in the background, the bioclimaitc strategies were developed as will be described in the following pages. The figures show the section of the house and functioning of different energy saving measures such as the glasshouse, thermal panels the ventilation system etc., at different times of the year.

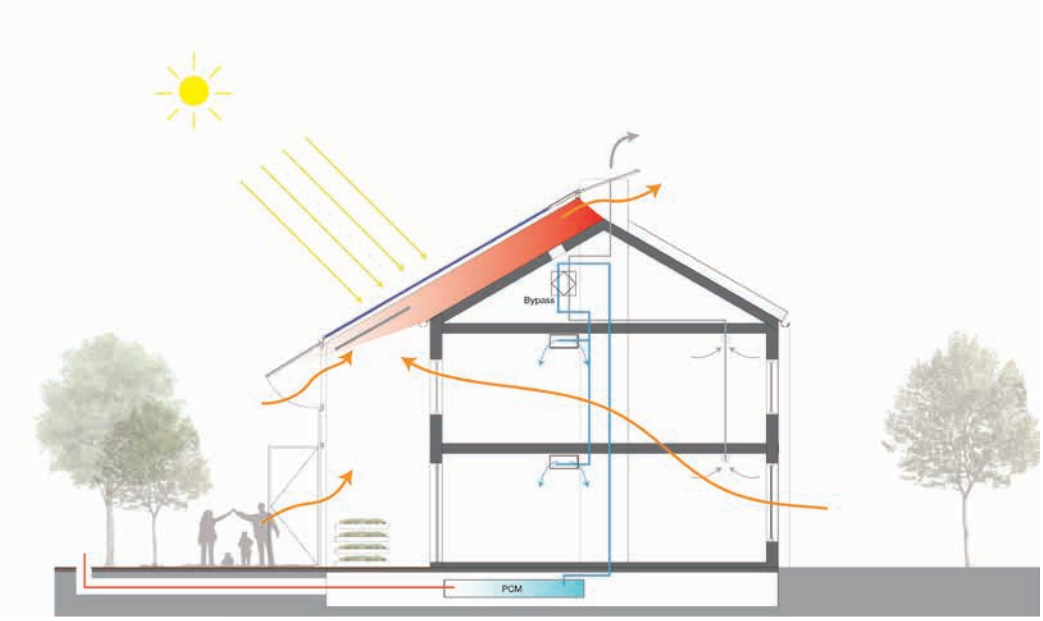


Figure 4.8 — *Climate scheme for Honselersdijk - Summer Day time*

Summer (Day time)
Summer day time, warm outside air flows to underground pipe and it is cool down by PCM. At the same time, it is possible to use natural ventilaiton when people want to open door and windows. In this case, cross ventilation can occure. The channels are inserted close to the garden surface to avoid to labourous digging.

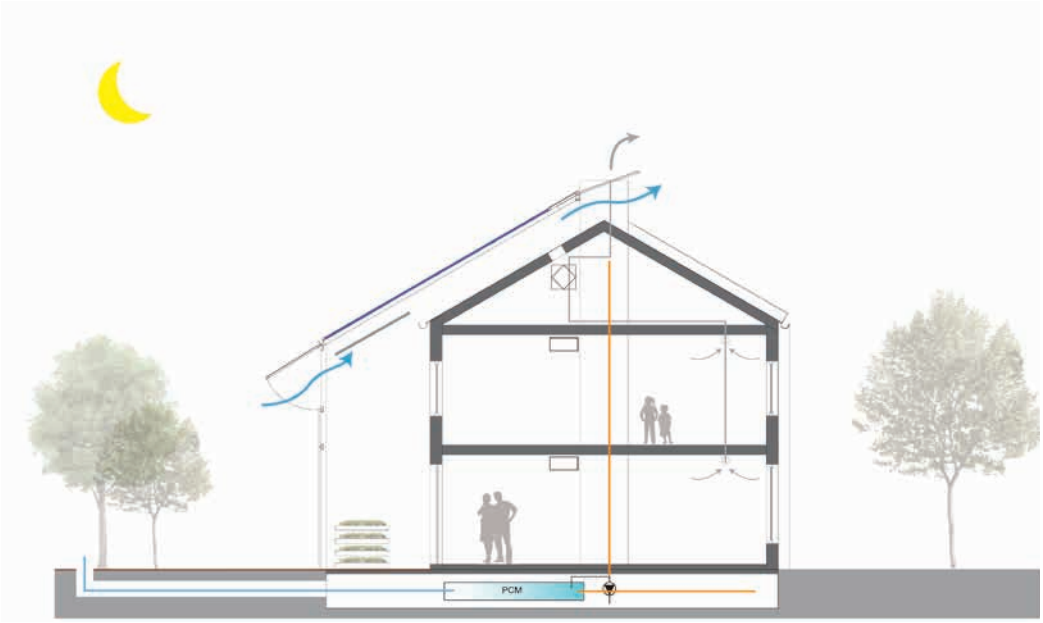


Figure 4.9 — *Climate scheme for Honselersdijk - Summer Night time*

Summer (Night time)
Ventilation system is different according to the outside temperature. Normally, cooled air comes into indoor like the same way of daytime. Heat exchanger also does not work during nighttime, only exhausted air from toilet and bathroom goes out throught the chimney and heat exchager.

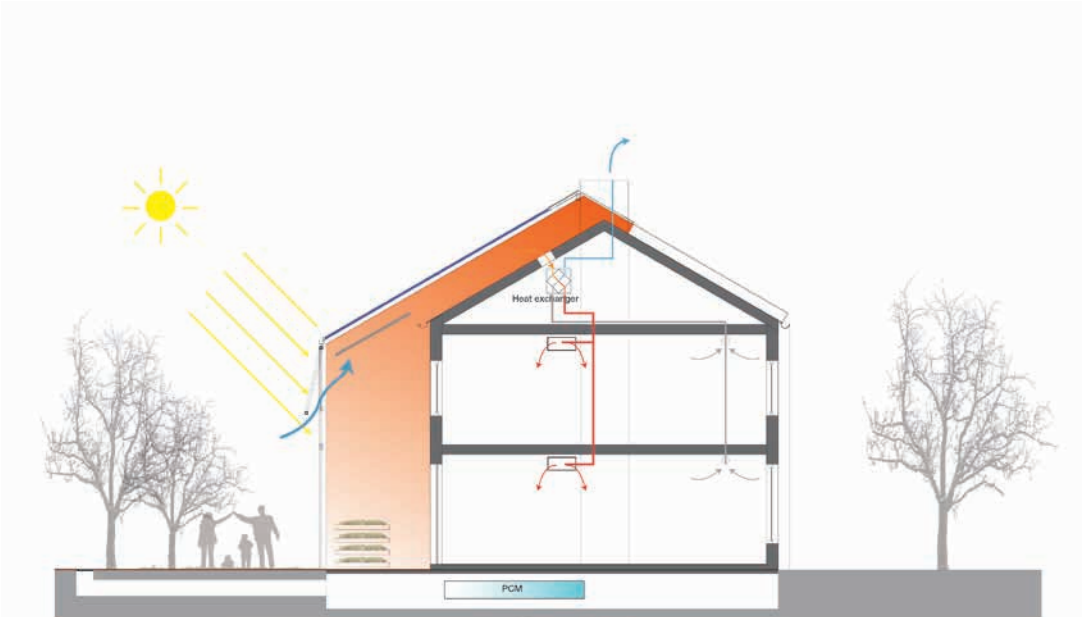


Figure 4.10 — *Climate Scheme for Honselersdijk - Winter Day time*

Winter (Day time)
In winter, heat exchanger plays a key role for indoor air condition. Warmed air by the sunlight in the glasshouse is passed by the heat exchanger and heated enough for indoor temperature. Further, exhauted air is cool down in the heat exchanger.

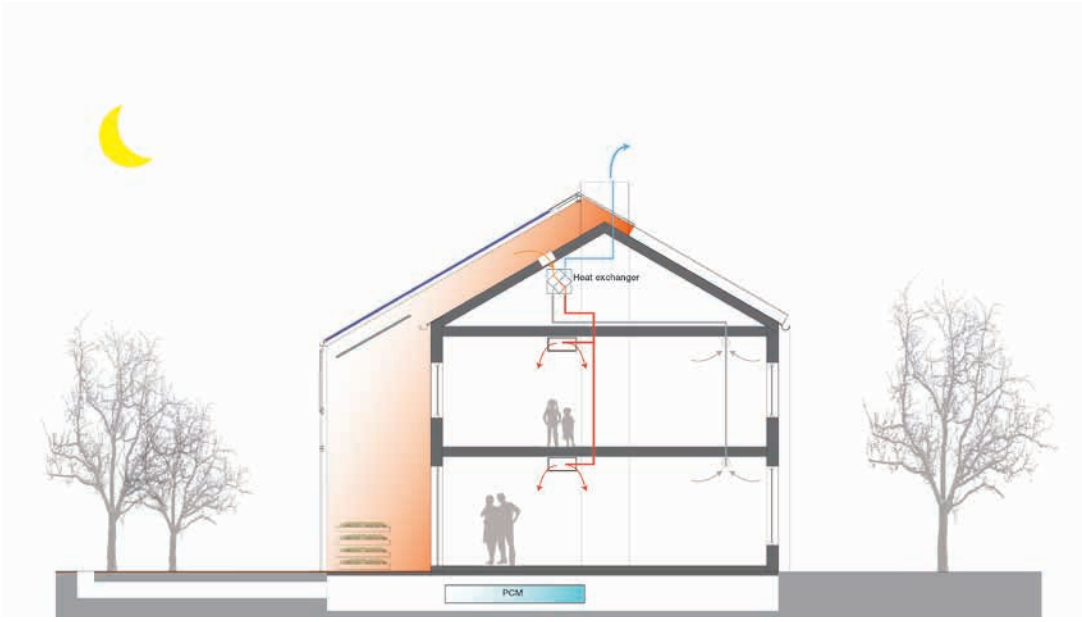


Figure 4.11 — *Climate Scheme for Honselersdijk - Winter Night time*

Winter (Night time)
Night time, all doors and windows are close. Compared to that of daytime, there is only one difference whether geenhouse will be opened or not.

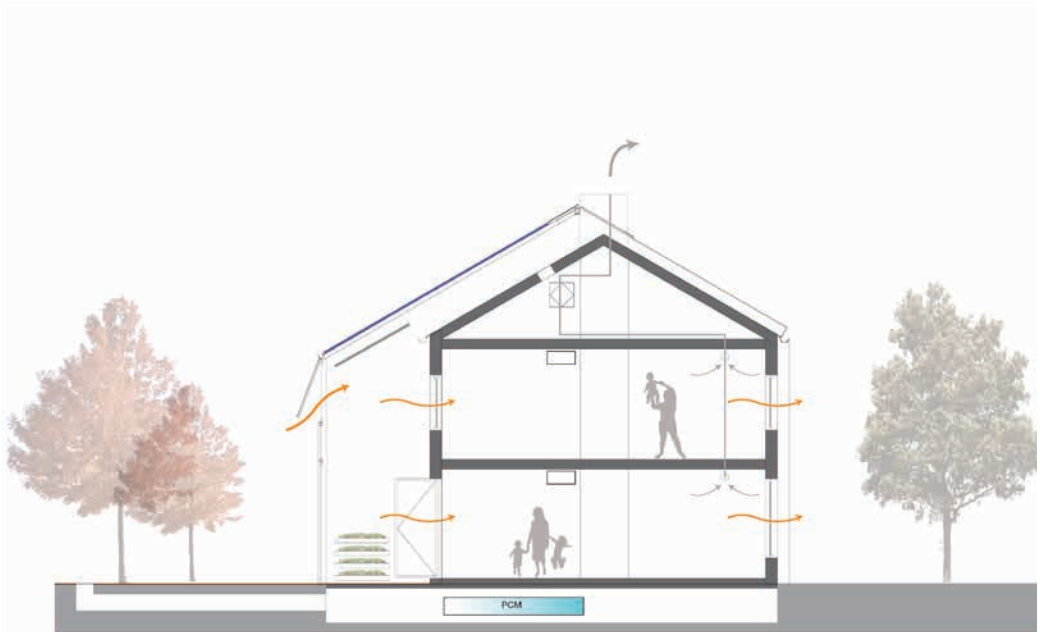


Figure 4.12 — *Climate Scheme for Honselersdijk - Spring & Autumn*

Spring & Autumn
With the Moderate temperature, there is only natural ventilation system by opening doors and windows.

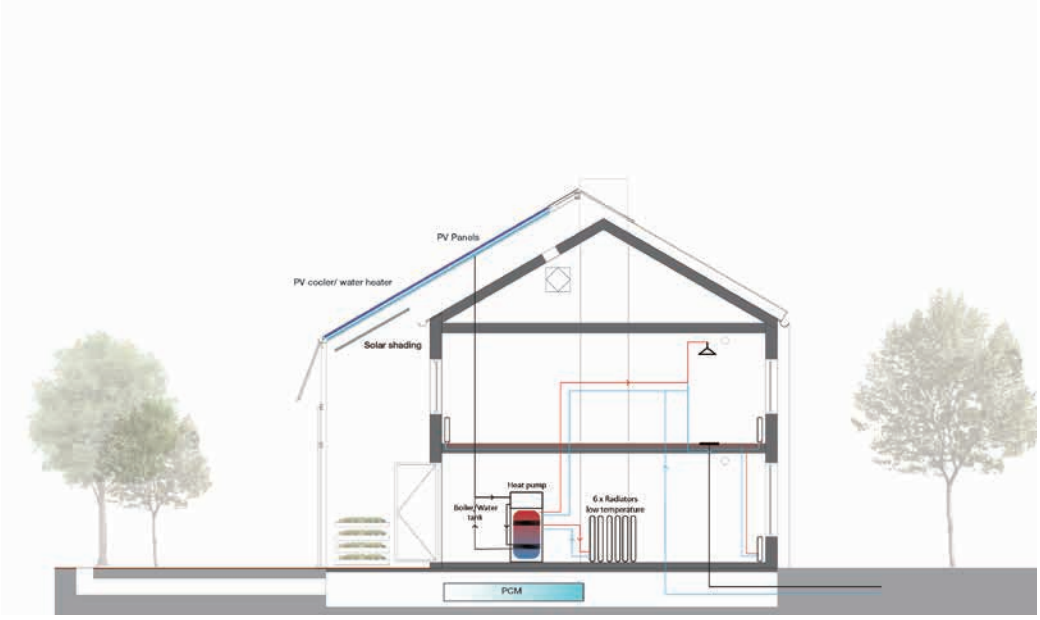


Figure 4.13 — *Hot water production system*

The schematic diagram shows the water circulation wih heating system. The heating of the house is done by using radiators and as such hot water production is very important. The heat pump system as shown in the figure above, provides hot water for shower and radiators.

4.2.2 SECTION II- Projected Performance of the Housing Design Unit

Housing unit and system description

Geometry

The project deals with renovating the existing houses. The case presented here is a house in Honselersdijk in Netherlands. The back façade of the house faces SE and thus is not aligned completely to the south (42^0 SE). This hinders the house's ability to harness the radiation from the sun to the maximum. However, the team takes this as a challenge and strives to achieve a positive energy balance regardless. The reason lies in the fact that majority of the houses in the Netherlands are not aligned properly to the North-South direction and in order to renovate these houses, it is important to make a design for these cases.

Another important factor about the design is the available roof area. Unlike other house types, the available roof area is limited and roof inclination is fixed. This presents a remarkable challenge to the team as these values are not optimum for maximum utilization of available solar energy. The area available on the south façade is 28 m2 and is used completely for producing electricity from PV cells. Hence a variant of solar thermal arrays for producing hot water were used.

Envelope

The main idea behind Prêt-à-Loger's concept is to improve the performance of the existing housing in Netherlands by enclosing the dwellings within a glass skin. 'The skin' would decrease considerably the amount of energy needed for heating the house in winter and would assure a complex but beneffic natural ventilation system. However, 'the skin' is not the only improvement Prêt-à-Loger team has been considering. Other important construction elements were also investigated, and replaced within the energy models. This way, the impact of each unit replaced could be exactly evaluated in terms of performance and costs. In Table 4.3, the main construction units considered for replacing are represented together with the U - Values characterizing them. Mainly the units represent the envelope of the house and/or 'the skin'. The table contains the main improvements Prêt-à-Loger has considered, and the performance of each of these units has been calculated and presented in later sections of this chapter.

U VALUES	HOUSE EXISTING CONDITIONS		HOUSE HONSELER-SEDIJK
EXTERIOR DOORS	2.557		2.557
WALL CONSTRUCTION (SOUTH)	2.557		0.14
WALL CONSTRUCTION (NORTH)	2.557		0.14
ROOF CONSTRUCTION (SOUTH)	0.34		0.168
ROOF CONSTRUCTIO (NORTH)	0.34		0.129
GLAZING WINDOWS (SOUTH)	SOLAR HEAR GAIN COEFF.	0.858	0.563
	LIGHT TRANSMISSION	0.898	0.745
	U - VALUE	6.257	1.96
GLAZING WINDOWS (NORTH)	SOLAR HEAR GAIN COEFF.	0.858	0.564
	LIGHT TRANSMISSION	0.898	0.745
	U - VALUE	6.257	1.499
GLASSHOUSE GLAZING	SOLAR HEAR GAIN COEFF.	-	0.427
	LIGHT TRANSMISSION	-	0.52
	U - VALUE	-	5.75

Table 4.1 — *U Values of the main construction elements of the envelope*

Passive design strategies

- Glasshouse as a buffer

The addition of glasshouse helps the house in many ways. In addition to providing aesthetic beauty to the house and providing the skeleton to the skin, it creates additional living space for the months of spring and summer and also acts as a heat buffer during the months of Winter. This helps in reducing the amounts of insulation to be added to achieve a high heating performance in the house. As a result the south facade has a lesser amount of insulation added to it. The effect of adding adding this air buffer will be discussed in the coming sections.

- Air preheating during winter

The air inlet for the winter months is through the glasshouse where the air is warmer than the outside air and thus it takes lesser energy to heat it to supply to the house.

- Cooling

The temperatures in summer in Netherlands are not extreme and thus present no need to implement an additional cooling system. The cooling needs are then taken care by natural means. Opening of windows creates cross ventilation in the house and cools it down naturally.

Energy efficiency measures

- Openings

For the summer, the natural ventilation will be on during the night to cool down the thermal mass of the house. That means that the regulation of the openings regards only the night hours between 23:00 till 08:00 in the morning. The Natural ventilation schedule is the same for the weekdays, weekends and holidays.

The ventilation rate in the house is set to 3 ac/h if the openings are going to be completely open.

Regarding the glasshouse, the demand for natural ventilation is higher. That is why the ventilation rate is set to 5 ac/h. It is considered that the openings have sufficient area to allow for that inlet.

For the winter period, the natural ventilation is off which means that the openings are going to be operated according to the occupants' needs.

- Building Automation systems (Comfilux)

The Comfilux system is a home automation system designed to increase comfort level with home functionality and energy efficiency, under the spectrum of simplicity and affordability. It is going to control four key functions of the house- lighting, heating system, the cooling and ventilation system, and the glasshouse. The Domotica system is mainly working through wireless connections achieved by z-wave or somfy systems. Making it easily applicable in existing residences.

For cooling and ventilation- temperature, CO2 and VOC sensors will control two 3-way electric valves and one air pump. The 3-way valves are used to determine where the air flow will come from, depending on whether cooling or ventilation is needed. Inputs through movement and light intensity sensors will control whether a light will open or close. sensors in the glasshouse control the temperature, humidity and irradiance (sun shading) inside the glasshouse. Temperature and humidity sensors will be used to control the temperature and quality of air inside the glasshouse. The shading system will also help in cooling the glasshouse although its main function is to reduce the intensity of the light. Smoke detectors will exist but won't be connected to Domotica.

- Heat pump

The heat pump which provides hot water for domestic use and heating purposes, works like a reversed airconditioner. Instead of using a working fluid to absorb heat from inside and releasing this heat to the outside, it substracts energy from the outside air and releases this to the water. This cycle is known as the refrigeration cycle. The water will be heated to a temperature of 55 degrees. This does require external energy to start the cycle of heating the water but it uses the heat from the outside air, therefore saving energy.

The heat in the outside air is drawn to the panel because of the temperature difference of the cold water and the warmer outside air. The heat is absorbed in the panel because of its black color.

This system does have the requirement of a warmer outside air temperature then the cold water. The system will therefore only be able to work in the summer. Electrical heating of the water will be needed to meet the demand for hot water of the household. According to the datasheet supplied by the manufacturer, this system can cover an energy demand of 455 kWh of energy in January by consuming 80.5 kWh at a COP of 5.64 (see Appendix 3.3 pp. 1231)

-Heat Recovery Unit

The house design also makes use of a heat recovery units to avoid wastage of heating energy resulting from exhaust ventilation. This unit can recover 95% of the energy that is being lost in the exhaust ventilation and make it available for reuse.

Ventilation

The limit in the house is 800 ppm of CO2 which is set by the competition rules. The capacity of the ventilation must be able to get this amount of CO2 out of the house. The amount of inhabitants will be 3 people for the most of the time. A person generates the following amounts of CO2 per person per hour.

Activity	Respiration [m3/h/person]	Carbon Dioxide Emission [m3/h/person]
Sleep	0.3	0.013
Low activity	0.5	0.02
Normal work	2	0.06
Hard work	7	0.35

Figure 4.14 — *CO2 production of a person.*

http://www.engineeringtoolbox.com/co2-persons-d_691.html

The inhabitants will be either asleep or on low activity work.
The 800 ppm In the house results in a 0,00081 [m^3/m^3 room]. The level of CO2 in the rooms can be calculated with the following equation:

$$c = (q / n V) [1 - (1 / e^{n t})] + (c_0 - c_i) (1 / e^{n t}) + c_i$$

where

c = carbon dioxide concentration in the room (m3/m3)
q = carbon dioxide supplied to the room (m3/h)
V = volume of the room (m3)

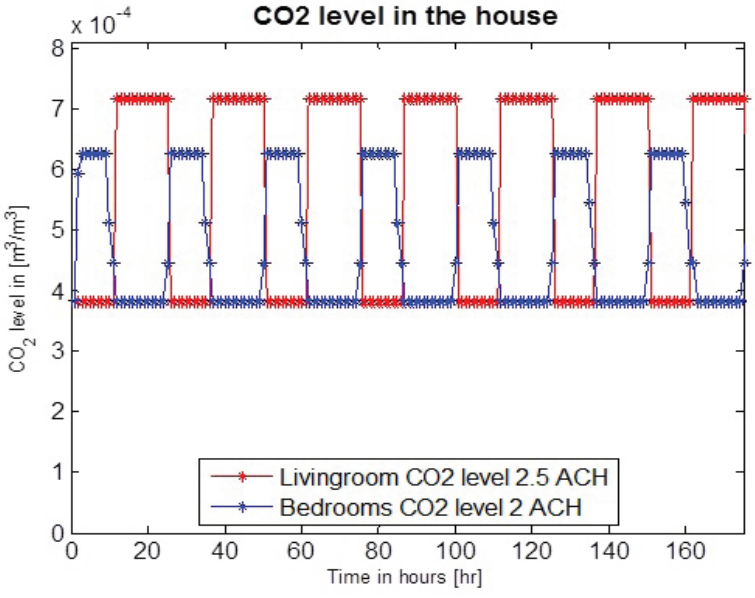


Figure 4.15 — *CO2 level in the house for the two floors*

n = number of air shifts per hour (1/h)
t = time (hour, h)
ci = carbon dioxide concentration in the inlet ventilation air (m3/m3)
c0 = carbon dioxide concentration in the room at start, t = 0 (m3/m3)

The amount of people on the top floor or the and ground floor are scheduled and used to determine the CO2 level.

The ventilation needed is expressed in air changes per hour (ACH). Figure 4.14 shows that the amount of CO2 never gets above the limit of 0.00081 when the ventilation is at 2.5 ACH for the living room and kitchen and 2 for the bedrooms upstairs. The amount of hours isn't specific to a certain month. The amount of people in the house doesn't change so shape of the CO2 levels won't change during the year.

This makes the amount of ventilation for CO2 needed 2.5 ACH. The total volume of the livingroom and kitchen is 72.5 [m^3]. The amount of CO2 required will be 181.25 [m^3/h], as can be seen in Figure 5.15 where the CO2 level is plotted for both floors.

Heating and Cooling Design

Software

The software used here is Design Builder, which is a state-of-the-art dynamic energy simulation program that generally fulfills the requirements for the energy calculations needed in our case. More precisely, the following features of the program are considered really useful for the accurate simulation of the existing situation (with and without the skin) and the selection of the materials needed and other additional measurements (shading, ventilation and cooling installations):

- Simulation of weather conditions: Real hourly site weather data are available for the precise location of the model.
- Simulation of natural ventilation: The ventilation rate and the operation schedule can be adjusted, simulating the real situation both in Delft (Netherlands) and Versailles (France).
- Import - export 3-D models: The different modules can be easily simulated, as 3-D CAD models can be imported from Revit. The Design Builder models can also be exported to other CAD applications, like AutoCAD and SketchUp.
- Dynamic results: Distribution curves are generated, so the outputs can be easily checked graphically, at the level of accuracy that is needed (hourly, daily, monthly or yearly).
- Construction simulation: The way that the building envelope behaves is modeled in a precise way. The materials used and their properties can be modified and trials are possible, so that the heat transmission through the building fabric will be optimum.

In addition, the energy needed for cooling and heating are calculated automatically after any simulation. This tool is considered really useful, as one of the main objectives of the project is the lower possible energy consumption in the dating circumstances.

Limitations

Although Design Builder offers a great deal of possibilities in simulating the energy situation of the model, there are some ''dark'' spots as well, as they are prescribed below:

- PCM (Phase Change Material) simulation: The PCM used in the building at Versailles can't be added to the model. Therefore, the way that the heat is absorbed or released, when the form of the material changes from liquid to solid or the other way around can't be included in the model.

- Accuracy of ventilation rate: In reality, the number of air changes depends on the air speed and the weather data of the region, at the precise time of day, define the value of ventilation rate. However, this isn't possible in this program and the rate of natural ventilation through windows should be imported manually. As a result, the translation of the real situation into the program model needs attention and further calculations.

Cooling design

In this section, the cooling design process is presented for the existing house in Honselersedijk in The Netherlands. For the cooling design, certain parameters should be provided as input regarding the location, the occupancies, the construction materials and the characteristics of the openings (glazing type, material of profiles, insulating properties). The results that are presented have to do with the temperatures inside the house, the heat gains and the energy required for the cooling of the house. These are listed both in a monthly and in an annual base and are illustrated in graphs and tables in the following pages.

To sum it up, the objective of this section is twofold: on the one hand it is about drawing conclusions regarding the behavior of the existing house under the implemented changes; on the other hand, it is about determining the indoor climate and cooling energy demands of the house in Versailles during the two weeks of the competition. All the above are analyzed in a detailed and elaborate way in the following pages.

For the house in Honselersdijk, the occupancies where defined according to the expected occupancy in every room of the house assuming a family with 3 members. Taking into consideration the area of each room, the density (people/m^2) was calculated. The metabolic rate was, also, adjusted according to the activities that will take place in each area. The equipment (laptops etc.) was determined according to the needs of the family.

The weekly schedule that was imported on the software is one matching the everyday life of the typical Dutch family. This schedule is different for the weekdays, the weekends and the holidays and different for every room of the house.The metabolic rate is defined differently in every room. More specifically, it is higher in the living room and the kitchen where the activities include light manual work and much lower in the bedrooms that only include resting. For instance, in the living room and the kitchen the metabolic rate is expected to be 110 W/person and 180 W/person respectively. For the bedrooms, the metabolic rate is set to 90 W/person.

The equipment was defined in order to be lower in the living room and the bedrooms and much higher in the kitchen. So, in the living room, only, some computers and light equipment is going to be used which results in a value of approximately 3.50 W/m^2. On the contrary, in the kitchen where the equipment includes a fridge, an oven and washing machine, the internal gains are much higher which means approximately 30 W/m^2.

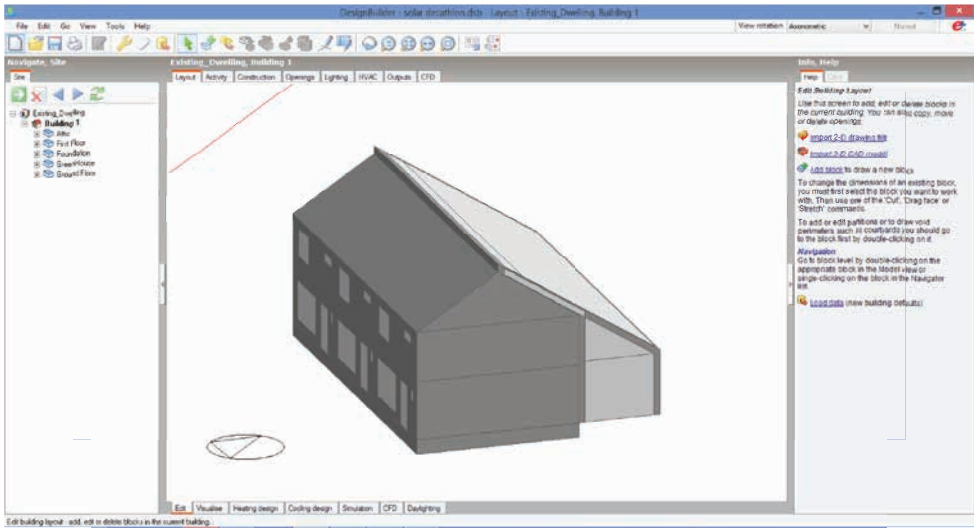


Figure 4.16 — *Lay-out from Design Builder for the heating/cooling design in Honselersdijk*

Heating Design

The aim of performing the heating design calculations is basically to define the size of the heating installation needed to satisfy certain interior climate conditions of an enclosed space. In the heating design simulations performed, it was evaluated the energy needed to assure that the temperature comfort conditions will be reached in the future construction.

The simulations were performed for the house in Honselersedijk and for the future structure which is to be presented in Paris. For the evaluation of 'Zone Heating' the local weather conditions were considered. Also, for increasing the accuracy of the results, the simulated dwelling was placed between other two similar structures, this way representing the typical dwelling row. Using this design method we could prevent extra heat losses and simulate the separation walls properly. As already mentioned, the results of the simulations represent the amount of energy needed to be supplied by the HVAC system in order to fulfil the interior climate conditions. The simulations were performed in a 'step-by-step' method, in order to accurately evaluate the impact of each technological solution designed by Prêt-à-Loger team in terms of efficiency. Using these results, not only the efficiency can be evaluated, but the feasibility of the entire renovation concept can be analyzed as well.

Technical characteristics

- For the dynamic simulations the 'DesignBuilder' software was used, developed by Design Builder Software Ltd.
- The simulation results were presented based on one year simulation period.
- Local conditions were considered for both existing and prototype structures.
- Includes consideration of heat conduction and convection between zones of different temperatures.
- Includes solar gain through the glazed openings.
- The HVAC equipment was also considered in the evaluation phase.

In the following figures, the heating demand for the house is simulated with different additions to the house. The numbers in the green represent the change in heating energy demand from the original house(as mentoned in Figure 4.18).

1) The first simulation was performed for the existing house in Honselersedijk. The existing house was simulated in local conditions, considering construction materials currently installed on the structure. This simulation model is considered as starting point for further improvements analysis. The next simulations were compared to these result.

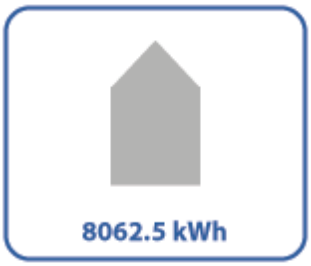


Figure 4.17 — *Heating calculation result for the orignal house in Honselersdijk*

2) The simulation was performed considering the existing house in Honselersedijk with adding 'the skin' structure, developed by Prêt-à-Loger team. An improvement of 34.15% was calculated, proving that the basic conceptual renovation element is being highly efficient.

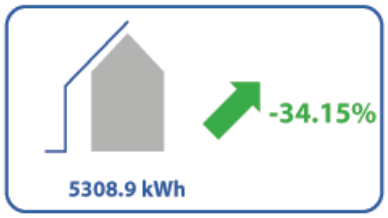


Figure 4.18 — *Original house with glasshouse*

3) The glazing of the house were replaced with ones of higher performance. The 3mm single glazing of an U-value of 6.3 were was replaced with Low-E Triple glazing (U-value = 1.49). The results prove that changing the glazing units would have an important impact on the performance of the house as well, and a major reason being the considerable reduction of the infiltration rate through the skin.

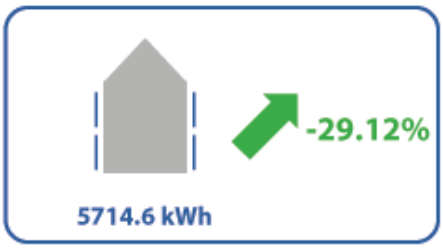


Figure 4.19 — *Original house with improved galzing on north and south*

4) The insulation level of the exterior façade was improved considerably, by replacing the existing structure with a new complex wall system. The new wall has a high performance in terms of preserving heat losses and the results of the simulations proved that. The improvement achieved by using this solution proves to be very important in the renovation process.

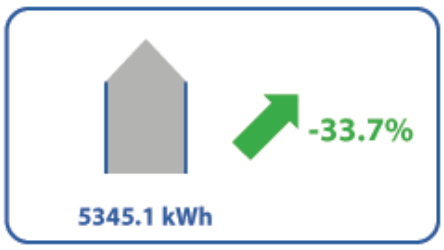


Figure 4.20 — *Original house with insulation on north and south facades.*

5) The roof was considered to be replaced with a structure having a higher performance. The impact on the results however proved to be not very effective as the other solutions presented. This solution has to be analyzed further, especially considering the financial factor.

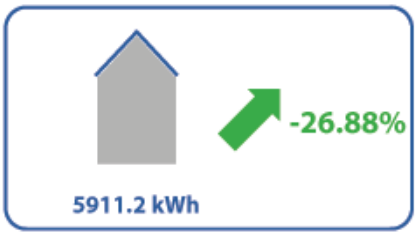


Figure 4.21 — *Original house with insulation on north and south roofs*

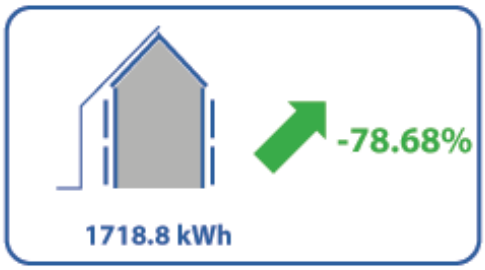


Figure 4.22 — *Original house with insulation on north and south roofs and facades and the glasshouse.*

6) The final simulation represents the numerous solutions presented above combined all together. The results were compared to the existing house performance in Honselerse -dijk. The numbers show how high is the impact of the renovation concept developed by Prêt-à-Loger in terms of heating design.

7) The same simulation concept was developed for the prototype house which is to be built in Versailles, Paris. The 'step-by-step' evaluation was not performed, it was only considered the total number of technical solutions developed by Prêt-à-Loger. The simulations showed an amount of 1719 kWh use of energy by the HVAC system to satisfy the comfort conditions and to maintain the interior temperature within the set-points. The detailed calculations are presented in Appendix 4.1 pp.1527.

Ventilation Design

The design for the ventilation can be made since the size of the ventilation needed has been calculated. A schematic overview of the system can be seen in Figure 5.23.

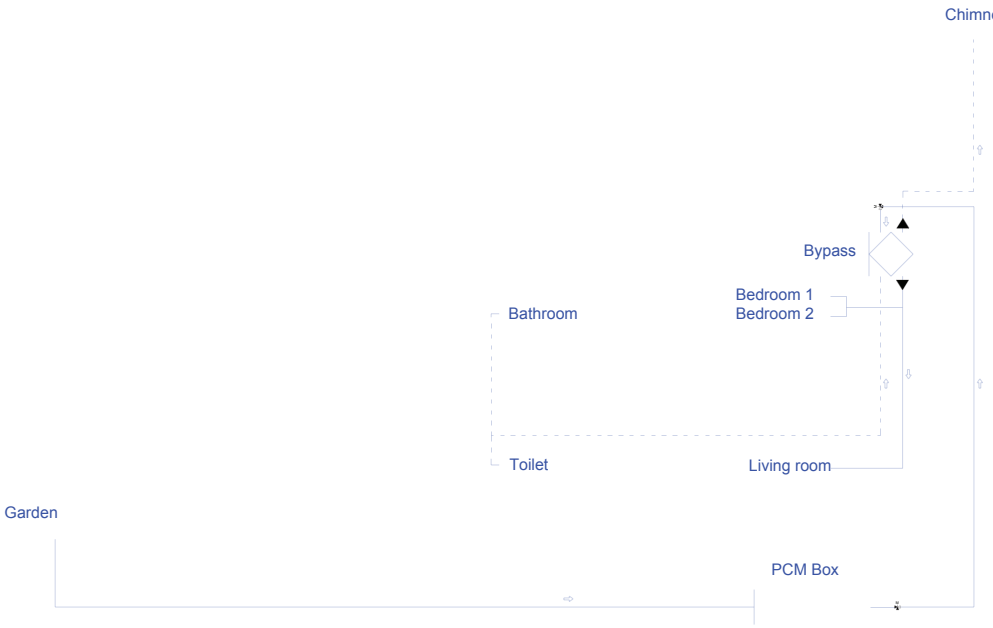


Figure 4.23 — *Schematic overview of ventilation designl*

The outside air will be taken from the garden area. This air will be cooled down by the PCM Box. There is a three way valve installed after the PCM box, making it possible to either let the cooled down air flow into the house, or let the PCM blow out its accumulated heat from the day in another channel.

The cooled air can now be blown into the upstairs part of the house where both bedrooms are located, and or to the living room and kitchen. The air that needs to get out of the house will leave the rooms through the bathroom air duct and the toilet air duct. After the recovery of the heat, using a heat recovery system, the air gets blown out of the chimney.

The heat recovery unit will not be functioning when cooling is needed. The heat recovery only takes place when the house is heated by needs to be ventilated.

Energy consumption ventilation and cooling

The ventilation system can have two different settings apart from off and stationairy. These two settings should be for ventilation on CO2 and one for cooling.
The following amounts of [kWh] are used ,taking the different pressure drops into account. The total energy used can be seen in Table 5.19.

Honselersdijk				
Pressure loss over CO2 section	0,000	[Pa]	80,000	[Pa]
Pressure loss over Cooling section	140,000	[Pa]	150,000	[Pa]
Airflow while CO2 ventilation	0,000	[m^3/s]	0,052	[m^3/s]
Airflow while Cooling	0,083	[m^3/s]	0,083	[m^3/s]
Time used per year CO2	0,000	[hr]	7965,000	[hr]
Time used per year Cooling	0,000	[hr]	401,000	[hr]
P	11,620	[W]	16,610	[W]
E	0,000	[kWh]	138,959	[kWh]
Total yearly use	277,919	[kWh]		

Table 4.24 — *Energy use of the ventilators over the year for Honselersdijk*

Cooling Design

The heat loss-gain diagram for the most unfavorable day is illustrated in the figure below:

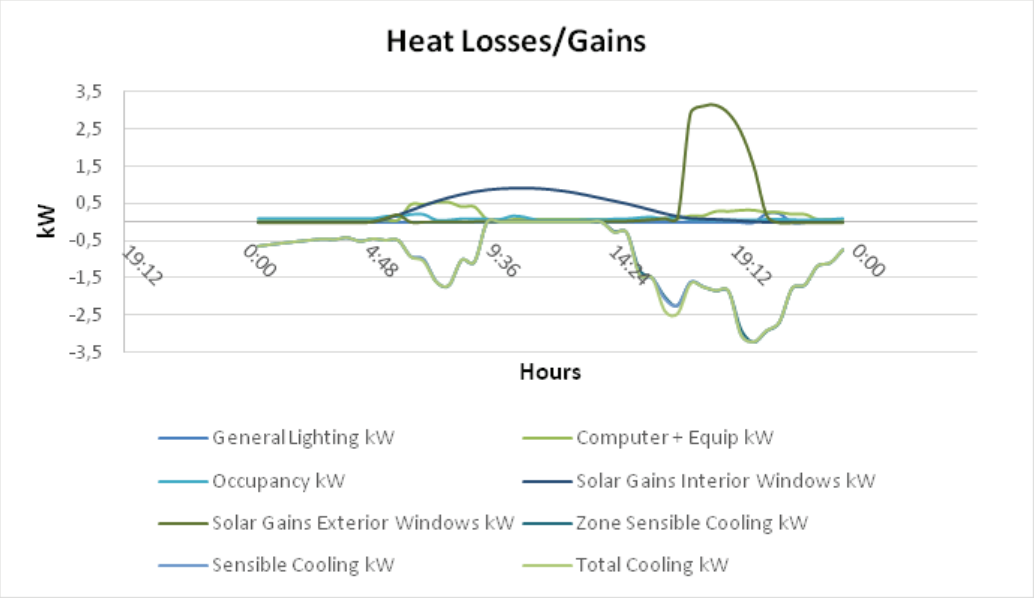


Figure 4.24 — *Heat loss-gain diagram for the Honselersdijk house*

More precisely, the lighting, the equipment, the occupancy, the solar gains from interior and exterior windows and the corresponding cooling load are represented for the warmest day during summer (7nd of June). Different colors are used for every different parameter. As we can see, the most critical factor in determining the cooling loads are the solar gains from windows, especially from the exterior windows during the afternoon that the sun sets. Another important factor is the equipment and appliances that increases the internal gains of the house.

The cooling loads for the warmest month (most unfavorable case for cooling design) are illustrated in the following figure:

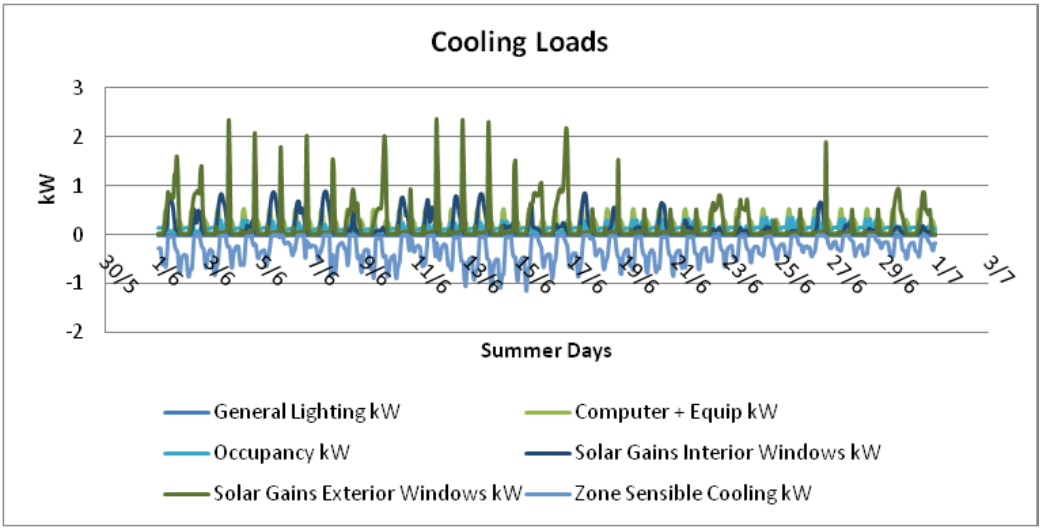


Figure 4.25 — *Cooling Loads for the Honselersdijk house*

In more detail, the following are illustrated in different colors: the heat gains form the lighting, the occupancy, the solar gains from exterior and interior windows and the corresponding sensible cooling loads for the month in which the largest cooling load is needed, June. As it is obvious, the heat gains from the exterior windows contribute significantly to the needed cooling load, but they aren't determinant for the needed values, as the glasshouse is also included, but it isn't cooled.

Regarding the inside temperature of the house, an overall simulation for the whole summer period (April to August) has been run, so that the fluctuation of the operative temperature is determined, in contrast to the outside temperature. Base on this analysis, the day with the most unfavorable results for cooling is determined, so that the behavior of the house in that day to be examined. That day is the 7th of June.

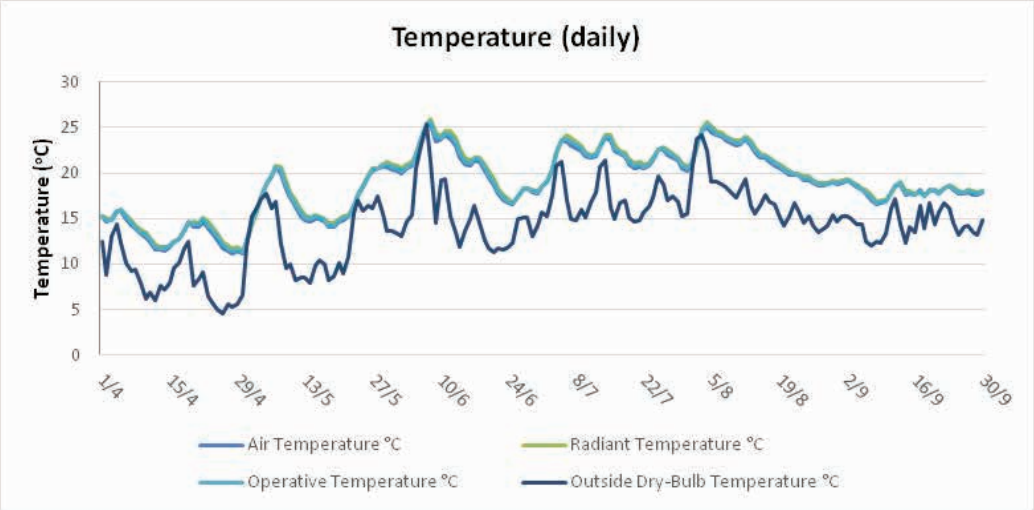


Figure 4.26 — *Temperature Diagram of the Summer Period Simulation*

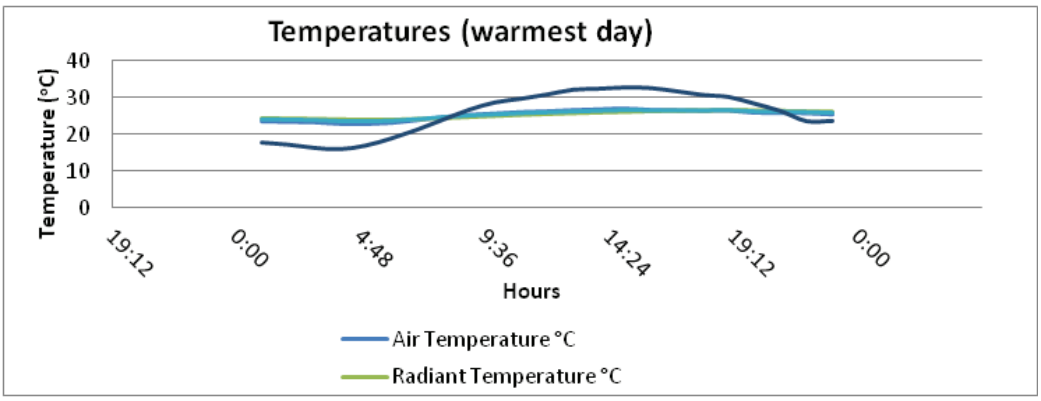


Figure 4.27 — *Temperature Diagram of the warmest summer day*

In the first graph, we can see that the curve of operative temperature is fluctuated more or less similarly to the outside temperature, without unacceptable extremes. In the second graph, we can observe the temperature inside the house and the outside temperature are illustrated. It can be observed that the largest values are during the afternoon around 14:30, when the operative temperature inside the house reaches the 26 degrees, while the outside temperature climbs at 30 degrees. This leads to a slight discomfort which is shown in the following table.

Date/Time	Discomfort hrs (all clothing)
	mins
7/6/2002 1:00	0.0
7/6/2002 2:00	0.0
7/6/2002 3:00	0.0
7/6/2002 4:00	0.0
7/6/2002 5:00	1.0
7/6/2002 6:00	1.9
7/6/2002 7:00	2.9
7/6/2002 8:00	1.2
7/6/2002 9:00	30.7
7/6/2002 10:00	44.4
7/6/2002 11:00	52.5
7/6/2002 12:00	45.0
7/6/2002 13:00	45.0
7/6/2002 14:00	45.0
7/6/2002 15:00	50.6
7/6/2002 16:00	36.1
7/6/2002 17:00	24.5
7/6/2002 18:00	31.7
7/6/2002 19:00	5.6
7/6/2002 20:00	5.6
7/6/2002 21:00	11.2
7/6/2002 22:00	13.1
7/6/2002 23:00	7.5

Table 4.26 — *(Left) Discomfort in minutes for the warmest summer day*

Date	Sensible Cooling (kWh)
1/4/2002	0
1/5/2002	0
1/6/2002	-22,69066
1/7/2002	-1,50447
1/8/2002	-13,29286
1/9/2002	-0,000073

Table 4.25 — *(Right) Monthly sensible cooling for the summer period*

The overall results, regarding the sensible cooling, are illustrated in the following table and graph:

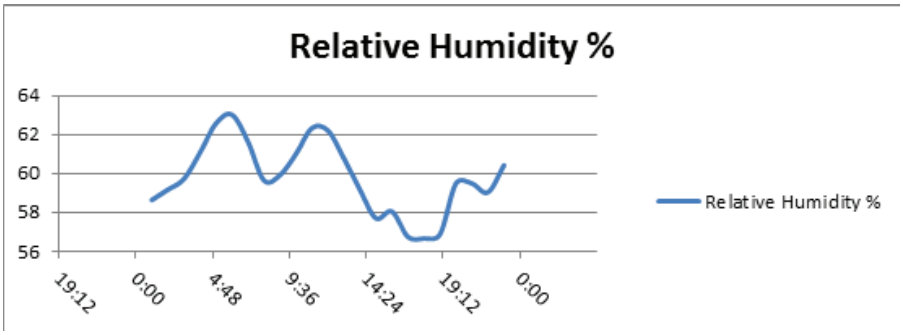


Figure 4.28 — *Relative Humidity Diagram of the warmest summer day*

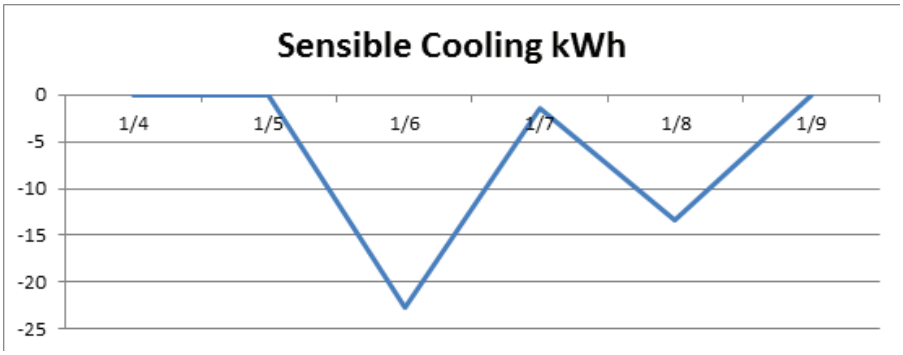


Figure 4.29 — *Sensible cooling for the summer period*

Besides the calculation results presented in 'Heating Design' chapter, it is important to graphically analyse graphically the impact of 'the skin' on the existing dutch houses. First thing considered is the energy needed for the dwelling to be heated in winter periods. The amount of energy needed basically defines performance of the house in terms of insulation and comfort.

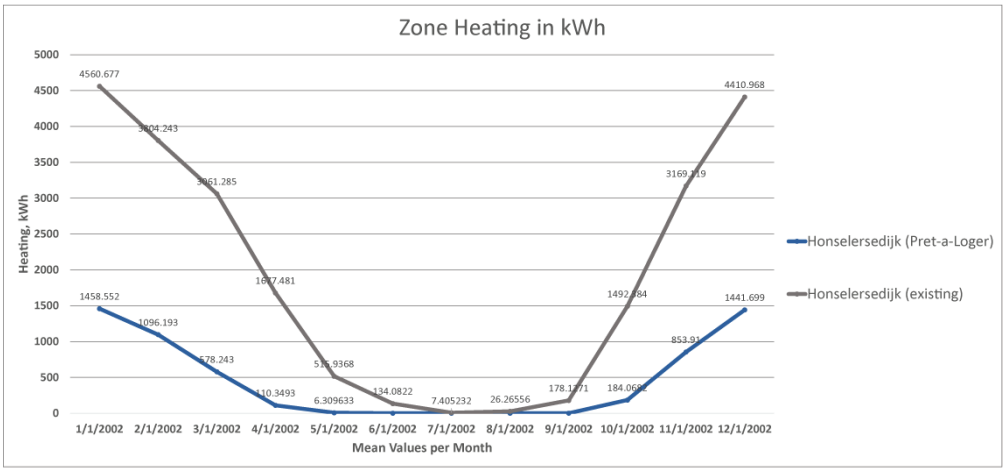


Figure 4.30 — *Zone Heating (Honselersedijk House vs. existing house)*

Figure 4.32 represents graphically the performance impact 'the skin' has on the amount of energy the house would consume in a full-year period.

Also, the team considered important to evaluate the amount of solar gain the new building would collect comparing to the existing house.

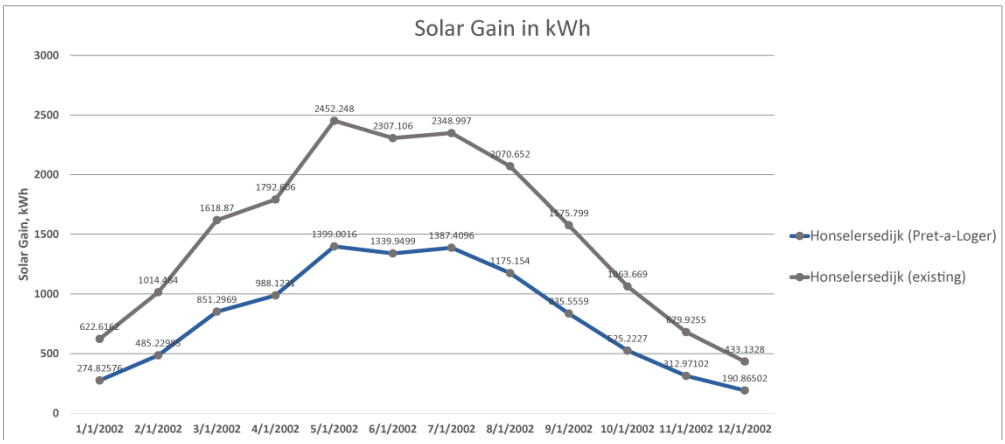


Figure 4.31 — *Solar gains (Honselersedijk House vs. existing house)*

The graph explains and shows the impact the new type of glazing has on the amount of solar gain collected within the structure. Even if the new construction will have the glasshouse attached, the amount of solar gain is low, mostly due to high performance glass used within the replacing glazing units.

Also it is important to evaluate what the improvement 'the skin' concept will have on the comfort conditions for the inhabitants. The next two graphs represent the temperature conditions within the existing house before and after Prêt-à-Loger's project changes.

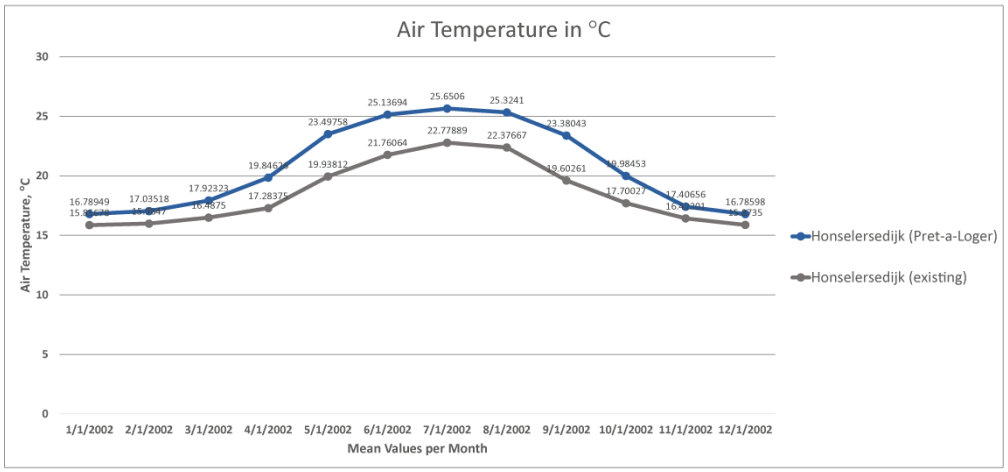


Figure 4.32 — *Air Temperature (Honselersedijk House vs. existing house)*

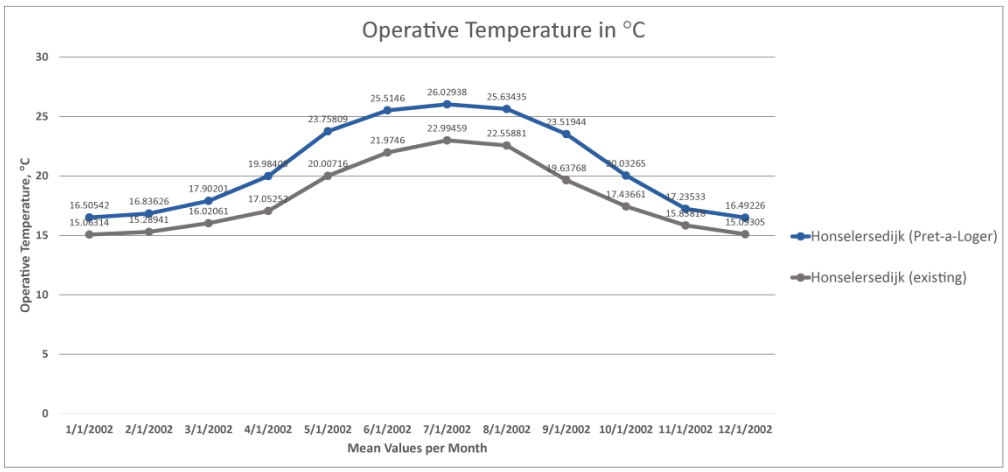


Figure 4.33 — *Air Temperature (Honselersedijk House vs. existing house)*

Both Air and Operative temperatures were compared, and it can be concluded that 'the skin' will also influence the comfort conditions for the inhabitants. The temperatures in the improved design model are definitely higher, both operative and air. Besides that, it is important to mention that the temperatures in the improved design model satisfy the temperature set-points which Prêt-à-Loger considered as comfort limits: min = 16 degrees C and max = 27 degrees C. Besides that, in the improved design model the temperatures within the glasshouse were not considered, since the space is not evaluated as a heated space.

Prêt-à-Loger team also considered to investigate the comfort conditions within the Glass House as well and to assess whether the space can be used by the inhabitants both in summer and winter.

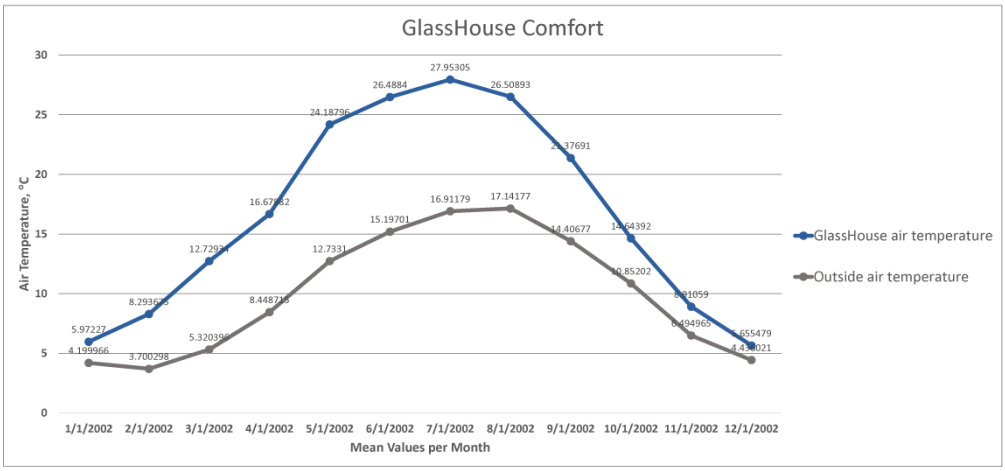


Figure 4.35 — *Air Temperature (Exterior vs. Glass House)*

From the graph we can see that comparing to exterior conditions the comfort level within the Glass House is higher. Even in the coldest year period the lowest mean temperature within the structure is approximately 5 C degrees. Even if the comfort conditions for a living space are not satisfied, it is important to mention that the space can be easily used as a winter garden or storage space.

Glasshouse Analysis

The glasshouse conditions were simulated in order to deterine whether the temperatures inside the glasshouse will be comfortable enough or not. For this ANSYS FLUENT was used. Use of a shading design was also evaluated.The simulations shows that the temperatures inside the glasshouse are not gping to be very high . A temperature difference of 2.5 ^{0} C at the maximum can be found in the livable areae of the glasshouse from the outside temperature.

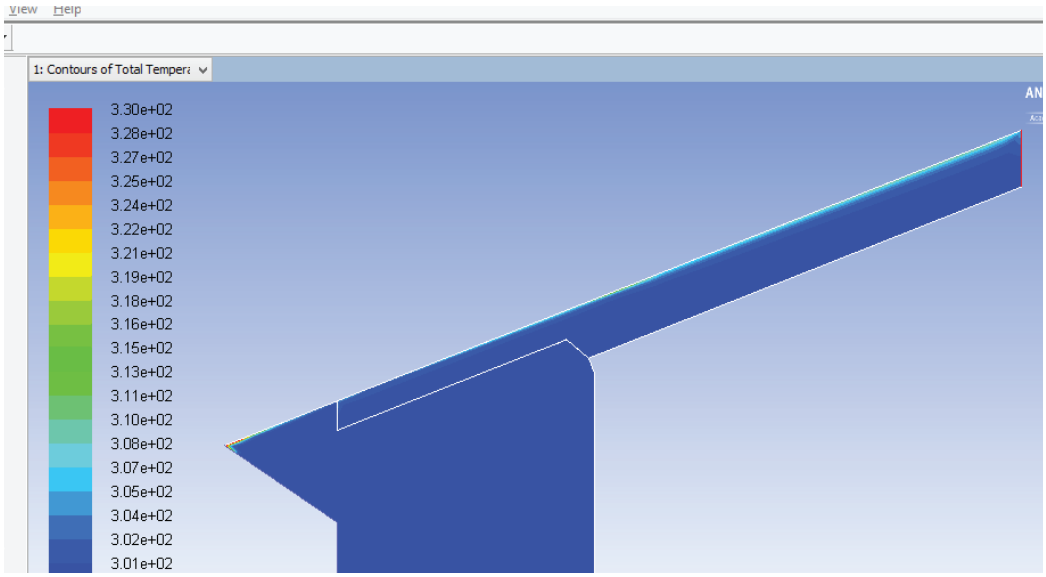


Figure 4.34 — *Temperature inside the glasshouse*

In the figure above, the calculated temperatures are shown. The scale on the left shows the lower temperature (same as outside temperature of 25^0 C) and the highest temperatures are 57^0 C. But in the living space the temperatures are as good as outside.

In the figure below, the velocities in different regions of the glasshouse are shown and as can be seen that there is a high air flow velocity in the top of the glasshouse.

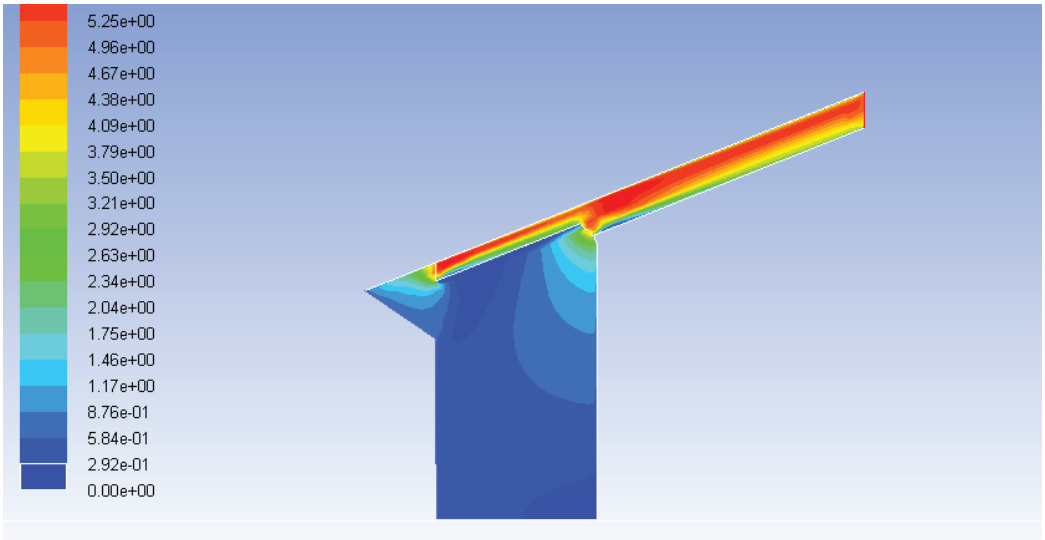


Figure 4.36 — *Velocity of air at different points inside the glasshouse*

Domestic Hot Water production

The domestic hot water production system works together with the radiator systems to cover the heating needs of the house. Solar compleet Heat pump system is used for this purpose. As per the manufacturer's test run, the system can cover heating demand of 455 kWh by working at a COP of 5.6. Based on these numbers the total hot water production and consumption calculations were made and tabulated below.

kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heating Demand	486	365	193	37	2	0	0	0	0	61	285	481
Energy used by heat pump	90	90	50							14	80	80
Energy used by electric boiler	35	150	0	0	0	0	0	0	0	0	0	28
Total energy consumed	125	240	50	0	0	0	0	0	0	14	80	108

Table 4.30 — *The Total electrical energy consumption(kWh) during different months to cover the heating demand (kWh).*

The table above shows how much energy will be needed during months to cover the heating demand. Based on the heating simulations carried out as described above, the monthly heating demand is calculated. This heating demand is covered by a combination of heat pump and electric boiler system. The energy consumption by both of them is calculated as shown in the table above. Therefore, the total energy thus needed to heat the house will be 467 kWh.

Simalarly, the electrical energy consumption for covering the sanitary hot water demand is calculated and tabulated in the table below. The energy avaliable from the heat pump is based on data as in Appendix 4.1 pp.1524. The hot water demand for sanitary purposes is taken as 114 ltrs per day on an average basis. The efficiency of the resistance heating is taken as 90%. Thus, the total electrical energy consumption for covering this demand is 874 kWh annually.

kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy demand for hot water	177	177	177	177	177	177	177	177	177	177	177	177
Energy used by heat pump	0	50	44	44	44	44	44	44	44	44	30	0
Energy used by electric boiler	197	47	0	0	0	0	0	0	0	0	0	197
Total energy consumed	197	97	44	44	44	44	44	44	44	44	30	197

Table 4.31 — *The Total electrical energy consumption(kWh) during different months to cover the Sanitary hot water demand(kWh).*

Conclusions

The bioclimatic strategies as designed during the initial phase of the project were tested and modified to make the project affordable and architecturally pleasing. As discussed in section II, the performance of the housing unit was analysed using models developed on matlabd and Design Builder.

The total amount of energy consumption for the house is tabulated below

	Consumption (kWh)
Heating	467
Sanitary hot water	874
Ventilaton energy	180
Cooling(average)	0
Pumps for radiators	129.6
Appliances	1395
Lights	98.43
Total	3144

Table 4.32 — *Breakup of total electrical energy consumption in the house for different purposes.*

4.2.3 Section III - Adaptations made by the Team for the prototype in Versailles

Climate analysis Versailles

Month of year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SUM
	01	02	03	04	05	06	07	08	09	10	11	12	1-12
Dominant Wind dir.													
Wind probability >= 4 Beaufort (%)	32	30	36	28	26	20	22	19	17	22	27	34	26
Average Wind speed (kts)	10	9	10	9	9	8	8	8	8	8	9	10	8
Average air temp. (°C)	5	5	9	13	16	19	21	21	18	13	9	5	12
Select month (Help)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year

Figure 4.37 — *Climate Scheme for Honselersdijk Spring & Autumn*

In Versailles, the wind speed is with 3~5 m/s. The number is shown that the wind speed is not fluctuated for one year. During winter, the lowest temperature is around 3°c and it is peaked with around 20°c in summer. In spring and autumn, 10 ~15°c is of outside temperature.

- Conclusion

The climate condition between Honselerdijk and Versailles is not so much different . The domestic wind direction is not so much different from that of the Netherlands. However,

the wind speed is lighter than the Netherlands with 3 ~5 m/s. It is similar the data for summer wind speed in Holland. In terms of averagetemperature, Versailles is 1 ~3 °c warmer than Honselerdijk for all seasons.

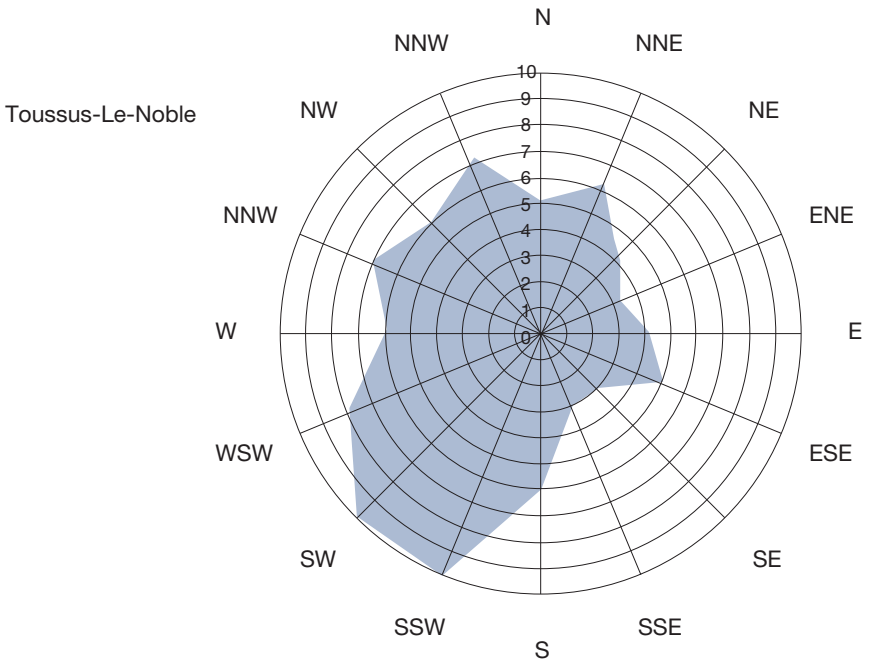


Figure 4.38 — *Wind speed & wind direction (year) for Honselersdijk*

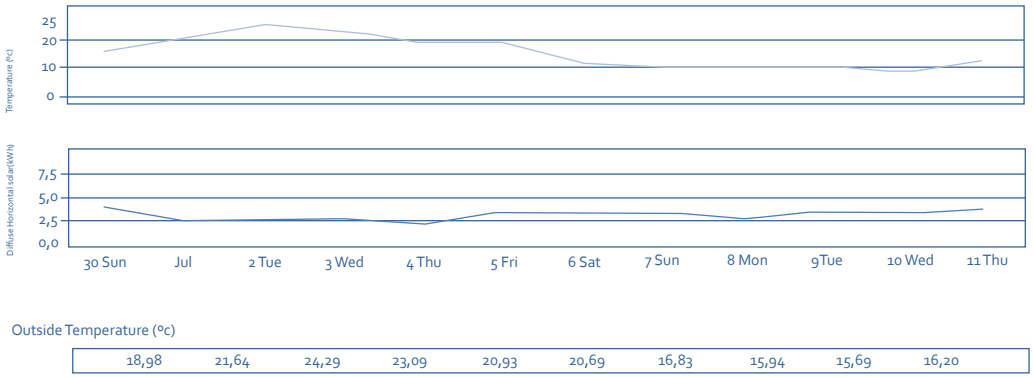


Figure 4.39 — *Outside temperature profile (Versailles)*

Outside Temperature (°c)

18,98	21,64	24,29	23,09	20,93	20,69	16,83	15,94	15,69	16,20

Major changes in the Design for the House in Versailles

Although the attempt was to resemble the house in Honselersdijk as closely as possible in Versailles, the competition regulations have led the team to choose additional and different systems than those in Honselersdijk. The major changes in the design for the house in Versailles are listed below.

- Use of PCM's

The house design lacks significant amount of thermal mass mainly because the prefabricated and fast contruction process make it difficult to add sufficient thermal mass. To simulate this PCM's are added to the house in Versailles.

-Use of SolaTUbes

The natural daylighting inside the prototype house is increase with the use of SolaTubes that transmitt direct daylight into the living room. This has been done to match the daylighting performance as desired in the competition.

- Difference in house geometry

The house geometry is also different for the protoype house in Versailles. According to the rules of the project, the housing unit should fir in the solar envelope as determined by the solar decathlon organization. The original house with it's high roof (more than 7 m) doesnot fit in this envelope. As a remedy to this issue, the geometry of the original house has been altered and new geometry can be seen in the project drawings. The calculated areas and volumes are different as are summarized in the technical summary.

The prototype house also features two bedrooms instead of three for the original house. The attic space is also absent in the protoype house.

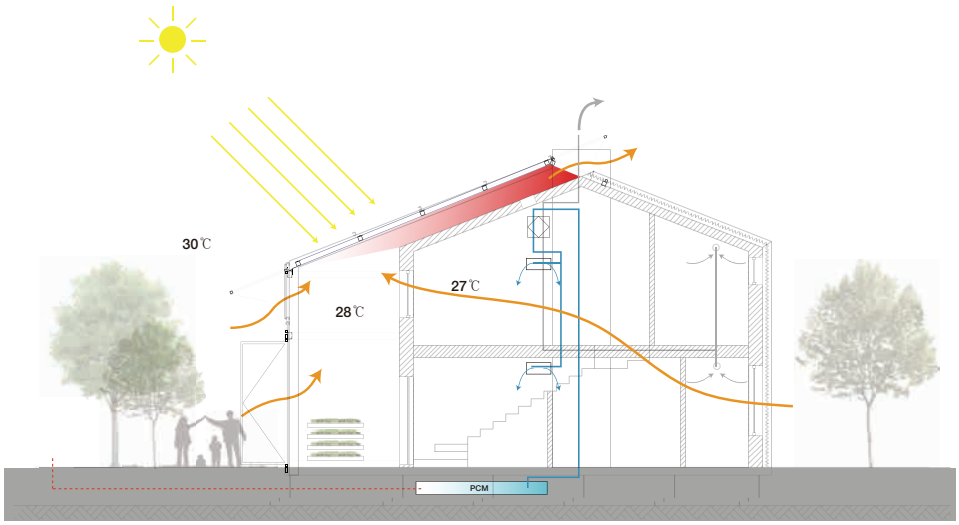
- Difference in construction elements.

THe south- east facade of the house in Honselersdijk has a different composition from the prototype house. In the local context, the project aims to cause minimum discomfort to the residents house while the house is being renovated. For this reason, the south-east facade of the original house will be renovated without replacing it. But t for the protoype house which will be presented in Versailles, this facade will also be pre fabricated. Apart from that, the doors and glazing also have different characterstics. These are summarized in the table below.

U VALUES	HOUSE EXISTING CONDITIONS		HOUSE PARIS
EXTERIOR DOORS	2.557		1.3
WALL CONSTRUCTION (SOUTH)	2.557		0.114
WALL CONSTRUCTION (NORTH)	2.557		0.89
ROOF CONSTRUCTION (SOUTH)	0.34		0.189
ROOF CONSTRUCTIO (NORTH)	0.34		0.14
GLAZING WINDOWS (SOUTH)	SOLAR HEAR GAIN COEFF.	0.858	0.63
	LIGHT TRANSMISSION	0.898	0.721
	U - VALUE	6.257	1.69
GLAZING WINDOWS (NORTH)	SOLAR HEAR GAIN COEFF.	0.858	0.47
	LIGHT TRANSMISSION	0.898	0.661
	U - VALUE	6.257	0.78
GLASSHOUSE GLAZING	SOLAR HEAR GAIN COEFF.	-	0.35
	LIGHT TRANSMISSION	-	0.45
	U - VALUE	-	2.595

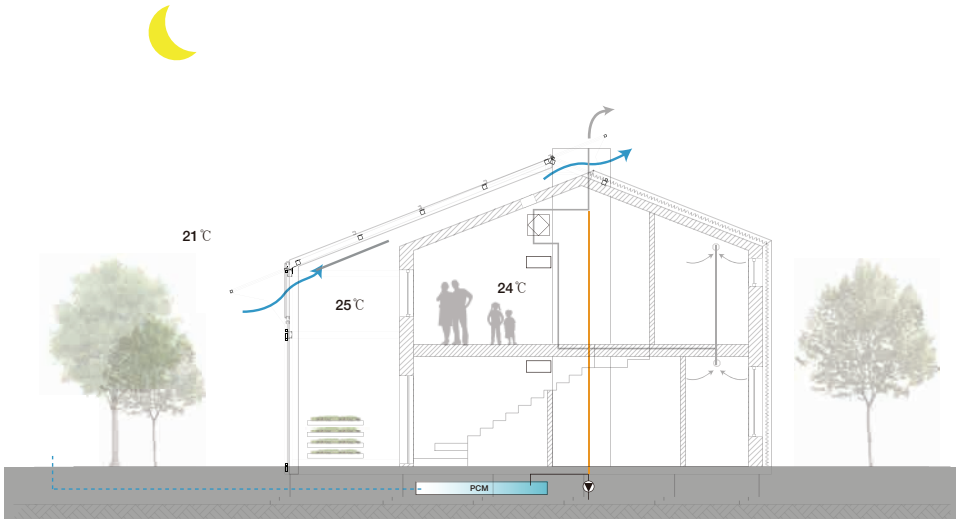
Table 4.33 — *U-values for different construction elemnts in the prototype house.*

In the following pages, the climate schemes for the prototype house in Versailles are discussed. These illustrate how the climate installations will function in the house at various times of the year.



Climate scheme for Versailles Summer Day time

Summer (Day time)
During summer, natural ventilation can work only for green house to be cool. The air from the outside can come into green house and the warm air goes out through the openable window to the top part of green house. On the other hand, PCM helps indoor cooling. Warm air go through underground and enters to PCM. The temperature of the air goes down by 20ºc. Exhausted air goes out through the chimney.



Climate scheme for Versailles Summer Night time

Summer (Night time)
During night time in summer, cool air comes into the greenhouse and the basement. The air can keep average temperature with PCM.

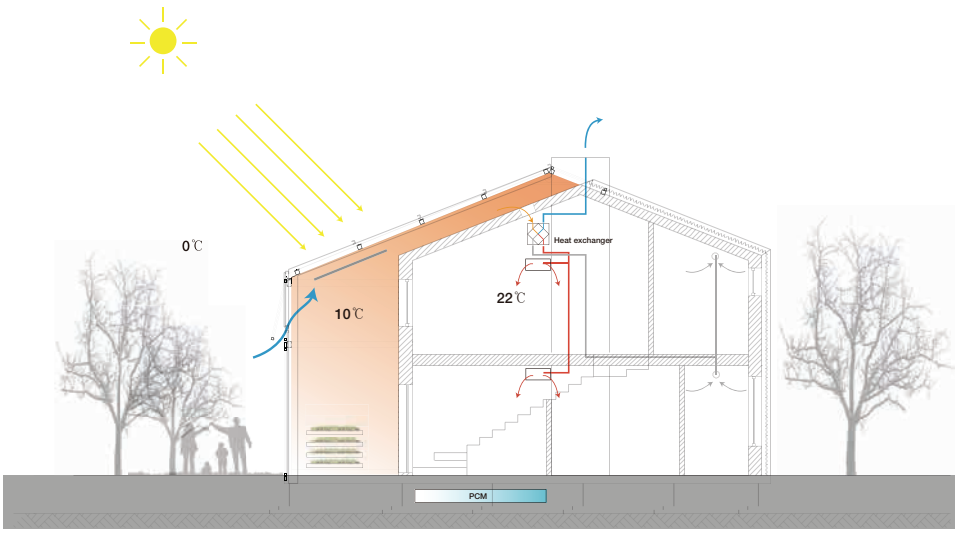


Fig. 83

Climate scheme for Versailles Winter Day time

Winter (Day time)

Green house plays a role as buffer zone during winter time. The air from outside of the building comes to greenhouse and warmed up by sunshine. However, the temperature of warmed air is not enough for indoor air condition. Thus, heat exchanger helps to increase the temperature by 22ºc. Otherwise, PCM does not work anymore during winter time.

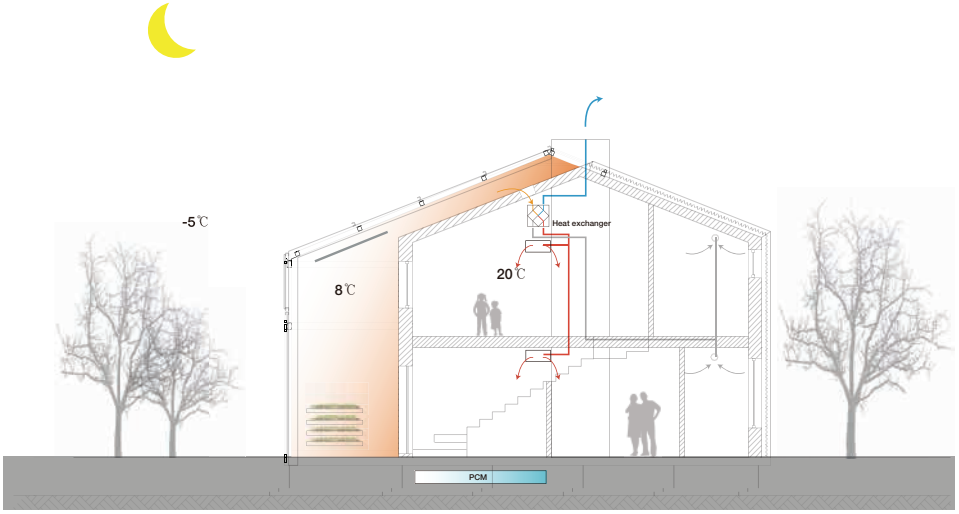


Fig. 83

Climate scheme for Versailles Winter Night time

Winter (Night time)

Operating system is almost same with winter day time. What difference is all doors and windows are closed. Warmed air from green house enters to heat exchanger and heated a bit, further, exchasted air also goes out through the heat exchanger and the air is cooled.

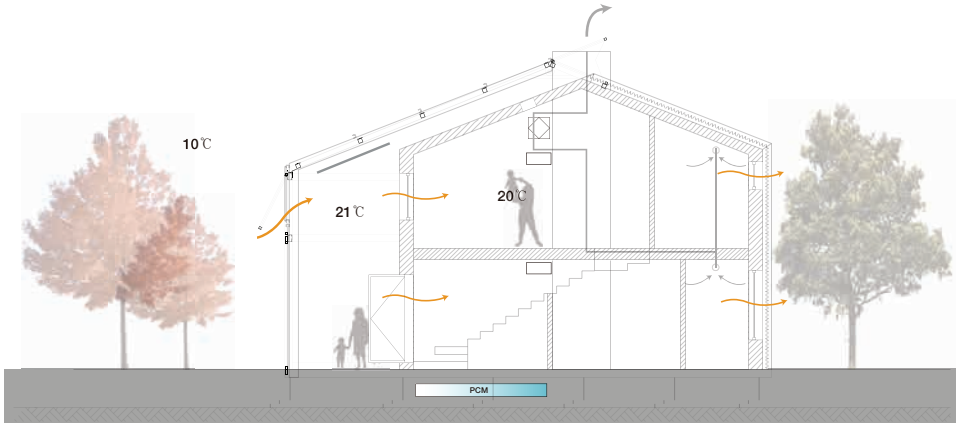


Fig. 83

Climate scheme for Versailles Spring &Autumn

Spring & Autumn (Day time and Night time)
During spring and autumn, the air temperature is quite moderate. It means that it does not necessary to use mechanical ventilation system except for outlet part from toilet and shower room.

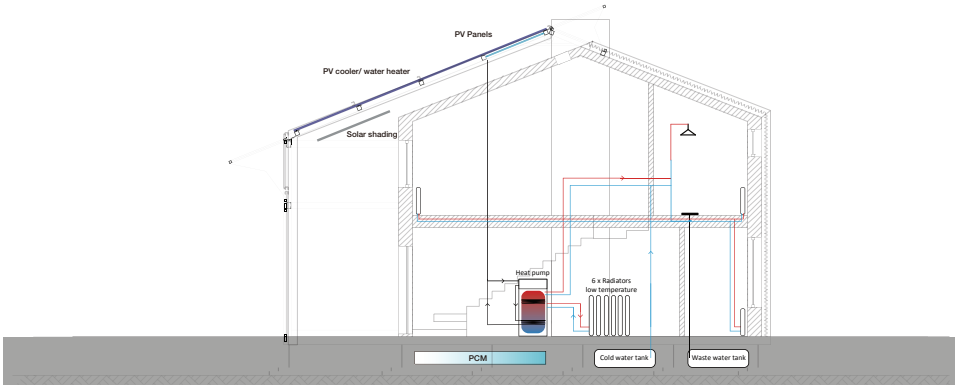


Fig. 83

Water Heating system

Water Heating system
Water warmed through solar water collector goes into heat pump then it supplys water to shower, 4 radiators in the house.

- Phase Change Materials (PCMs)

The cooling capacity needed for the entire house is equal to 1.5 [kW]. The phase changing material that will supply the cooling has a working temperature of 23 degrees Celsius. This makes this way of cooling only work when the temperature is higher than 23 Celsius. The temperature in Paris throughout the year are seen in Figure 5.40. This results into a possible amount of time of operating of 554 hours. The data about PCM can be found in appendix pp.1211.

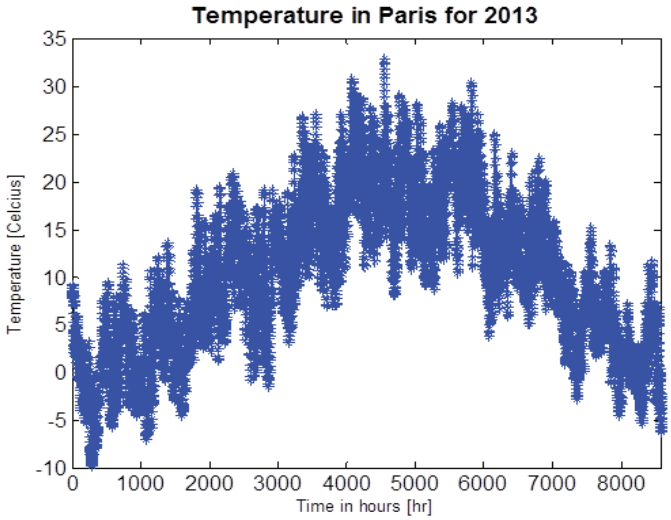


Figure 4.40 — *Temperature in Paris in 2013*

The phase changing materials which are used in the concept are modeled following the equations given by Autarkis. The results will show how the PCM's will react during the predicted weather in Paris. The calculations are made in MATLAB Simulink. The formula's used will be explained and the results discussed.
The temperature change over the entire day will be seen as a sine function:

$$\hat{\theta}_v = \frac{T_{max} - T_{min}}{2} + \left(T_{max} - \frac{T_{max} + T_{min}}{2}\right) \cdot \sin\left(\frac{2 \cdot \pi}{24} t\right)$$

The 24 is the number of hours in a day and t is time of the day in hours.
The average temperature during the day:

$$\theta_v = \frac{T_{max} - T_{min}}{2}$$

The function of the temperature during the day will be "disturbed" by the workings of the PCM. This disturbance is described by:

$$\theta_p = \theta_v + D \cdot \hat{\theta}_v \cdot \sin(\omega(t - \Delta t))$$

Where D is the damping of the sine function given by:

$$D = \frac{1}{\sqrt{1 + (\omega\tau)^2}}$$

The difference in time is the delay between the outside temperature and the reaction of the PCM on this temperature given by:

$$\Delta t = \frac{invtan(\omega\tau)}{\omega}$$

The omega is the frequency of the sine wave which is always once every 24 hours in this case.

$$\omega = \frac{2\pi}{T} = \frac{\pi}{12}$$

The time constant τ is panel specific and shows how soon it absorbs heat:

$$\tau = \frac{C_p}{H_v(1-F)}$$

The constant of the PCM's will be shown below:

$$C_p = 19{,}3\ \left[\frac{Wh}{K}\right]$$

$$H_v = \frac{V_v}{3} = 1$$

$$H_p = 3{,}22$$

The V_v is the airflow per panel per hour which is 3 for our PCM.
F is the factor of Hp and Hv in a e-power.

$$F = e^{-\frac{H_p}{H_v}}$$

The outlet temperature of the PCM is calculated with the following formula:

$$\theta_{out} = \theta_p + (\theta_v - \theta_p)F$$

The behavior of the PCM with the inlet temperatures of Paris can be seen in Figure 5.41. The cooling done by the PCM is shown in Figure 5.42

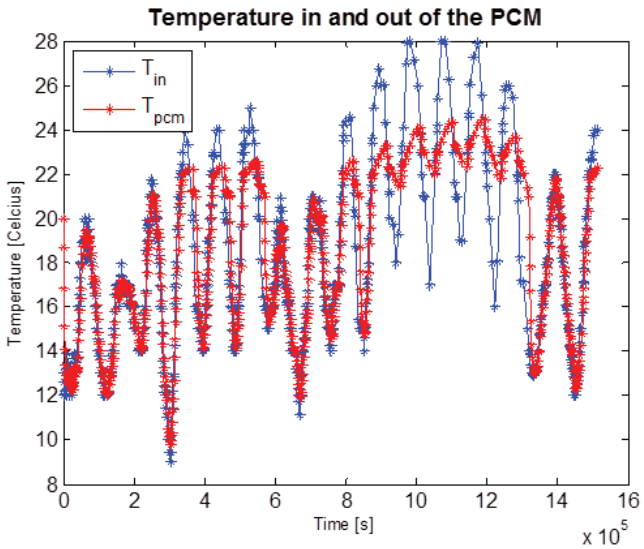


Figure 4.41 — *Temperatures in and out of the PCM*

The available cooling power of the PCM over time is plotted. It can be seen that the cooling power of the PCM is thus 300 W.

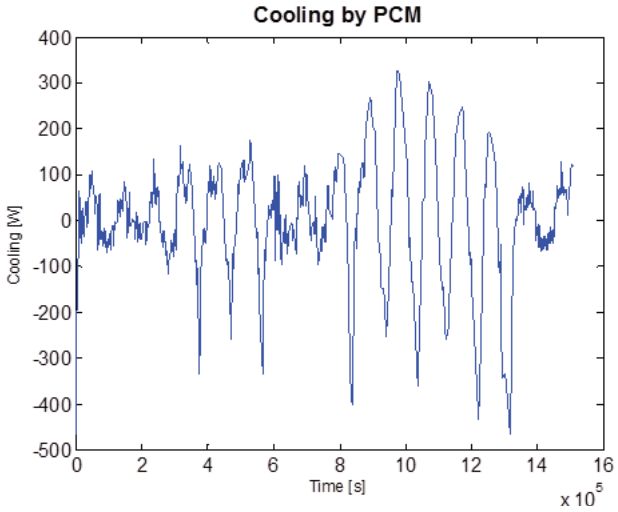


Figure 4.42 — *Cooling by PCM over time*

House Simulation for 12 competition days

In the graph below, the heat gains from the lighting, the occupancy and the solar gains from exterior and interior windows are presented for the warmest day of the competition days which is the 2nd of June. Furthermore, the zone sensible cooling is also visible. It can be observed that the maximum gains come from the solar gains of the exterior windows, but since as exterior windows the greenhouse is concerned, they don't affect the power for the cooling. It becomes, also, visible that the occupancy of the house is the most critical in determining the cooling loads.

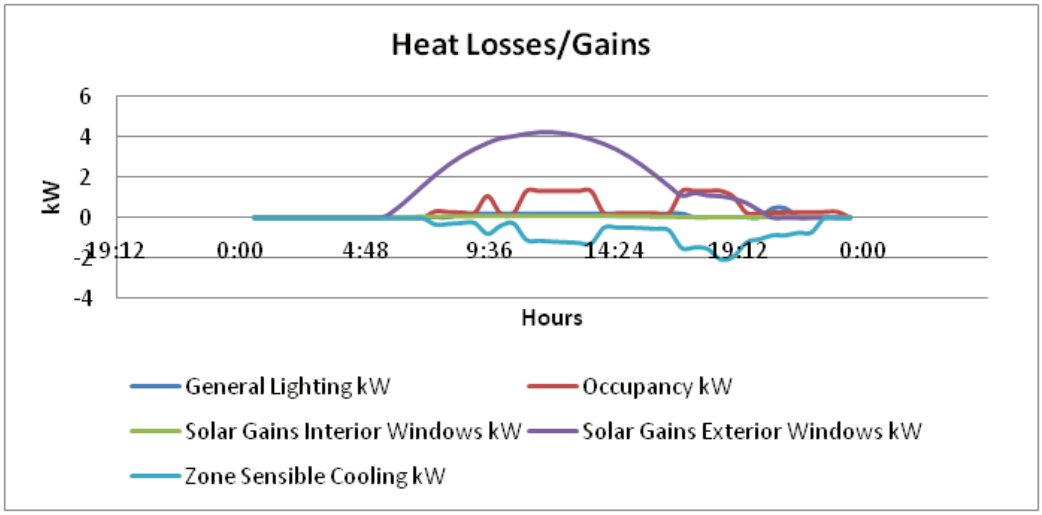


Figure 4.44 — *Heat gains-losses for the warmest day for the house in Versailles*

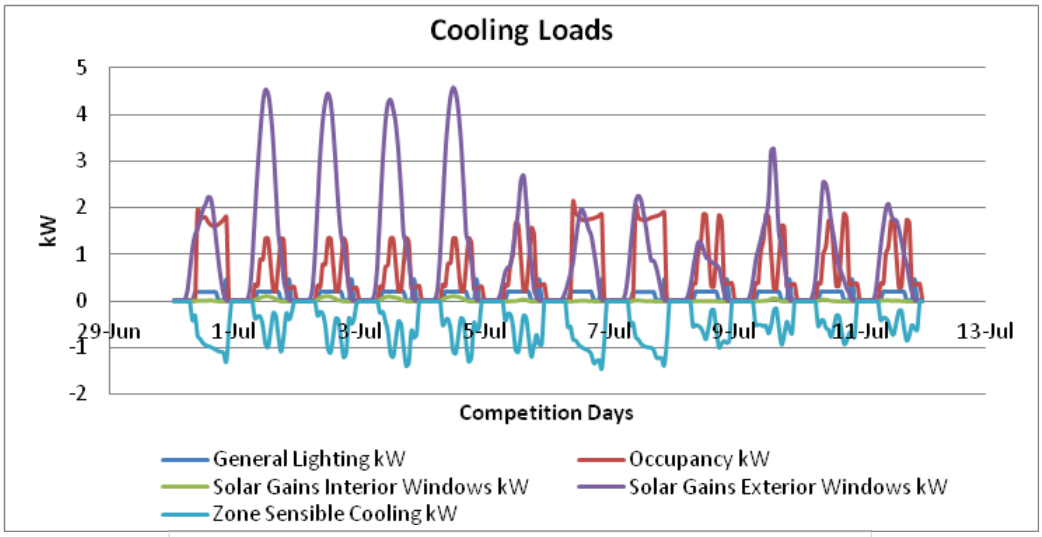


Figure 4.43 — *Cooling Loads for the competition days*

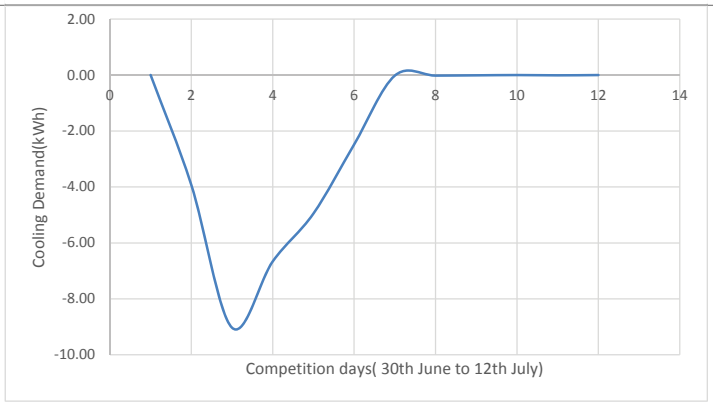


Figure 4.45 — *Cooling demand for the Prototype house during 12 competition days.*

In the graph above, the following are illustrated in different colors: the heat gains from the lighting, the occupancy, the solar gains from exterior and interior windows and the sensible cooling for all the competition days, which are from the 30th of June till the 11th of July. It becomes visible that the largest amount of heat gains come from the solar

gains of the exterior windows, but since the exterior windows represent the glasshouse these are not added for the calculation of the cooling loads of the house. The cooling loads (blue line) are actually determined from the loads of the occupancy (red line).

As far as the inside temperature of the house is concerned, it has to be mentioned that different set point and setback temperatures have been used in order to conclude to the most optimum simulation, from the energy consumption and comfort point of view. The day that has been chosen is the 4th of July which is a warm day.

Table 4.34 — *Setpoint and Setback Temperatures*

	Ground floor	First floor
Setpoint temperature (°C)	26	28
Setback temperature (°C)	28	30

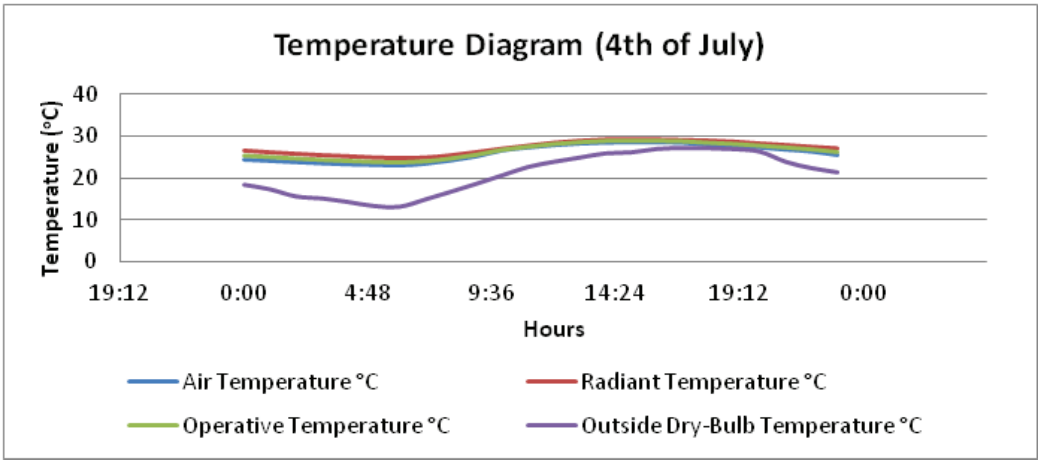


Figure 4.46 — *Temperature Diagram for a warm competition day*

The graph shows the temperature inside the house as well as the outside temperature. It can be observed that during the afternoon around 14:00 the operative temperature inside the house is around 28 degrees. This leads to a total of 2.4 hours of discomfort in the day (10%).

Finally the warmest day is chosen, wherein the outside drybulb temperatures soar to above 30^0 C. The inside temperatures can be seen below. Also the relative humidty is also on the higher side, but because of the energy efficiency and affordability criteria no dehumidification systems are installed in the house.

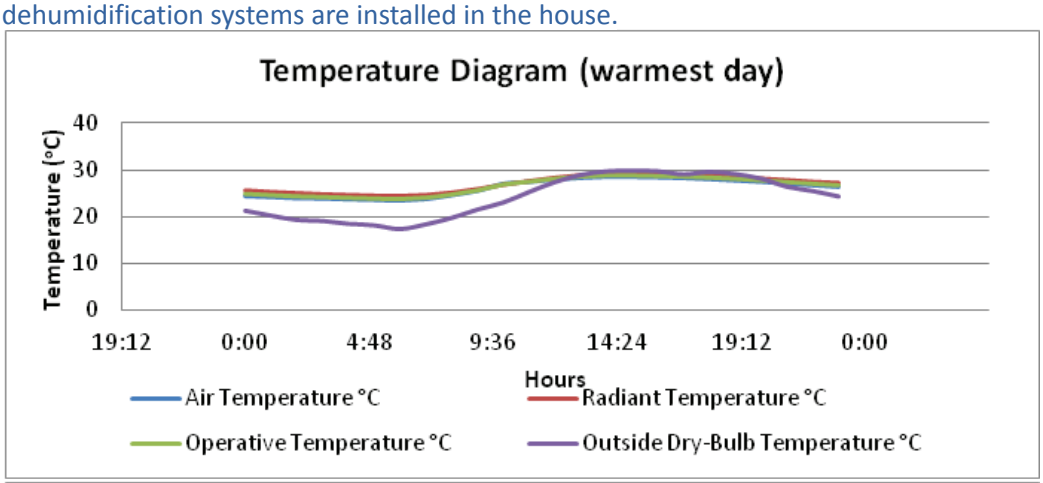


Figure 4.47 — *Temperature Diagram for the warmest competition day*

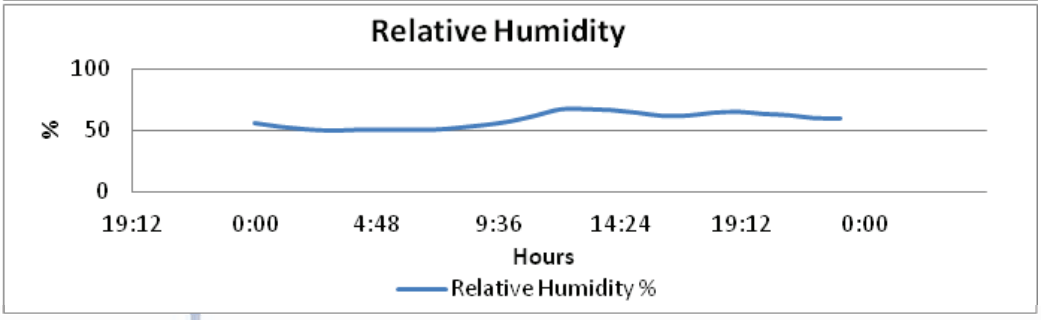


Figure 4.48 — *Relative Humidity Diagram for the warmest competition day*

Total energy consumption

The consumption of the house during the competition days was calculated. According to the criteria of the competition, a daily average was calculated and this was used to determine the annual consumption. These values are summarized below:

	Consumption (kWh)
Heating	0
Sanitary hot water	401.5
Ventilaton energy	100
Cooling(average)	85.2
Pumps for radiators	0
Appliances	1482.89
Lights	108.19
Total	2177.78

Table 4.35 — *Break up of Total energy consumption of the prototype house in versailles*

5 Innovation Report

Innovation in the “House with a Skin” project comes directly from the proposal submitted answering the Request for Proposal of the Solar Decathlon Organization. While brainstorming and deciding about our proposal, we understood that our motivation lies within what is already built, right where environmental and social challenges meet.

The social approach of the project makes the team think about the final user in every line drawn and in every addition, subtraction or modification to a house that has existed as it is for more than 50 years. However, Prêt-à-Loger has also managed to merge in the same house what is needed according to our vision for a sustainable future, where people can keep their memories while adjusting their way of living to the requirements of today’s sustainable needs.

We also understood that innovation doesn’t come from new technologies incorporated into the project, neither new strategies to solve everyday problems of an average dweller. We understood that innovation comes from combining in a smart way existing technology to ensure affordability of the solutions while keeping the project as real as possible.

5.1 Innovation in Architecture

The innovation is in the existing.

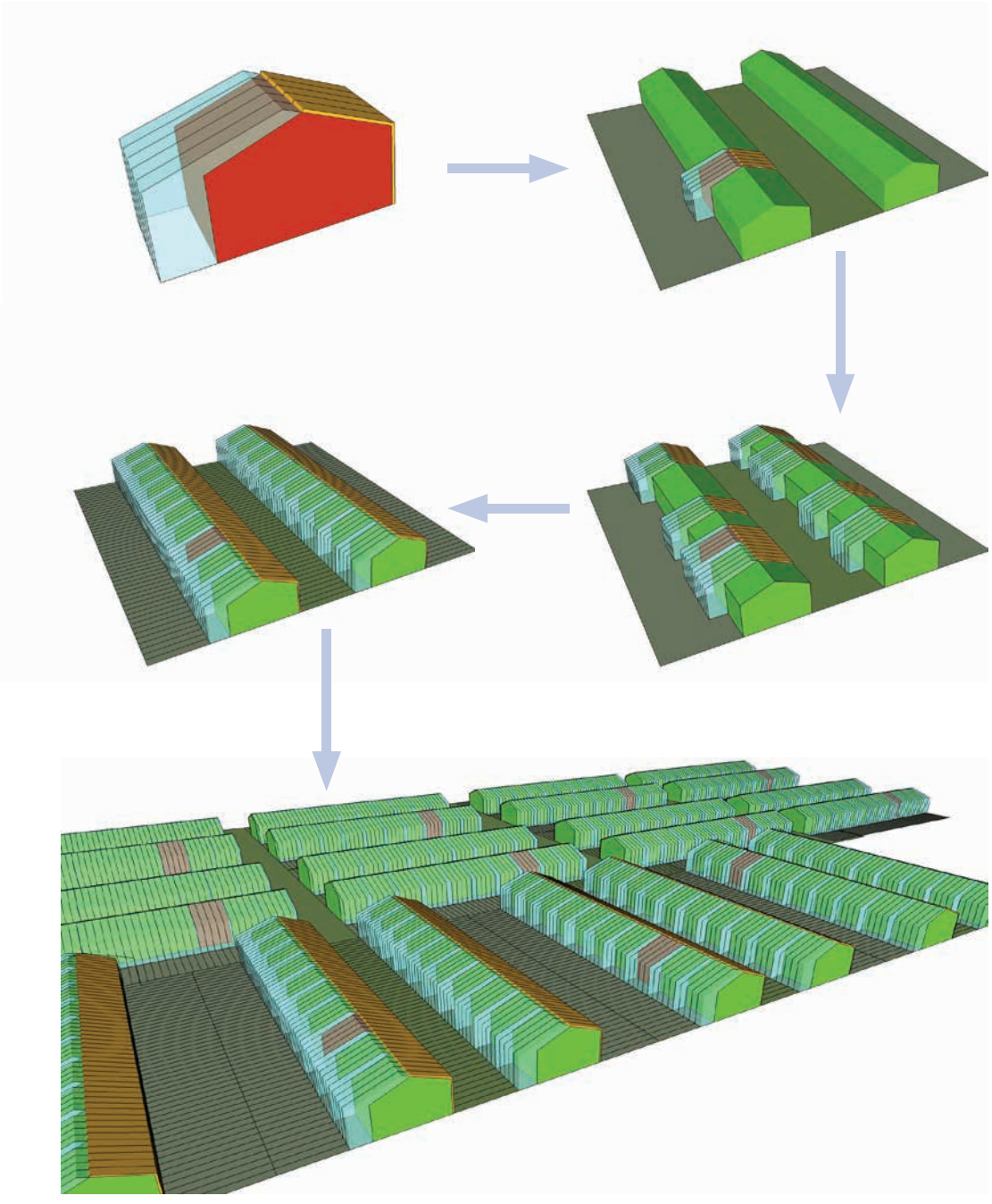
Even though it might sound contradictory, the innovative aspect of ‘Home with a Skin’ is not in the newest technologies and applications. It is in retrofitting the existing. In the current society everything seems to be possible: technology is developing at a tremendous speed, everything seems to be innovative. But what is innovation? We believe that innovation is not just about the ‘newest,’ the ‘brightest’ or the ‘seemingly impossible.’ Innovation is about using the current knowledge for providing an answer to the biggest challenges. In the building industry, this challenge is not building a new energy neutral or positive house. It is not about passive building by blindly insulating to the max: everyone can do that. The real challenge is adding quality to the ‘uninspiring’ existing building stock and making it future proof again. Innovation is not just about applying the most expensive and advanced technologies. It is about applying the right technologies in the right context. It is about making quality achievable for all people. It is about finding the balance between sustainability, affordability and quality. Turning the uninspiring and malfunctioning into a high quality affordable energy neutral homes. Only when we respect this balance, we can make the leap towards a sustainable society. (chapter 5.2)
Optimizing the use of space

One of the major challenges of designing with the existing is dealing with the existing. In the case of Honselersdijk this means minimal plot and living dimensions, optimized according the purely functional approach of the 60’s. However when analysing this existing one will find the underlying solution: it is not just the amount of space that determines spatial quality, it is also about the use. The house design in Honselersdijk is far from optimized in terms of space use: throughout the year the design consists of a house and a garden, even though the garden can only be used 50% of the time. By applying an adaptable skin to this house, the lack of space is not improved by adding space, but by optimizing the use of the existing space. The skin creates an adaptable zone which changes in terms of climate and use throughout the year, according the type of activities. This simple design approach is innovative in itself for is doesn’t change the amount of space, it optimizes the use. And this is exactly what sustainability is all about: reorganising the existing, optimizing our living space, for we cannot enlarge the total area that is assigned

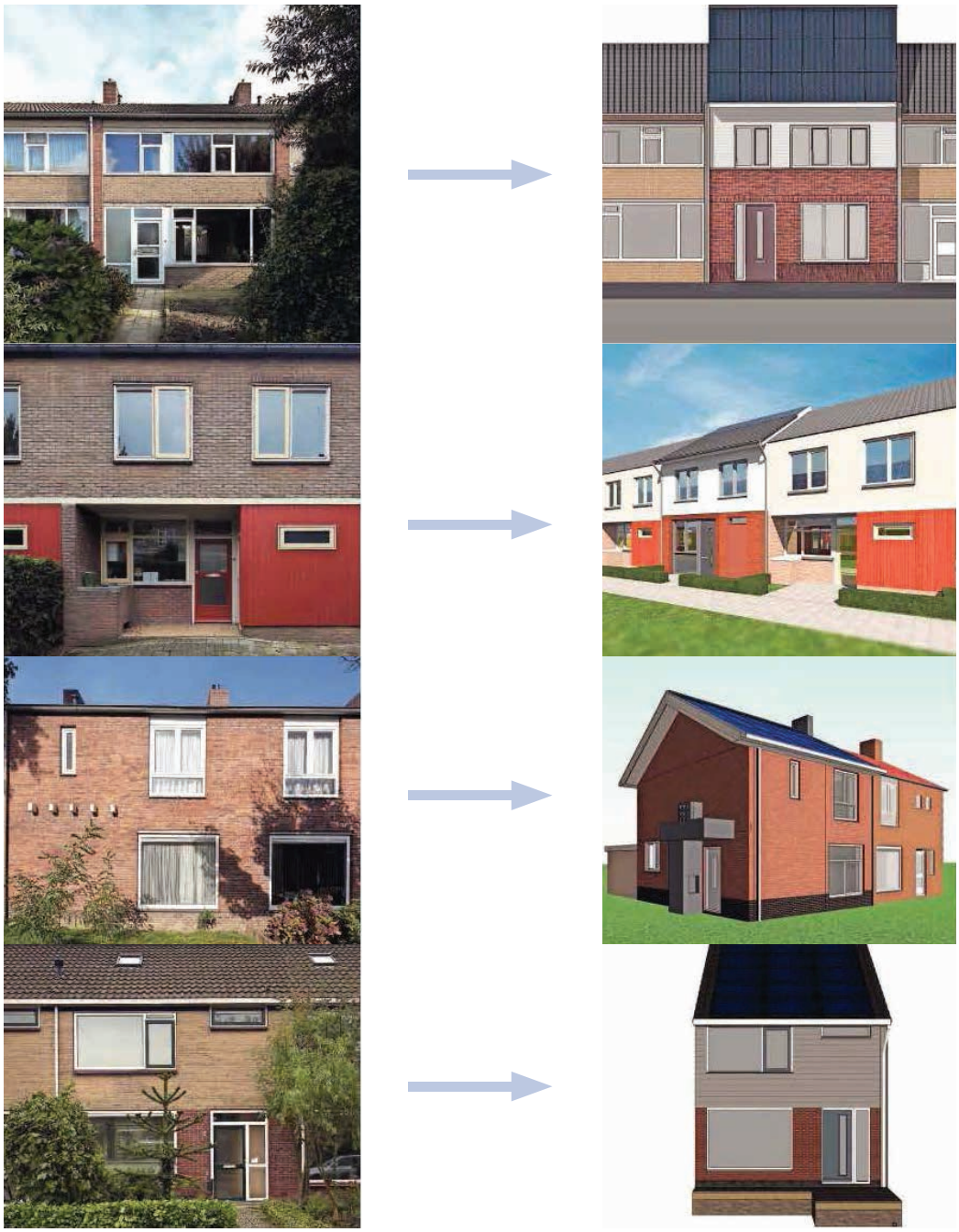
to us on this planet. (chapter 5.2)

The innovation is in the relation to the urban scale

The innovative part of the architectural concept of the Skin, is that it has the objective and the potential to contribute to the sustainability on a larger scale: house, the district, neighbourhood and even the city. First of all this is because the Skin has a strong relation with the public space (chapter 1.1) and second of all, the Skin is designed in such a way that it can be applied to one house as well as to a whole row of houses. Because of the toolbox, the concept of the Skin is adaptable to any context and user's identity. Combining these two major advantages, the strong relation with the public space and the adaptability, the whole neighbourhood can become sustainable from both a bottom-up approach as well as a top-down approach, initiated by one inhabitant alone or a whole building corporation. Therefor the Skin not only contributes to the sustainability and quality of the dwellings, but at the same time to the sustainability and quality of the public space and the urban concepts of the street (chapter 5.1).



In it's typological context, an energy neutral renovation, the architectural concept of the Skin is unique and innovative compared to existing energy neutral renovations. In principle, these renovations are still in their experimental phase (chapter 1.5). By comparing the main examples of this typology, it becomes clear that only climate performance is improved, while lack of spatial comfort remains the unimproved. One could question to what extent these houses are made future proof. Prêt-à-Loger, however, looked for a solution for improving both climate performance as well as spatial performance of these houses by an integrated approach: The Skin. In this project, spatial and climate comfort are integrated in one architectural design by adding a greenhouse, which functions both as a climatic as well as a spatial buffer-zone (explained further in chapter 2.1). This makes the architectural concept of the Skin truly unique and innovative in the current context of energy neutral renovations.



5.2 Innovation in Engineering and Construction

The integration of two of the most important construction systems in the Dutch industry, the lightness and transparency of the greenhouses and a house thought down to the very last millimeter in terms of functionality. This provides the perfect balance between structural efficiency and functional proficiency.

Due to enormous investments in the sector of greenhouses technologies and long experience, the Netherlands play the leading role in the world in this branch. Dutch greenhouses are the most modern in the world and exceed all others in crop capacity, energy efficiency and other technical, technological and economic criteria. Now, through a smart integration, all of these benefits are brought and placed within the reach of the final user, the dweller.

Losing the properties of lightness and transparency of the greenhouse was risked at the design process; nevertheless, our design team was able to include all the technologies and functions without losing the identity and properties of both, the house and the greenhouse. Our project encompasses both, tradition and technology, and evolution and experience in order to configure one final design.

The row house, a dwelling that inherited tradition and technique through centuries, evolved according to the changing needs of its inhabitants. The evolution in terms of construction systems and interiors configures an almost perfect artifact to satisfy the needs of its occupants. Once again, Prêt-à-Loger will have the challenge to show the tradition and knowledge embodied in the house. On one hand, representing such an important figure of the housing industry becomes a challenge not easy to accomplish. On the other hand, merging the greenhouse and its features to this “existing” house becomes a greater challenge. Building the prototype and then adding the skin is a double challenge that the team is attacking with modularity, lightweight structures and easy assembly processes. But, the biggest challenge of the team is to bring a piece of Holland to Paris, as alive as possible, to represent tradition and technology.

5.2.1 Innovation Engineering and Construction – Electrical

Considering the electrical installation of the house, the Pret-a-Loger team seized the opportunity to proceed with many innovative solutions while trying to keep the design of the original house in Honselersdijk.

One of these innovations, the plug and play cable installation, is a standard that enables newly added electrical elements to be implemented. These elements can be plugged into an existing system allowing its maintenance or replacement without doing any major changes. This configures an easy process that helps replace the existing installations with a minimal intervention, as compared to previous mainstream solutions. Furthermore, all the cables can be replaced just by removing the skirting board. Additionally, cable junctions are used to connect the various cables, helping mobility and replacement, achieving a swift and clean process.

We find other innovation in the switches selected. The Prêt-à-Loger team decided to use wireless switches in cooperation with RF adapters, which are placed on the lights. This means that a person can turn on, turn off or dim the lights through those switches without any direct contact through cable, since all the communication is done through RF signals. The simplicity achieved in the electrical design becomes evident in the amount of cables needed, while minimizing the risk of an electrical shock accident.

On the other hand, all the lights installed inside the House with a Skin pavilion are en-

ergy-efficient, solid state LED lights. These, in addition to the solar tubes lights which provide natural light through the roof during the day, minimize the energy needed to illuminate the home during the day.

Following Prêt-à-Loger's philosophy, these solutions respond to the need of intervening in a house being the least invasive possible. Referring to the affordability report, the need to bother the least possible the dwellers, as one of the requirements to commercialize the idea, becomes a key issue to be solved. It is also clear the advantages in energy efficiency, described in the Engineerng and Design Construction narrative, under Electrical System Design (refer to relevant part).

5.3 Innovation Energy Efficiency

In order to achieve a positive energy balance, Prêt-à-Loger has devised innovative means to maximize the efficient utilization of all energy sources and sinks. As is explained in Figure 6.1, the addition of a glasshouse to the existing structure increases the solar gains thereby reducing the need for heating. It provides a thermal buffer to the existing house so as to reduce the amount of insulation needed to bring down the heating energy demand. Finally, the air in the greenhouse can be used as a source of preheated air for ventilation inside the house.

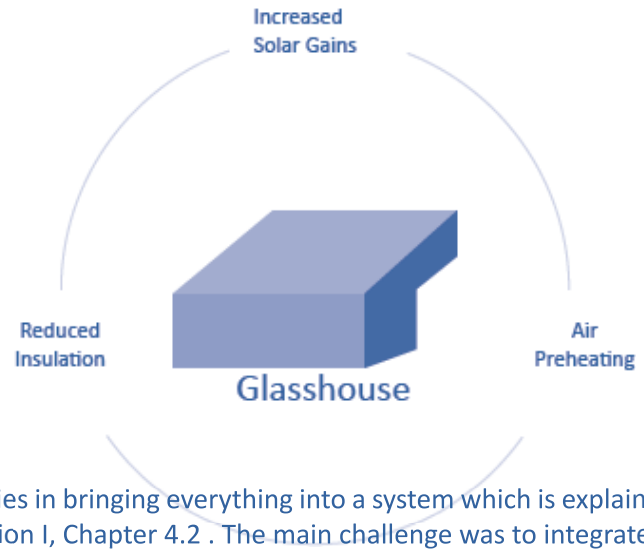


Figure 5.1 — *Main benefits of Addition of Glasshouse*

The innovation lies in bringing everything into a system which is explained in the climate schemes of Section I, Chapter 4.2 . The main challenge was to integrate the new system into the house without having to deconstruct the inner partitions. As a result the ventilation system was integrated into the chminey and the heating system was combined with the hot water production panels which operate on the principle of heat pumps. Another innovative aspect of this hot water production system is that it cools down the photovoltaic panels and thereby increases their efficiency.

5.4 Innovation Communication & Social Awareness

Being innovative in communication & social awareness is not an easy task. One can have the feeling that everything 'has been done already'. In order to grow awareness and spread the word, you need to be smart about the way you communicate in order to be effective and succesful. We are in this process of creating ideas that can help us spread our message.

One we believe is really powerful, is educating the younger generations. We are setting

up a series of workshops for this, of which the first one has already been realized. The purpose of these workshops is to educate children of ages 5-15 in a fun and interactive way about the use of renewable energy, reducing energy need and sustainable building. We let them draw their own house, and then ask them to provide this house with solutions to make it more sustainable. This has proven to be a trigger for children to think about renewable energy and energy saving measures. If you want to change the future, you have to start with educating the people that will live in that future to make a difference.

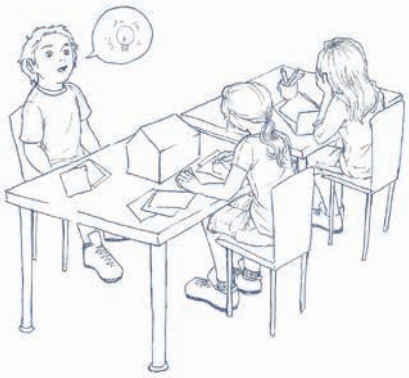
When we redesigned our logo and visual identity, we wanted to create a mark that not only catches your attention, but also gives you all the info you need to understand our project, our story and our ambitions. Because we are now in this phase between old & new visual identity, we are still working on using this new identity for marketing purposes. We would like to produce more audiovisuals, on all aspects of our project. We think high-quality and interesting content is the key to create a better bond with your 'fanbase', which is exactly what we want. We noticed that good audiovisuals help a lot in this process.



A short introduction on the topic of sustainability and the role in the design process will be explained. 1



In small groups they will work on a design task. 2



The groups will study on a prefabricated basic model and make drawings. 3



In the end there will be a short presentation for the whole group. Sharing gained knowledge from the course. 4



Afterwards the group will get a tour through the Prét-à-Loger model. 5

5.5 Innovation in Urban design, Transportation and Affordability

Prêt-à-Loger addresses innovation through financial and planning efficiency on the urban level. Our urban strategy is building up a completely special dual process where the top-down and bottom-up initiatives coexist and enhance each other. We believe in a future where sharing resources will be the basis for the establishment of balanced and cohesive communities. In terms of urban planning this dual approach is facilitated by a well-elaborated parametric urban toolbox presented in section 1.1.5. This allows the local inhabitants to take an active participation in the design and decision-making processes providing them with considerable amount of choices and, meanwhile, provides the local authorities with sufficient possibilities to create an explicit strategic framework. This simultaneous empowerment of both institutional bodies and local inhabitants defines this parametric design toolbox as an innovative approach.

The 'Max Town' concept aims to incorporate the flows of energy, vegetation, food, water, waste and mobility into an enclosed system where the output of one flow can be utilised as an input for another one. This is supported by the elaboration of a comprehensive planning framework, which proposes a strategy that establishes links between these flows on the various scales. This idea together with the local energy generation promotes an environmental-friendly vision of self-sustaining streets, neighbourhoods and even towns. On the regional level Prêt-à-Loger realises the necessity of personal vehicles in the suburban network. Therefore, a system facilitating electric bicycles handling distances of 10-20 kilometres is established alongside high-speed express buses on the existing lines and introduction of a car-sharing system.

In order to reach the sustainable goals of the Netherlands the construction sector is shaping itself towards energy neutral renovations to deal with the large supply of buildings in need of renovation. To deal with the difficulty of being affordable and energy neutral at the same time, the capacities of the industrialised production are utilised and, what is more, brought to the next level. Although, standardisation in the context of residential energy neutralisation is already often described as being innovative in itself, the team of Prêt-à-Loger involves the specific demands of each individual end user.

A way of combining the advantages of industrialised production for the many standardised dwellings in the Netherlands has been found. At the same time the team still provides a way of involving the inhabitants and offering them a design product, tailor made to their desires and needs. A range of selected products have formed the Renovation Toolbox. It consists of various sub-parts that can be selected by the involved stakeholders. However, the basis of the toolbox is always shaped by the glasshouse, which provides not only strong climatic advantages but adds additional space to the dwelling as well. This unique combination of both locally renowned row housing typology and glasshouse technology allows a new lifespan to be given to the dwellings. Furthermore, by renovating the existing house the project preserves the often strong bond that inhabitants have form with their homes while improving energy and climate values at the same time.

Financially, the price of the current toolbox varies from 70,000 to 140,000 Euro providing a considerable decrease of energy demands in the range of 80%-110%. Investments for various packages are already lower than the current competition prices in overall. Prêt-à-Loger's main market advantage is adding new space to the house with varying seasonal functional possibilities that is accessible on more affordable expenses. New legislation in the Netherlands allows housing corporations to charge the residents with the amount of saved energy bill in order to create a sufficient cash flow allowing invest-



ments. Depending on the solutions chosen and existing energy costs, the design has the capability of being paid back in a period as short as 20 years. Besides the renovation, due to the end-user involvement and the further interaction with the Domotica system, the project does not only refurbish the houses but creates awareness. According to Prêt-à-Loger, sustainability should not only be promoted as a necessary aspect of the urban development but also as a desirable one.

5.6 Innovation in Sustainability

Prêt-à-Loger found an opportunity to innovate where others just found useless and not worth to save buildings. By making a rough analysis, besides the poor performance in energy efficiency, row houses represent a huge effort to provide of housing to Dutch families in the 60's. But, independently from this, those houses embody energy and represent an environmental footprint while they were built. So, why spend more energy, effort and money in tearing these houses down and building new ones?

"House with a Skin" is a concept that takes conscience of these facts and proposes retrofitting the houses to provide with a new life and turn them into homes again, where their tenants can keep enjoying their life and memories in an energy and carbon neutral home. But, not only are these opportunities created to give one more opportunity to these houses, but also to prevent keep filling up landfills with construction materials, which adds in an important percentage.

In this sense, cities are like living creatures, consuming resources and emitting waste as a result. And usually, the larger and the more complex they become, the greater the necessity of infrastructures, the greater their dependence on surrounding areas and, last but not least, the greater their vulnerability to change around them. So why add more pressure to the environment to the one that it already has? (v. Timmeren, 200?).

It is hard to estimate how much energy and how many years can take to recover the energy lost in demolishing a comparable existing building and building a new green and efficient building. Furthermore, repurposing old buildings—particularly those that are vacant—reduces the need for construction of new buildings and the consumption of land, energy, materials, and financial resources that they require.

We believe that this is not needed, hence the necessity to preserve these houses. Not only because of the sentimental value, but also because the houses are already out there, therefore, they don't need to be demolished, they need to be brought back into life. By valuing the character and sense of place, it can help get the most out of prior investments in infrastructure and development, and encourage growth in already-developed areas.

By preserving existing affordable rental housing offers many advantages over new construction. People can still be living in those houses while being renovated, there is no need to put more pressure on additional land to allocate new dwellings, and furthermore, there is no need to spend more energy to build new houses when the ones existing can be just as good, or even better than new ones.

6 Sustainability Report

6.1 General concept of the project and sustainability

6.1.1 Introduction

In a time, when the effects of environmental change have become evident and ever present, everyday life will have to take a turn in the pursuit of sustainable development. According to the 'Sustainability Monitor for the Netherlands' (CBS, 2011), "more innovation, better education and a greener economy are required to achieve sustainability." Besides having this necessity high on the political agenda, people have started to become more aware and slowly implemented changes in their personal lives, addressing common topics such as water consumption, energy savings and waste separation. In order to better assess where improvements can be made, the current average consumption of a typical Dutch family was determined (figure 6.1). Assuming that the household is made up of two people (two adults, one child), it can be seen that one a yearly basis 131.4 m^3 of water and 4,305 kWh of electricity are consumed and 2,184 kg of waste are produced.

Figure 6.1 — *Average Dutch family consumption and production*





2,184 kg/year



131.4 m^3/year



4,305 kWh/year

- 51.2% Residual waste
- 26.1% Vegetable / fruit
- 9.6% Old paper
- 7.6% Bulky waste
- 2.9% Glass
- 1.0% Plastic
- 0.8% Electrical waste
- 0.5% Textile, clothing
- 0.3% Chemical waste

- 68.5% Sanitary
- 12.8% Washing machine
- 12.4% Kitchen
- 4.4% Cleaning premises
- 1.5% Exterior consumption

- 25.1% Hot water
- 20.6% Cooling
- 18.8% Lighting
- 17.8% Heating
- 17.8% Appliances

TU Delft and Prêt-à-Loger realise that sustainability goes way beyond greenhouse gas emissions: aspects on all three levels, environment, economy, and society have to be addressed to ensure that current and future needs of the planet and its inhabitants are met (figure 6.2). There is a strong feeling that plenty of these aspects extend to the many realms of the living environment that affect everyone in their daily lives. Therefore, Prêt-à-Loger believes that such a change towards sustainability should begin at the very basis of a person's life: the home.



Figure 6.2 — *Sustainability at Prêt-à-Loger*

As a result, Prêt-à-Loger aims to approach sustainability in several ways. When wanting to have a big impact on the process of (the Netherlands) becoming sustainable, a large playing field has to be sought after. Building new houses represents only 1% of the building activity in the Netherlands. Therefore, retrofitting the existing building stock is the most effective way to not only conserve resources and avoid the production of unnecessary waste, but also to positively influence the energy performance in large numbers. This is of great importance, because currently, the majority of inhabitants in the Netherlands lives in row houses, of which 86% of the total stock of 4 million, has an Energy Label below C. While by 2020, every new building in Europe must be energy-neutral with an Energy Performance Coefficient of 0.0, old buildings will continue to perform poorly, unless interventions such as the ones that Prêt-à-Loger designed, are implemented. Linda Hildebrand's (2014) research supports this argument by stating that, "if the main supporting structure of a nineteen-sixties' building is sound, with ceilings of a sufficient height, then redevelopment – with improvement of the façade – is on average seven times more favourable than the option of demolition/new build when it comes to energy investment." This argument is precisely what makes the proposed solution so strong, as will be demonstrated in chapter 6.1.2.

Moreover, when aiming at becoming more sustainable by using existing buildings, much consideration for the users of the house, their needs and desires have to be made. If the homeowner is not convinced by the need to upgrade his home, or change the way he is using it, there is little opportunity for Prêt-à-Loger to have an influence on the overall sustainability of the Dutch building stock. Based on personal experience and interviews with the inhabitants of such houses, it is believed that the homeowners would not require much convincing as they are aware of the various issues with the house themselves. Presently, there are a number of problems with the existing house ranging from bad energy performance to structural and comfort condition concerns, which are described in chapter 6.1.2. With the help of this existing awareness, the transition will

become more appealing when it is financially affordable and beneficial, and even more so when there is a prospect of earning profit. Chapter 6.2 contains the urban affordability analysis and will address the aforementioned aspects.

Besides promoting environmental and economic aspects, Prêt-à-Loger approaches sustainability on a social level as well. By transforming existing buildings, the cultural and societal values of the communities are preserved. On a smaller level, the homeowner will also benefit, because building a new house implies that users have to relocate for the building phase, which is a large step to take. With the Prêt-à-Loger approach of retrofitting, it is planned to renovate with the users remaining in the house; consequently avoiding this inconvenience in the user's everyday life. (This, of course, is dependent on the level of intervention.)

One of Prêt-à-Loger's main objectives is to create a strong connection between science, design and practical applicability to develop a comfortable and healthy climate in and around buildings. Moreover, the goal will be to provide everyone with easy access to affordable, renewable energy sources. The following paragraphs and chapters will give further insight on the sustainability approaches that are being taking on the various levels of the project.

6.1.2 Where the sustainability story begins

One of the greatest challenges of the theme of Prêt-à-Loger for Solar Decathlon 2014 is essentially the idea of working with existing structures. By itself the theme is mainly about applying refurbishment techniques in inefficient houses in order to make them energy neutral and upgrade their architectural quality. Prêt-à-Loger's story begins with the existing house in Honselersdijk, a small town in the Westland region of the Netherlands. The project represents the actual building that has been retrofitted after applying pieces from what is referred to as toolbox. This improvement will then be presented in Versailles.

Figure 6.3 — *The beginning of the story*



Analysis of the existing situation

The Dutch house of the present analysis [Stompersdijk 10, Honselersdijk] belongs to the building estate of the 60's period and is considered to be typical of that time. During the 60's and 70's the use of concrete prefabrication was extremely widespread also for the construction of dwellings. However, the case study of Stompersdijk 10 is primarily constructed out of clay bricks, as was customary for such Dutch buildings, even before the 20th century. Nevertheless, clay bricks are even today a typical material used in the Dutch housing industry – mostly as exterior cladding – and it is this material that has been defining the look of the row houses in the whole of the 20th century. Despite the different building material of its loadbearing structure, the row house of Stompersdijk 10 can very well represent the Dutch building stock of the 60's and 70's in terms of housing typology, structure, climate and energy performance.

Due to the character of Prêt-à-Loger, it is crucial to analyse the current situation for Stompersdijk 10. This research can establish the elements of the building that are problematic and most contributing to energy losses. To determine a course of action for the

renewal of the typical row house, Prêt-à-Loger has focused mainly on the structural and climatic performance of the existing situation. That is because on one hand, structural elements constitute the biggest part of building elements in a construction and on the other, climatic conditions in and around the house are determined by the everyday behaviour of the users and determine the energy consumption of the household.

Structural Analysis

For Stompersdijk 10, as in all typical row houses, the loadbearing function is taken up by the wooden elements of the house – wooden floors and gable roof – and transferred to the transverse brick walls that are shared by two consecutive houses. Stability of the whole structure is achieved by the facade walls of the house and to a lesser degree also by the chimneys that go through from bottom to top. The big openings on the facades are spanned by a concrete beam incorporated in the brick wall. Interior partitions also contribute to the transfer of loads to the ground, but have significantly less capacity as they are constructed with only one layer of bricks. The entire house is based on a reinforced concrete plate with deep pile foundations underneath that keeps it elevated from the wet and soggy ground.

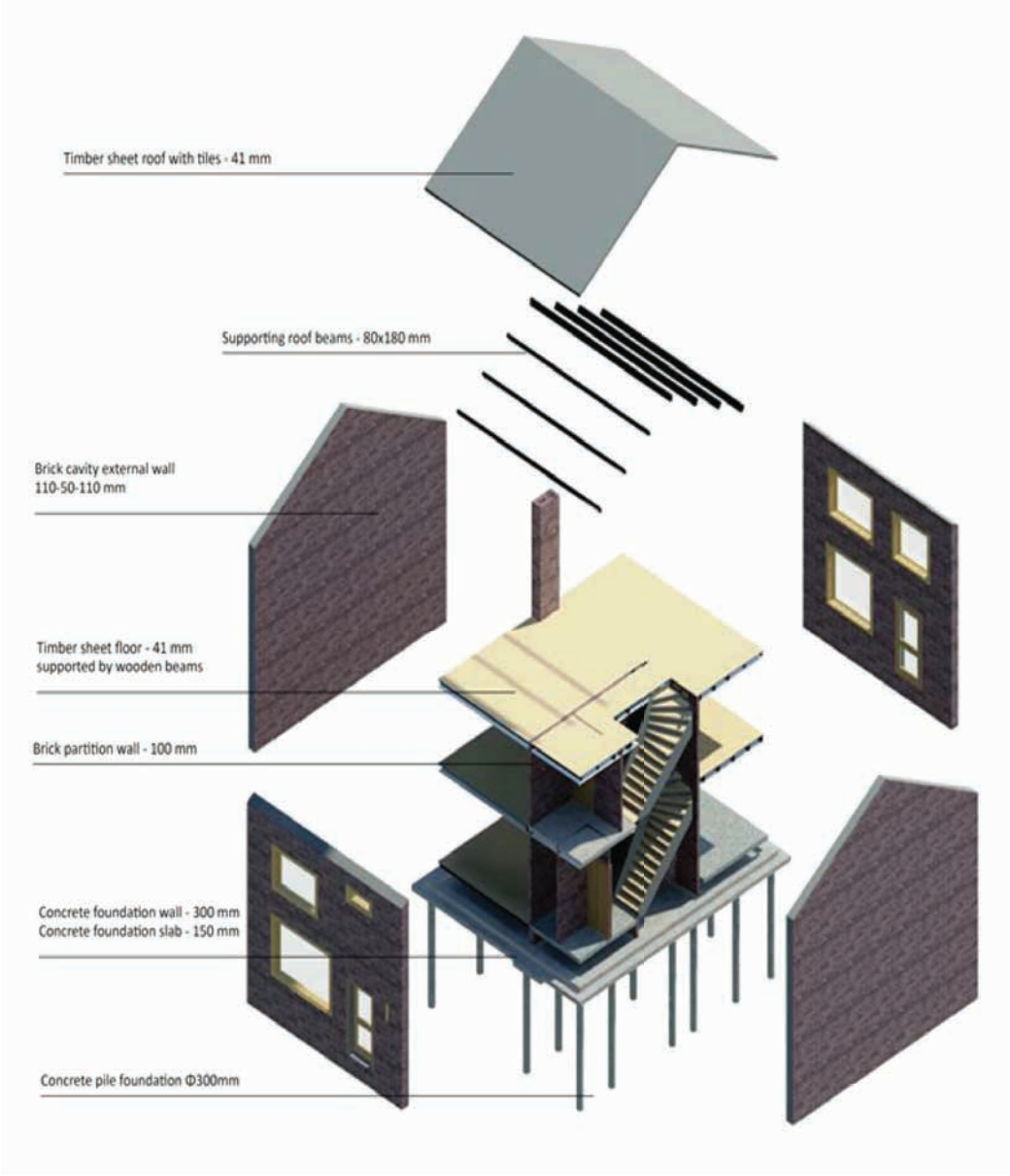


Figure 6.4 — *Structural Analysis: exploded view*

OWN CONTENT

A simplified calculation of the loadbearing capacity of the existing loadbearing walls of the row house, using the conservative method provided by Eurocode 5, shows the following:

$\frac{q_{sum}}{N_{Rd}} = \frac{81.29}{234.06} = \mathbf{0.34}$ this is the loads that the existing walls are carrying

$\frac{q_{sum}}{N_{Rd}} = \frac{74.84}{168.52} = \mathbf{0.44}$ this is the additional loads that the existing walls are capable of carrying.
Extended calculations of this can be found in chapter 3.1.

Energy Efficiency Analysis

Looking into the climatic performance of Stompersdijk 10, one quickly realizes that there is no added insulation in the external walls, and the only contribution to external insulation is the air cavity of the loadbearing structure. From the survey and the visits to the house, as well as the houses location [Netherlands] and the frequent precipitation there, it was further assessed that the humidity rate inside the house is very high. It was possible to notice the presence of spots and damage to the finishing of the house due to moisture and cold bridges.

Figure 6.5 — *Energy Efficiency Analysis and Losses in Building*

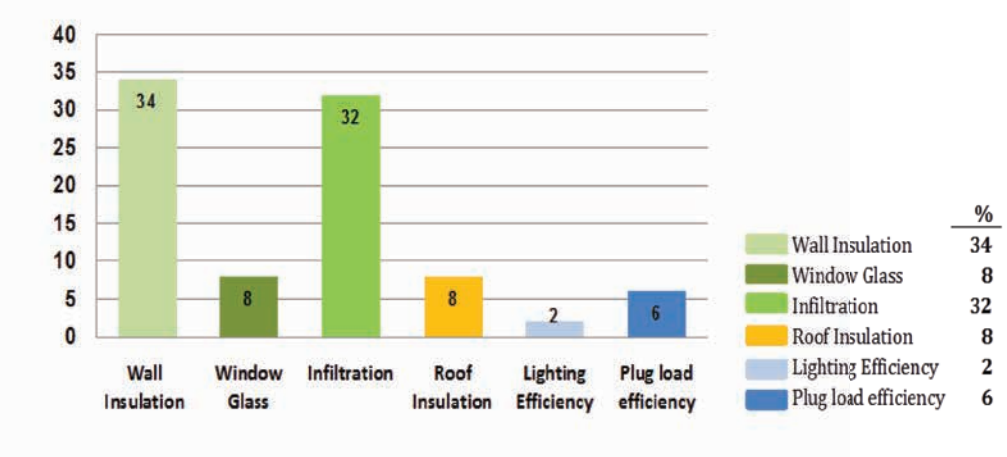
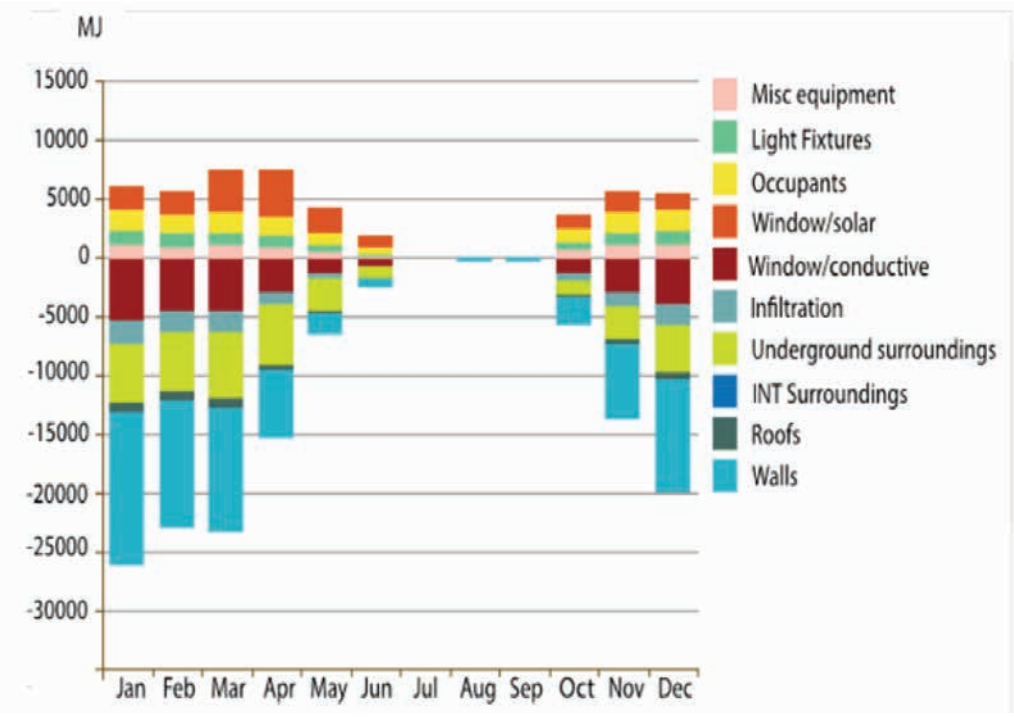


Figure 6.6 — *Energy consumption and losses throughout the year*



The lack of wall insulation and the infiltration mainly because of the poor fitting of the window and door frames are the main factors which contribute to the loss of energy. Given the energy losses and the severe winter conditions in the Netherlands, the heating system clearly represents the biggest contribution to the CO_2 emissions. The house is still equipped with a gas system for heating and kitchen use instead of an electric one. An estimation of the peak heating loads needed in the house can be seen in figure 6.5 and 6.6. For a detailed analysis of the climate of the existing row house please see chapter 4.2.

Conclusion

It is evident that more than 50% of the existing structural capacity is not being utilized by the row house as it is now. The existing construction is found to be sound and able to last for many years to come. Historic buildings all over the Netherlands [Amsterdam Oude Kerk – 1300, Breda Castle of KMA – 1538, Royal Palace of Amsterdam – 1655] are proof for the durability of bricks, even with today's air pollution levels in the cities. For more typical row houses that consist of prefabricated concrete panels, cladded with clay bricks, the case is that its structure could hold more than twice the load it is already carrying. With that in mind, Prêt-à-Loger strongly proposes the preservation of those houses over their demolition and the redevelopment of urban areas.

Demolition seems to result in a complete waste of existing infrastructure in the housing sector while at the same time unnecessary material and energy resources would have to be employed for the reconstruction of this infrastructure from scratch. However, the indoor climate of an existing row house is unfavourable and at the current situation does not provide the required comfort without high-energy consumption. The damage registered to the inner finishing proves the high humidity within the walls. Better insulation, water tightness and different energy sources (such as solar energy from photovoltaic panels) can considerably improve the existing situation achieving an energy-neutral house while at the same time minimizing the resources that contribute to this transformation.

6.1.3 Demolish as little as possible

The most straight forward association and idea behind retrofitting is preserving what is already there. In this sense, it should be aimed at demolishing as little as possible where structural and architectural feasible. How this translates practically into the architectural narrative has already been extensively described in chapter 2.1. But there are more aspects to this story – namely the sustainable ones.

Retrofitting does not only have economic benefits where money for new materials can be saved, it also serves environmental purposes by preventing waste and avoiding the need for materials for new construction. Moreover, the social aspects of a house are also taken into account by respecting the existing, preserving memories and cultural value. Prêt-à-Loger is attempting to achieve this with its case study in Honselersdijk, where a typical mal functioning Dutch row house from the 1960's is located. An existing house will be taken and retrofitted with a Skin. Clearly, the aim is to not simply demolish mal functioning houses and replacing them with new buildings, but to preserve what has already been invested into.

6.1.4 House and garden function as one

While it is important to work on improvements of the house and preserving as much of the home as economically and architecturally possible, it is of crucial importance to inte-

grate the house into its surroundings as well. That means that the living space has to be extended from the house into the garden, and as far as the broader urban environment.

Starting on the small scale and the one that might be most easily influenced, Prêt-à-Loger integrates the house and the garden so that they can function as one unit. Moreover, the garden design also contributes to the functioning of the house as shown in figure 6.7. The Skin serves different functions. It creates additional space in the glasshouse that can be seen as the buffer zone between the house and the garden area. As a result, one can enjoy a more temperate climate transition between those two areas, which in itself can be used as a comfortable living space. However, these aspects will be more elaborately discussed in chapters 6.3.7 Space Planning and 6.3.13 Exterior Design.

For now, it is sufficient to bear in mind that it is important to look beyond the boundaries of the home, because there is more to it than only the house. The living space and personal environment can and should extend to the outside and surpass the boundaries of the plot. Prêt-à-Loger has been looking extensively into the benefits that can arise from the application of the solution. Amongst these, it can be found that e.g. people tend to become more consciously aware of their surroundings, taking weather changes into account, because it influences the electricity production of their houses and that a bigger sense for belonging is developed when taking care of shared community gardens. These things do not only contribute to the social sustainability of a neighbourhood, but also to the economic and environmental development of the region. Therefore, Prêt-à-Loger has put much effort into integrating the “Home with a Skin” into the urban context and in shaping the design of the neighbourhood, as will be described in the following chapters.

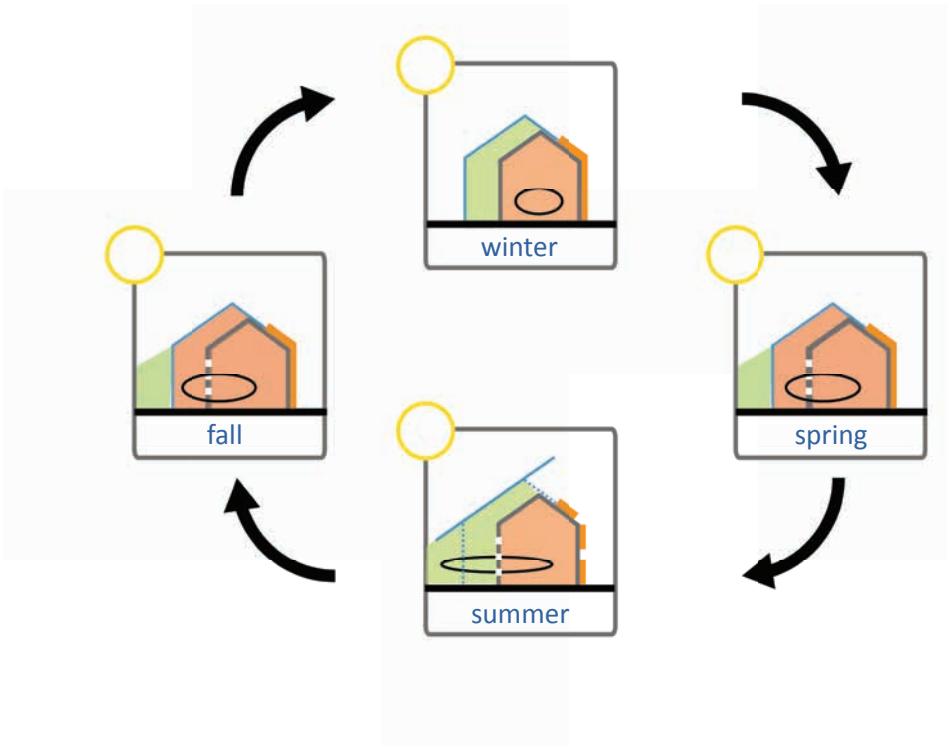


Figure 6.7 — *Applying the Skin to 50% of the building stock*

6.2 Urban Design, Transportation and Affordability

6.2.1 "Home with a Skin" on neighbourhood scale

Since the housing sector contributes to about 30-40% of the total greenhouse gas emissions in the Netherlands (chapter 1.2.2), Prêt-à-Loger sets out to increase the energy efficiency and the user quality of existing post-war row houses in the Netherlands while implementing the 'Stroomversnelling' approach, which has been explained in chapter 1.2. This is done by retrofitting these houses with a sustainable skin, where the emphasis is on more than just creating energy efficient and comfortable spaces, but also on promoting a lifestyle in balance with the environment. This aspect, in particular, is important with regards to the urban sustainability of Prêt-à-Loger and the typology of the row-house throughout the Netherlands.

The existing public domain associated with row-house neighbourhoods can be considered collective since it is shared among a myriad of different residents. However, when looking at the quality of the public space in front of the individual houses, it becomes apparent that this space is not treated as such. While private gardens in front of the dwellings form a transition between the public and private domain, it has been observed that the semi-private areas are usually cultivated or paved for completely private use, or neglected due to a lack of interest towards their maintenance from the residents.

The urban sustainability approach of Prêt-à-Loger focuses on flexible optimisation of both row houses and their associated public space to achieve environmental, economic and social sustainability. As stated in chapter 1.3.1, the emphasis is not on densification of the building stock, but rather on sustainable adaptation through the densification of functions and flexibility of the excessive space that serves pre-dominantly the automobile networks. With these adaptations, the existing urban structures are preserved, so that existing local societal and cultural relationships between and within the urban communities can be sustained and enhanced.

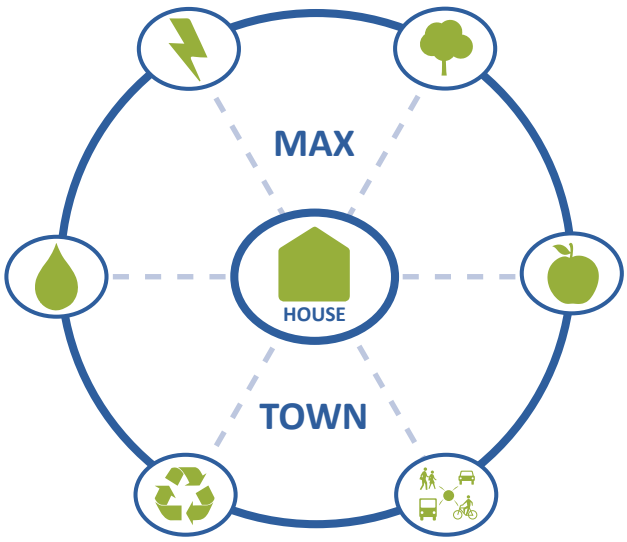


Figure 6.8 — *The 'Max Town' concept*

The approach is a bottom-up engagement and involves municipalities and residents as much as possible. Education about sustainability and community building among the residents are an important part of the approach. To support this sustainable approach, Prêt-à-Loger introduces the concept of 'Max Town' (chapter 1.1.4), which promotes optimal use of the urban resources and future developments by maximising the (re-)use of materials, energy and food, thereby minimising the production of waste (figure 6.8). This

ensures optimal land-use within cities while optimising transportation and can facilitate 'green zones', which can provide citizens with fruit trees and bushes and various vegetable plants, facilitating local and sustainable food production and consumption. This collective use of space will likely ensure that it will be maintained more intently, since the ownership of the domain is handed over to the users of the space.

To achieve the sustainability goals, an urban toolbox has been created, which has been developed in chapter 1.1.5. The goal of this urban toolbox is to create a flexible and adaptable neighbourhood with room for green spaces where more than one house can be sustainably retrofitted. The Skin facilitates this, since it can be applied to a myriad of row house types owing to the individual and urban toolboxes, and can even be used as a spatial element do discern between the public and private domain. Municipalities and residents can choose to include various solutions on an urban scale such as urban gardening, waste & water management features, energy & mobility organisation, etc. This freedom of choice allows for different urban implementations to be combined and adapted to specific situations and contexts, facilitating their enhanced performance and durability. This will help to promote that the adaptation of the neighbourhood is about more than only improving the energy label of the houses and encompasses environmental sustainability and durability on a larger scale as well. By allowing municipalities and residents to share ideas and enhance the sharing of goods, the social well-being of residents will also improve due to a shared interest, as stated in chapter 3.

6.2.2 Energy and water savings on the urban scale

One of the main aspects of urban sustainability is how much the Skin can contribute to the reduction of energy, water and waste flows on a larger scale (figure 6.9). The Skin provides individual houses with energy neutrality and even additional energy production through the use of photovoltaic panels, passive heating and cooling (chapter 6.3) and the use of a green roof for insulation. The Skin can further help to save up to 18% of drinking water through the use of water collectors for flushing toilets, cleaning of premises and watering the garden (chapter 6.8). The green roof, as a rainwater retention unit, will reduce the pressure on the sewage system during heavy rains. By applying the Skin to more houses in one neighbourhood, this individual benefit will add up and become noticeable on an urban level, helping to reduce the energy and water flows on an urban scale.

Figure 6.9 — *The different levels: from household to town*



The implementation of the Skin on an urban scale will occur in three phases which coincide with 2020, 2025 and 2035, as is stated in Chapter 1.1.4. When enough houses are equipped with the skin, a collective energy grid can be created. The decentralised energy production of the houses, along with external sources, like windmills, will make the streets and neighbourhood more self-sustainable. External sources, such as windmills and biomass power plants, can be added to the smart grid to create buffers and enhance the energy grid.

As explained further in chapter 1.1.4, this decentralised energy production will result in less energy losses during distribution and transmission on a regional scale. Moreover, it will actively involve local residents in their energy production, which ideally will raise awareness and provoke responsibility in terms of energy use. Eventually, this could lead to self-sustaining communities and towns, especially in combination with the collective use of public space. Aside from its function for local food production, the public space can also be used for water retention and could become an inherent part of the smart-grid in terms of transportation, as will be explained in the next section.

The sustainable benefits will differ depending on the application of the skin. Based on a scenario where 50% of the building stock is retrofitted with the Skin (220 buildings per neighbourhood) 138.6 MWh could be produced 1,969 MWh and 6,483.4 m^3 drinking water could be saved annually, according to the calculations in chapter 6.2. On the scale of Honselersdijk this would entail a production of 551.35 MWH and savings of 7,831.25 MWh and 25,786.25 m^3 of drinking water in 2030 (figure 6.10).



Figure 6.10 — *Applying the Skin to 50% of the building stock*

6.2.3 Transportation

The transportation associated to the housing sector contributes greatly to the greenhouse gas emissions in the Netherlands. As stated in chapter 1.4.1, approximately 20% of the carbon footprint of the average Dutch family is due to their transportation, of which 18% is associated with personal travel by car. In 2011 alone 31 billion kilograms of CO2, 99 million kilograms of NO_x, 6.6 million kilograms of PM10 and 22.8 million kilograms of VOS was emitted in the Netherlands just by cars (KiM, 2014).

A part of the reason for this is the substantial sub-urbanisation and sprawl during the second part of 20th century within the territory of the Randstad conurbation. Currently, the government of the Netherlands attempts to halt these tendencies by the implementation of policies which forbid new urban development outside of existing urbanised areas. Nevertheless, the population of these areas keeps on growing, causing densification of the sprawled urbanised areas. To accommodate this growth, the transportation networks need to be improved. To prevent a further increase of emissions from this transportation, a sustainable approach is proposed.

As has been described above, Prêt-à-Loger's case project is located in Honselersdijk, which is a satellite city within the Randstad conurbation (figure 6.11). As indicated in chapter 1.4, most of the residents of Honselersdijk commute to one of the surrounding larger cities, making the town highly car-dependent. This is especially true since public

Figure 6.11 — *The Randstad conurbation*



transport connections are poor in and around Honselersdijk and the public space within the town is predominantly designed for cars. Since 70% all travels are less than 7.5 kilometres (Mobiliteitsbeleid, 2011) a lot could be won by improving the local infrastructure and encouraging cycling and pedestrian travel for short distances.

Therefore, one of the main implementations on the urban infrastructure is to increase the 'green mobility' within the town boundaries by removing cars from numerous service streets with minor connectivity frequency and encouraging cycling and walking as attractive alternatives. The streets can then be transformed into collective green areas, as has been mentioned before, creating public spaces that are targeted more towards the needs of local residents, instead of cars. The electric bicycle could play a crucial role, since it follows the Dutch culture of biking and makes traveling over short distances, without using a car, very accessible. The close proximity to two of the largest cities of the Netherlands also means supported cycling could also be feasible for longer distances as a healthy alternative to other transportation modes, since people are able to travel longer distances up to 20 kilometres with electric bikes, as has been stated in chapter 1.4.2.

For longer distance travel, smarter and more efficient usage of the private motorised vehicles is proposed in chapter 2.4.1, highlighting the electric car. The introduction of this electric car will coincide with the development of the decentralised energy production of the Skin on an urban scale and will form a part of the smart grid, together with the Skin, and will also be executed in three phases between 2020 and 2030. To reduce the necessity of private car ownership and to lower the energy demand and the pressure on the existing infrastructure, a shared vehicle program is envisioned for these electric cars. In order to facilitate this, collective parking areas will be strategically placed throughout Honselersdijk to provide an easily accessible parking spot for every household. These parking areas are clustered around electricity hubs, which are connected to the smart grid and can incorporate electric, hydrogen and hybrid cars. This means that the cars can be powered by the surplus electricity generated by the houses and with additional solar stations on location and windmills outside of the urban area. Since the solar stations on the collective parking locations will only be able to produce 154.35 MWh per year and the cars demand 1,287-2,847 MWh per year, as calculated in chapter 1.4.2, the connection to the grid and to potential external windmills is necessary. Windmills are seen as a very suitable solution, since a windmill with a rotor diameter of 44 metres in this region will be capable of producing 5,670 MWh per year, which is more than sufficient for the

electric cars and could therefore also feed the smart grid. Chargers can also be directly connected to the Skin for energy exchange and storage between dwellings and individual owned cars and electric bicycles.

Public transportation in the area is also addressed, since this can support the green mobility and relieve the necessity for cars in the region. More 'green bus lines' powered by natural gas or a more sustainable option like biogas, hydrogen or electricity will be created to make connections to The Hague, Rotterdam, Hoek van Holland and other destinations, thereby integrating the two existing bus lines through Honselersdijk. Furthermore, fuel-free alternatives will be added in the form of electrical light rail routes, which could be powered by solar or wind energy. The extension of the Randstadrail from Rotterdam to the Hoek van Holland could play a vital role in realising this.

This intensification of the public transportation will connect Honselersdijk and the direct vicinity around Honselersdijk with The Hague, Rotterdam, Delft, Hoek van Holland, The Maasvlakte and all other important industrial and economical locations in a sustainable way. This intensification of public transportation in combination with the utilisation of (electric) cars and bicycles is estimated to decrease the number of cars in Honselersdijk by 30%, as stated in chapter 1.4.2.

6.2.4 Feasibility

Since most of the employed elements are prefabricated, like the north wall, photovoltaic panels and green roof, increased production of the specific elements will not likely have a big impact on the environmental sustainability of the process. The production of these elements is already based on mass production. An urban application of Prêt-à-Loger would merely increase the demand of the produced elements. However, the specific process for these prefabricated elements can become more efficient by repetition and trial-and-error (chapter 6.4).

Only the elements that form the construction of the glasshouse are designed specifically for this project. However, since these are based on the greenhouse production in the Netherlands, one of the largest producers of greenhouses internationally and the producer of 80% of all greenhouses in Europe (AgriHolland, 2013), they can built on the existing technologies and innovate these further in this specific niche. Socially and economically, this could improve this section of construction, since the focus within the production process is currently on greenhouses for agriculture. Introducing a new use for these production processes can expand the activities and secure continuity to the sector when the production of agricultural greenhouses decreases. This way the urbanisation of the Prêt-à-Loger greenhouses could create jobs now and retain jobs in the future. Environmentally, the mass production will likely not have a large effect, since the basic processes for construction are already in place and since the elements of the glasshouse, steel and aluminium, are highly recyclable.

The feasibility of the transportation strategy can be divided among the electric bicycles, cars and public transportation. The difference between electric cycling and travelling by a normal (small) car is approximately 46 cents per kilometre, which means the bikes will pay themselves back over time (including electricity price, maintenance and use). The electric car sharing concept will instigate a large investment, but since the network of cars is shared among the residents the price will be divided among them, relieving individual investments. Furthermore the electric cars will have a very limited price of costs, which means they will also pay themselves back over time. The green buses will likewise involve an initial investment that is higher than conventional ones, but the price of use is substantially lower. which means the price difference per bus could be returned in 5-5.5 years. The lightrail project is already an initiative as part of the successful Rand-

stadrail network in South Holland. Overall, the feasibility of the transportation strategy will therefore be dependent on the long-term application of the transportation nodes.

6.2.5 Economic viability of industrialisation

For the industrialisation of Prêt-à-Loger's solution, a scenario for the application of the Skin in Honselersdijk has been modelled for housing corporations in the chapter 1.2. All values in this chapter have been derived from these models.

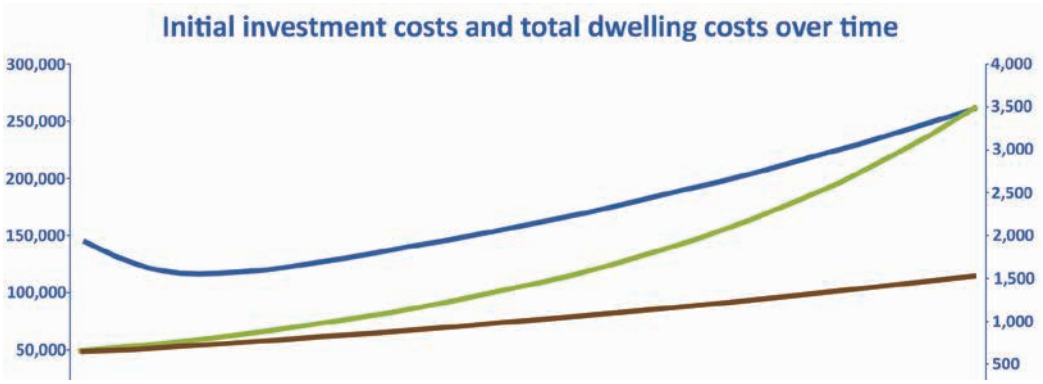


Figure 6.12 — *Total living and dwelling costs over time*

For the proposed lifetime of 50 years, an adjustment to the dwellings has to be made in order to ensure this 50 year lifespan, leading to an initial investment of €86,413 at this point. However, the initial investment will decrease with time, especially within the first 10 years of development, resulting in an average profit of nearly €24,000 per dwelling over a period of 50 years.

With the implementation of the Skin two main target groups have been selected: housing corporations and individual homeowners. As has been explained in chapter 1.2, individual homeowners are different from housing corporations since they look more at comfort, space and improved aesthetics than to savings on the energy bill. Also, since people only live in the same house for 11 years on average, it is less interesting for them to invest with payback periods of 50 years. It has been speculated these individual owners would benefit from the adjustments due to the increased value and lifetime of their dwelling, but it becomes more interesting and feasible when 50 year contracts are used that can change with the homeowner. The initial investment would then come from external investors, which is explained in more detail in chapter 1.2.

The price of the initial investment is expected to drop due to the simple and effective way in which the Skin can be produced, adjusted and constructed. This will be especially relevant when the different parts of the Skin will be mass produced for application on a larger scale. As will be explained in chapter 6.4, mass production will greatly improve the efficiency with which different elements can be produced and will decrease the occurrence of errors and loss of materials, which is strengthened by the simplicity of the skin. This will reduce the production costs, time and difficulty and hence lower the initial investment over the years. After approximately 10 years, this decrease will be levelled out due to inflation of material costs. The price of the Skin will then slowly increase with inflation.

The increase of revenue of the dwelling over 50 years also plays a big part with the predicted profit after this period, as explained in chapter 1.2. Naturally, this profit will mostly be achieved by the energy savings that the Skin will provide for the dwellings. The price of energy from fossil fuels will increase over time, causing an increase of living costs after 50 years. By creating a personal 'free' energy source and cutting down on en-

ergy losses, the total living costs will decrease substantially and will increase only slowly over time, resulting in a difference in living costs of approximately €1,500 per year after 50 years (figure 6.12). This will increase the value of the dwellings substantially, which, combined with the energy savings, will enable the housing corporations to increase the rent of the dwellings over time, eventually resulting in higher revenues per dwelling. Because of this drop in investment and rise in energy prices it is expected the urban application of the Skin will be economically feasible within 5 years for both external investors and housing corporations (figure 6.13).

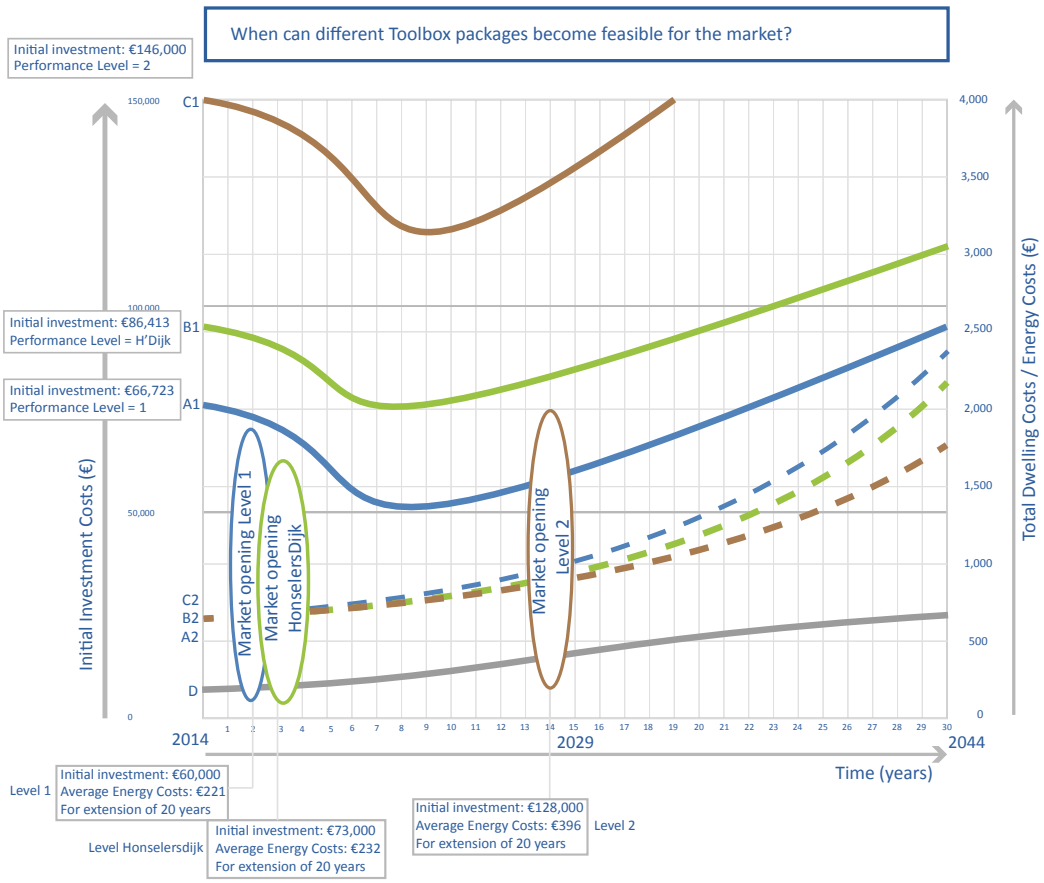


Figure 6.13 — *When will the Honselersdijk variant become feasible for the market?*

- A1 Initial Investment Level 1
- A2 Total Dwelling Cost Development
- B1 Initial Investment Level Honselersdijk
- B2 Total Dwelling Cost Development
- C1 Initial Investment Level 2
- C2 Total Dwelling Cost Development
- D Expected Energy Price Development

6.3 Bioclimatic Strategies: Passive design strategies

6.3.1 Climate in the Netherlands

The Netherlands has a temperate marine climate. It is mostly affected by the North Sea, which moderates the temperature during the whole year, resulting in mild summer and winters. Over the last 30 years, an annual temperature average of around 10 degree Celsius has been monitored, which can be seen in fig. 6.14. The average temperature during winter is just above freezing point and in summers around 25 degrees Celsius.

Figure 6.14 — *Annual average temperature in the Netherlands*

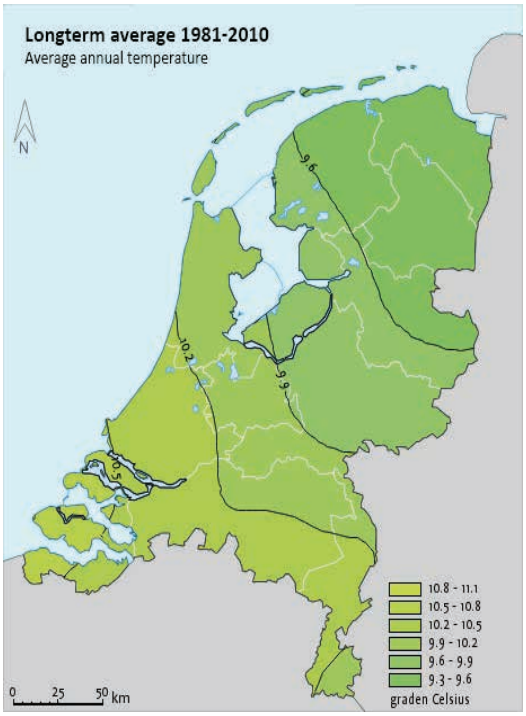
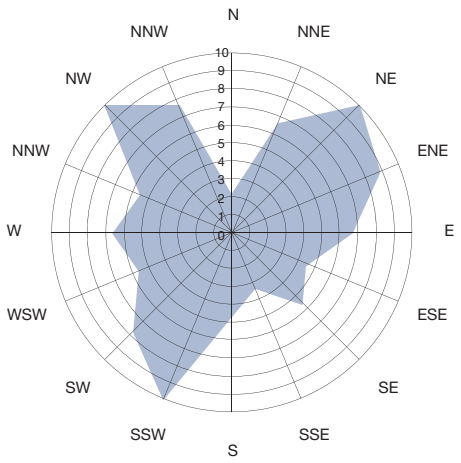


Figure 6.15 — *Annual wind frequency*



The wind is mostly influenced by the sea and gives a prevailing wind direction of south west with average wind speeds of 5 km/h (fig. 6.15). The Netherlands has a reputation of being a rainy and wet country, though by average it only rains 7% of the time. Monthly it rains between 42.3 - 82.8 mm with most rain falls occuring in October and the least in April. The seaside has the most sun hours with approximately 1,650 hours of sunshine per year. The relative humidity is between 75% in summer and 89% in winter.

6.3.2 General strategy

In order to “protect” houses, and more importantly people, from these climatic conditions and the environment, it has to be ensured that buildings are well prepared for that. The climate design created by Prêt-à-Loger is based on a passive greenhouse system that matches the Dutch climate requirements. The concept at hand is to put a Skin over the existing building, which, among other benefits, will solve climatic problems.

The Skin works together with the existing house to form a passive system based on natural ventilation, thermal mass and water storage. After applying the passive climate system, the energy demand will already be greatly reduced. In a second step, when using active technologies such as PV modules that produce energy, it is possible to make the building smarter and even energy neutral. The reduction of energy demand combined with energy production, derives in a sustainable and energy neutral row house, ready for the future.

Design with orientation

When designing a house and looking to reduce its energy consumption by working with nature's energy, is essential to develop a spatial configuration and an optimal constructive solution which allows to capture and then convert free energy from the environment to be used in advantage of the building. In other words, the aim should be to operate with natural forces around the building rather than against them (Almusaed, 2011, p. 263). For these purposes, the position of the house in the urban context, and more importantly, the orientation of the house itself, must be taken into account. This is especially the case in the construction of new buildings and an aspect that already informs the design since its initial stages.

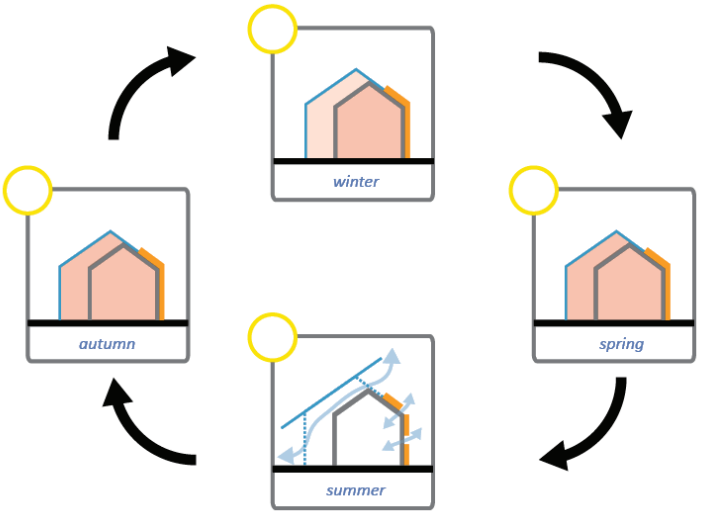


Figure 6.16 — *"Home with a Skin" – designed with orientation and adaptation*

However, for the case study in Honselersdijk, Prêt-à-Loger is dealing with an existing house with an orientation that is already predetermined and not optimal. Therefore, the spatial configuration and the optimal constructive solution to be added should take advantage of the existing orientation. Even though there are other limitations, this situation will still be taken advantage of and solutions are adjusted to them. This is done by combining the orientation with the right materials on the right facades: the glass Skin on the south and insulation on north side, as shown in figure 6.16.

Design with adaptability

If nature changes the boundary conditions in the environment, from season to season and from day to night, then it is logical that the solution is designed to be flexible and adaptable to these conditions. As can be seen in fig. 6.16 the Skin is designed in a way that allows it to be flexible in its function, meaning that it can adapt to and throughout the different seasons. The climate performance of the house is mostly optimized based on passive design strategies. As will be demonstrated later, in cold months the Skin is closed, acting as a heat buffer that insulates the house. The insulation on the north façade adds to that as well. In the warm summer months, the Skin and the windows on the north side can be opened, allowing for natural ventilation.

Being able to play around with the flexible Skin is clearly an added value and brings advantages for the owner as well. The bioclimatic conditions in the house can be adjusted to the users' needs and preferred comfort conditions Therefore, it can improve and outperform similar buildings in Honselersdijk and other row houses in the Netherlands that do not have the Skin and cannot flexibly react to the changing conditions.

6.3.3 Project's envelope

The envelope is where Prêt-à-Loger puts its major effort to solve the problems of the existing house. Many of the passive solutions and some of the active ones can be found here. The solutions developed as part of the envelope tend to solve the two major needs in the house, both the spatial and climatic conditions, which are far below today's standards for a comfort living in The Netherlands.

The main problem, in order to keep the comfort levels, is the massive amount of energy consumed in one year, around 1,800 m^3 (SenterNovem, 2007a), and secondly, the building physical state of the house which results in other comfort problems such as moisture (For more info please refer to fig. 5.2.6).

The existing envelope of the house in Honselersdijk consists entirely of bricks that do not have any insulation. By being enclosed by its neighbours, the house holds mainly the walls on the north and south and the roof as the actual envelope. Today, there is neither insulation in the roof nor in the cavities of the walls. Consequently, major heat losses in the original house happen through walls with 3.2 kW, external ventilation 3 kW, external infiltration 2.2 kW and glazing 1.9 kW, among others (For more info please refer to Fig. 5.4.11 Break-up of heat losses from the House in Honselersdijk). Therefore, it can be concluded that major savings can be achieved by reducing the heat losses mentioned above.

'The Skin', as a major component of the toolbox, has the objective to solve as many of these problems as possible in the least invasive way. Built with a main steel frame (Steel – S355) which supports an aluminium frame with integrated PV glass system and single glazing panels, the Skin is a lightweight glasshouse attached to the Southern part of the house (For more info please refer to 13. Structural Calculations). For the Dutch weather, heat gains and heat storage is a compulsory requirement to low down the energy consumption of a house, hence the important role of the skin.

However, adding the glass Skin on the North side proves to be not cost efficient, since there is no solar radiation falling on that side (For more info please refer to Fig. 5.4.12 Solar radiation as received by different surfaces on the Honselersdijk house). Instead, insulation on the North face of the house will be added to help prevent heat losses on that side. As a result, increased U values are achieved and read as follows: U-Value (north): 0.141 W/m^2K; versus U-value (south): 0.203 W/m^2K. Also, the air tightness level is expected to be reached in the current project for 0.3 ACH, after all of these interventions (For more info please refer to Fig. 5.4.13 Cross sections of the Insulated North façade wall (left) and the North roof (right)).

6.3.4 Glazing

As for the glazing situation of the house, it currently presents old standard double glazing windows in a plastic frame. After years of use, these windows present a bad condition, with poor performance, becoming a major source for heat losses. Therefore, the original glazing is replaced in the north side with one of a better performance, which is triple glazing where the frame is made out of 100% recycled plastic. This decision was based on four aspects, namely affordability, sobriety, comfort and sustainability. The proposed windows configure a system with a combined U-Value of 0.141 W/m2K and SHGC of 0.416, and with Light Transmission of 0.682% (For more info please refer to fig. 5.4.14 Profile for the Window frames). The South side will keep the existing double glazing windows, since it is also not cost efficient to replace them due to the existence, now, of 'The Skin' in that side.

In terms of affordability, triple glazing can present a fairly high initial investment cost, compared with other windows, however, the payback time has been steadily decreasing over the last years, therefore making it affordable for the homeowner and helping save money in the long run (Lente Akkoord, 2013). In terms of sobriety and comfort, triple glazing windows will prevent major extent drafts and will improve the insulation. Furthermore, from the sustainability point of view, an study already suggests that "Triple glazing would repay its extra 11 kg CO_2 cost in its material lifecycle in just months" (Bosschaert, 2009), hence justifying the decision from a LCA of the materials perspective.

Finally, triple glazing windows are part of the toolbox to allow the homeowners to choose for modules that they deem necessary.

6.3.5 Justifying the means with calculations

The main objective to achieve with all these strategies, part of the tool box, is to reduce the original 7,551.2 kWh of energy consumption of the house. Figure 6.17 shows the contribution of the different strategies to decrease the energy consumption. It needs to be noted that all solutions combined include other passive strategies that are not part of the envelope. (For more info please refer to Fig. 5.4.30 Change of house energy consumption as different elements of consumption).

However, any energy neutral or energy positive house can only be reached if energy was generated. 'The Skin' will generate 3,700.00 kWh per year in 43.61 m^2 of PV array panels, which constitute 4,993 [kWp] of installed power (For more info please refer to 4.1.2 Technical summary Honselersdijk 'Home with a Skin'). According to the simulations, this will create a surplus of 770.57kWh.

Figure 6.17 — *Different strategies for managing energy consumption*

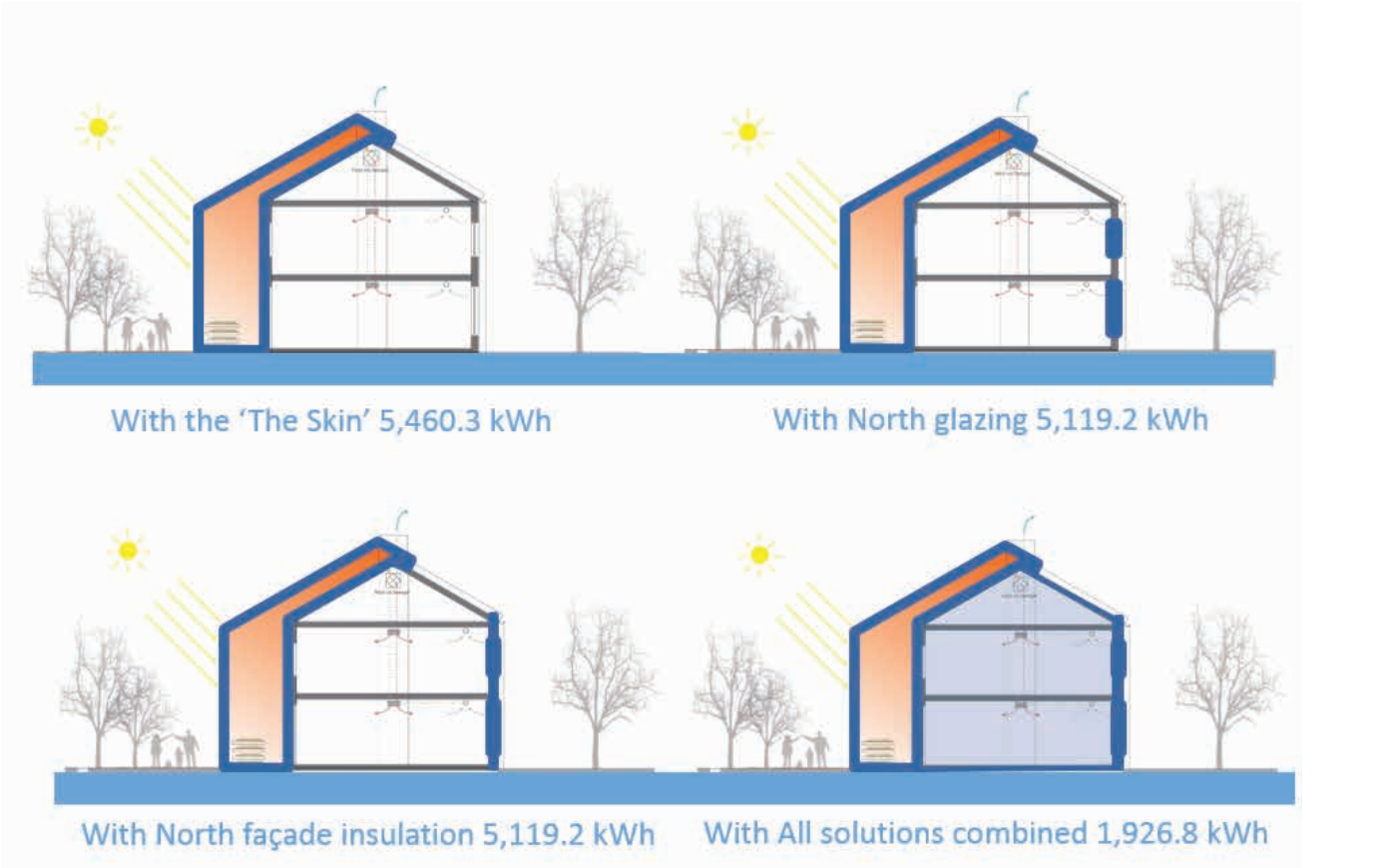
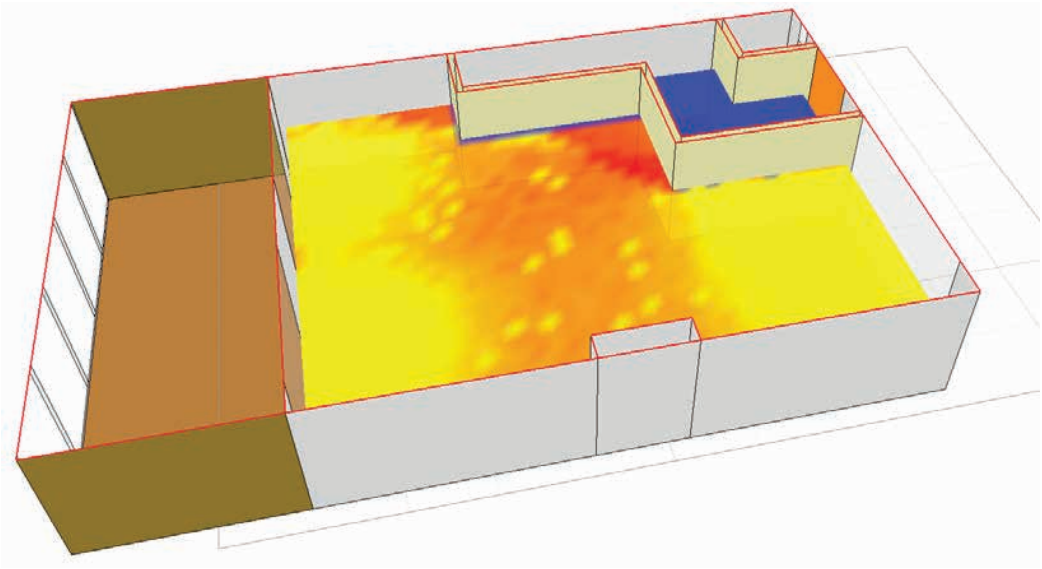


Figure 6.18 — *Plan with the measures of the existing house with the addition of the glasshouse.*



6.3.6 Daylight

The existing house challenges Prêt-à-Loger's design in terms of daylight. The lack of sun into certain spaces in the house impacts the levels of visual comfort in a negative way. The hallway and the staircase, where artificial light is needed during late hours in the morning and early hours in the evening, and especially during winter time, ask for additional measures to provide enough light levels in these spaces. These measures should be preferably passive.

An initial analysis to determine the adequate levels of light per different activities informs the type of strategies and different decisions to be taken. Three points in the house were defined as reference to simulate and calculate the daylight factor (DF), as shown in figure 5.2.39 Calculation points for the daylight factor inside the house. The results show a DF 1: 4.44 % in the dining room, DF 2: 4.13 % in the kitchen, and DF 3: 4.60 % in the living room (For more info please refer to Fig. 5.2.39 Calculation points for the daylight factor inside the house). The horizontal illumination outside is Eo: 10806 lux. These parameters indicate a well naturally illuminated house.

However, the house is affected by the presence of 'The Skin', which includes 50% transparent solar panels and by a possible shading system with 37% transparency. In a worst case scenario, with 'The Skin' included, results show a DF 1: 2.78% in the dining room, DF 2: 2.02% in the space in-between, and DF 3: 2.75% in the living room (For more info please refer to fig. 5.2.50 Disposition of the calculation). The horizontal Illumination outside is Eo: 14006 lux. In this sense, it is clear that the house could be improved in quantity and quality of light to match its original situation.

So far, the percentage of 4% DF will be difficult to reach if Prêt-à-Loger only considers the existing house. This is especially due to the modifications done in the house to comply with the building regulations of the competition, particularly because of the omission of the second floor and the reduction of the total height floor to ceiling. However, this percentage can become very high if the glasshouse is being considered as part of the living room. Furthermore, any passive effort to improve light levels inside the house can contribute to more efficient energy consumption.

On the basis of this, the first solution, part of the toolbox for daylight improving, is to change the colours of walls and ceiling for reflective light colours in the inner spaces. Also, the use of Led technology due to low energy consumption, while helping colour perception, was a logical choice.

Solatubes with sensors that control the lighting is another passive solution implemented in the design. Located in the spaces that require artificial light in a normal basis in this type of houses, like the bathroom and the staircase already mentioned, ensure adequate light levels of comfort without the use of additional electric energy. Solatube is responsible for daylight entering the bathroom and staircase, while techcomlight provides the artificial lighting whenever it is needed (For more information, please refer to Fig. 5.2.60 and Fig. 5.2.61 Lux values artificial lighting and Solatube bathroom and staircase respectively).

Finally, "Home with a Skin" configures a space that can be adapted to sunlight conditions through semi-transparent PV-panels, with adaptive sun-shading devises. This space can be used during extended daylight hours with sufficient light levels to provide a comfortable stay during most of the year. In this space direct sunlight would only be allowed when desired, and blocked especially during summer time to avoid glare and heat gains. However, daylight (diffuse light) was taken into account when deciding for the type of glasshouse with integrated PVs. The 37% transparency of the PV-panels comes in handy when designing to keep the daylight comfort levels, especially inside the southern part of the house.

All these solutions take part of the design to achieve as much as possible Daylight Autonomy (the percentage of working hours when lighting needs are met by daylight alone), not only in terms of the right amount of illumination, but also light that is well distributed.

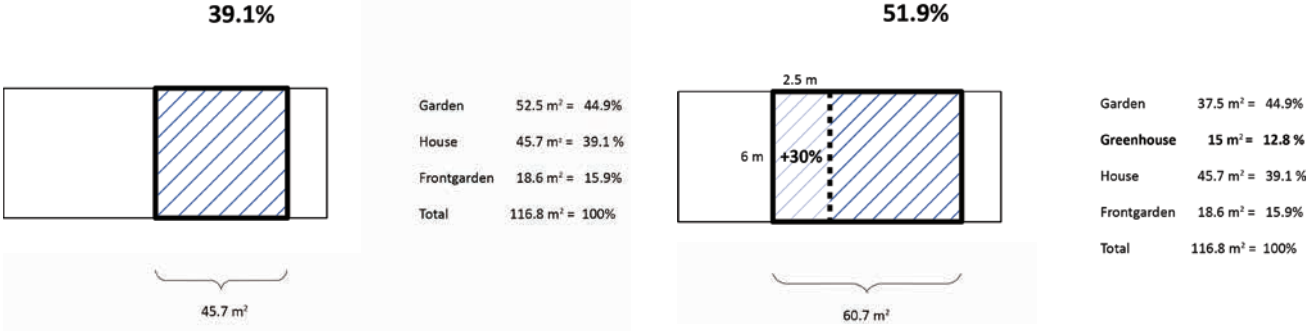
6.3.7 Space planning

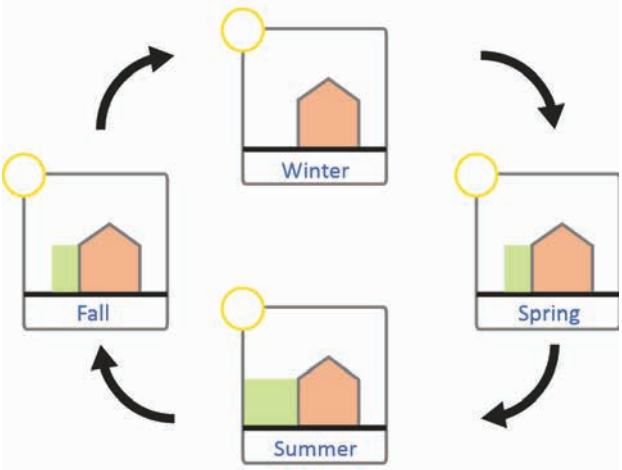
But perhaps and as explained before, the relevance of 'The Skin" is better defined by its adaptability. It allows for the 'space' to change throughout the year in accordance to the seasonal activities. In winter 'The Skin' will create a buffer zone, with temperatures suitable for a winter garden, while the living space remains the 'warm core.' This way people can enjoy green all year around, despite the grey and cold weather (For more info please refer to fig 5.2.16).

Furthermore, during spring and autumn, the temperatures in the Skin remain comfortable enough and allow the Skin to function as an extension of the living room. In this sense, the doors between living room and the Skin can be opened, allowing the inhabitants to fully enjoy this additional space surrounded by nature. During summer the focus of activities is mainly on the outside. The Skin adapts to this by opening up completely, so people can make fully use of their garden. (For more info please refer to Fig.5.2.17).

This way, "Home with a Skin" focuses mainly on exploiting (and expanding) the capacity of the house to create and adapt a space at and around the garden, creating a lively mix of uses. Visually the options explored show the potential of uses and how the space could be transformed, seasonally and over time, see Fig. 6.19.

Figure 6.19 — *Making use of 30% more space*





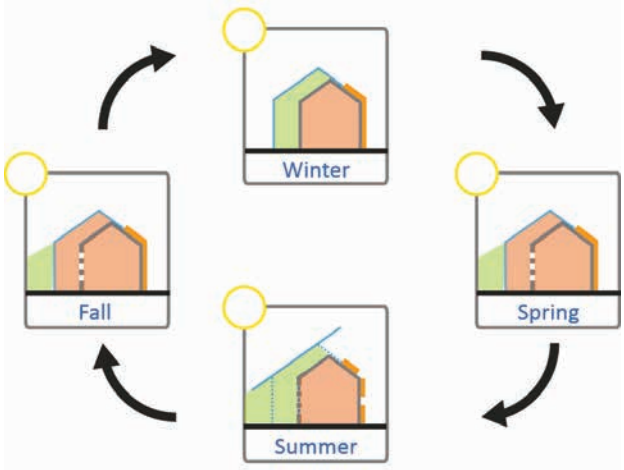


Figure 6.20 — *Existing house situation*

Figure 6.21 — *"Home with a Skin" – providing extra space in the seasons*

Flexibility and adaptation is enhanced by the fact that 'The Skin' configures a comfortable extra living space during spring and autumn, a large garden during summer and a winter garden during winter time; hence optimizing a space that otherwise is not used during this time. This characteristic becomes relevant particularly in winter, since during this time the space use of the estate accounts only for 50% of the area, now more of this space can be enjoyed, making the use of land mass more efficient.

This versatility creates the possibility of using a higher percentage of the total area, year round. Through this solution, besides providing a living space which is comfortable most of the year to the dweller, it generates freedom of use to exploit in several different ways.

Increasing the usability and liveability of a space, that otherwise is forgotten or left behind, is definitely the most important feature of the skin. The clear distinction and depiction of improvement of the "Home with a Skin" (Fig. 6.21), compared to the existing situation (Fig. 6.20) is made visible in the graphs below.

6.3.8 Passive heating strategies

The starting point for the passive heating strategies is, as explained before, to ensure proper insulation of the house. This allows for not only using energy to generate the heat to replace heat losses, but also to reuse heat.

In this sense, the glasshouse functions as a heat buffer turning a one-envelope house into a layered home-within-a-home, integrating an intermediate temperature zone. It does not only aid to the house insulation, but also gathers heat to be used in the general heating of the home. Pre-heated air is used for ventilation resulting in a reduction of energy consumption for heating. Furthermore, 'The Skin' configures a buffer thermal zone that due to its higher internal temperature helps prevent heat losses from the house. The solution also works the other way around, external infiltration losses are reduced as the glasshouse zone (when closed) has a stagnant air volume.

The air in between the building and the glasshouse is warmed up by sunshine. By using a heat exchanger, air is brought into the house at a temperature approximately of 22 °C (For more info please refer to Fig. 5.4.36 Climate scheme for Versailles Winter Day time). The heat recovery system, located at the top of the chimney, would recirculate incoming air, which is pre-heated and moved back into the house.

Heat excess at the top of the glasshouse, the one that will reduce the efficiency of the PV-panels, would be used to heat water for usage in the house through a heat pump system (figure 6.22).

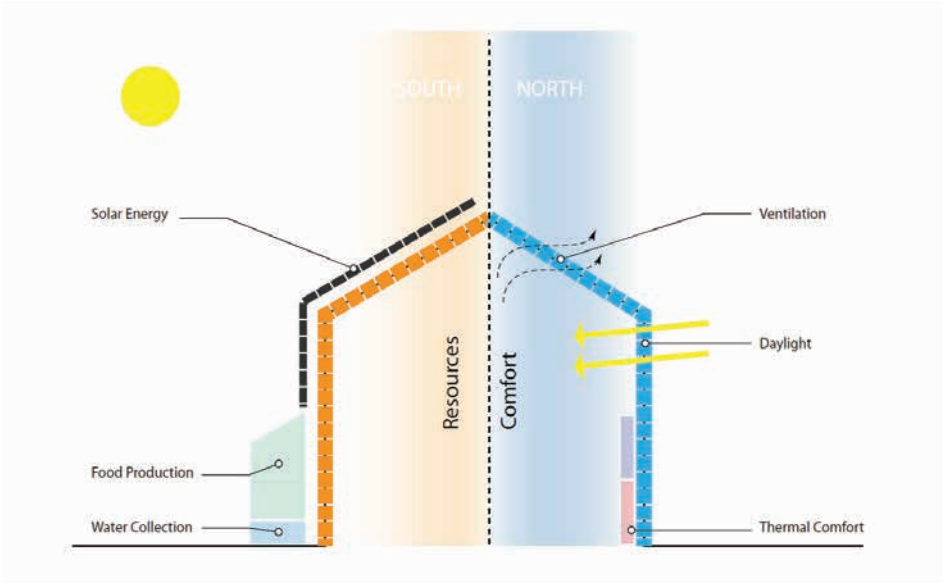


Figure 6.22 — *Exterior contributions*

6.3.9 Passive cooling strategies

The main strategy for cooling the house in Honselersdijk is natural ventilation. According to the climate data explained in this chapter, cooling is not as important as heating in The Netherlands. Therefore, mostly passive strategies are used for cooling the house. Calculations were done in two steps, based on CO_2 production and ventilation.

6.3.10 Ventilation

Ventilation to achieve a proper air indoor quality, is the starting point of the performed calculations. The limit of CO_2 allowed in the house is 800 ppm of CO_2. Calculations were done under the premise that the maximum ACH needed in the bedrooms will be 2.10, based on the CO_2 production of 4 occupants. This is equivalent to 126 [m^3/h] (Engineering Toolbox, 2014). (For more info please refer to House, Appliances and HVAC Simulations section and Fig. 5.4.17)

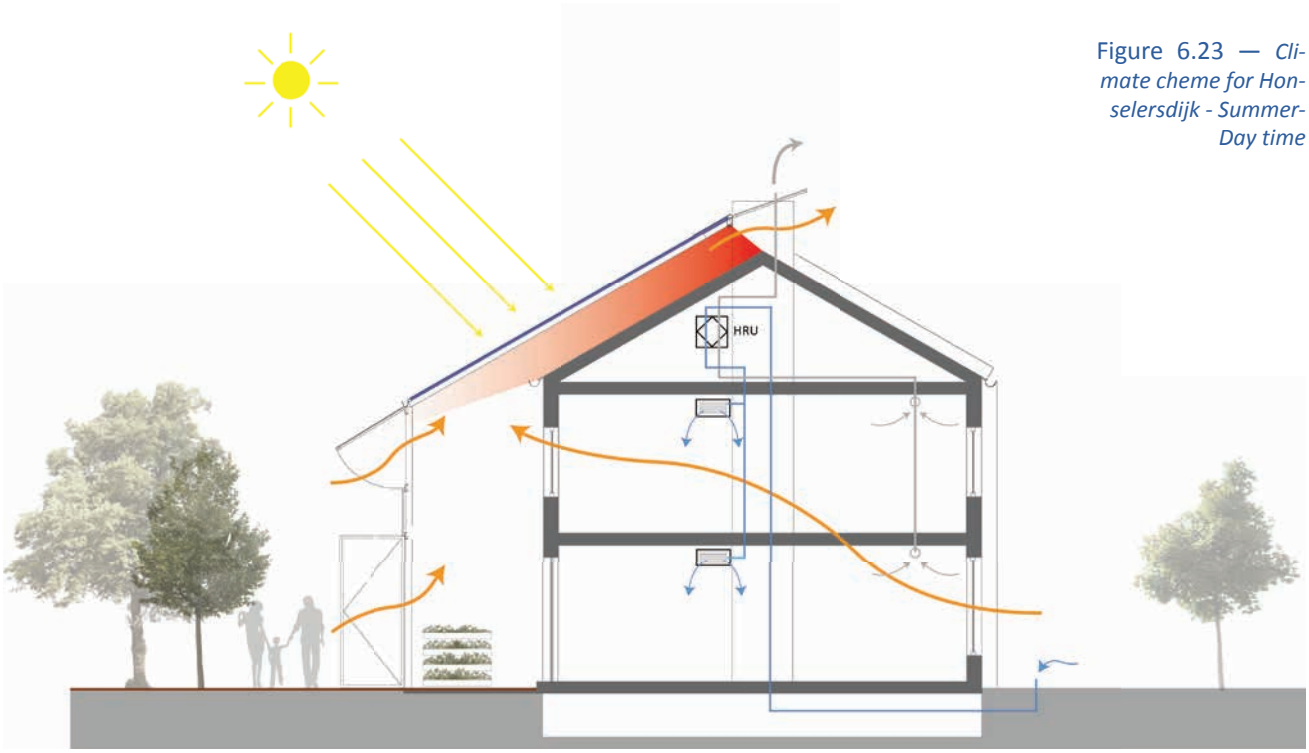


Figure 6.23 — *Climate cheme for Honselersdijk - Summer-Day time*

6.3.11 Cooling

The cooling capacity needed for the entire house is equal to 3 [kW]. This was defined by making a thoughtful analysis of the possible heat gains in the house. The ventilation rate chosen was 10 ACH inside the glasshouse and the schedule defined that the operation should always be active. As can be seen, cooling is required only during the months of June, July and August (For more information please refer to Fig. 5.4.29 Sensible cooling in kWh). The total cooling demand is approximately 600 kWh (For more info please refer to Ventilation cooling based, chapter 4 of this project manual) and according to the calculations, it is expected to be covered by cross ventilation only (figure 6.23).

6.3.12 Hybrid or semi-passive systems

Due to the construction system of the existing house in Honselersdijk, a crawl space is created to prevent moisture in walls and floors. For the prototype in Versailles the same space is used to cool down the house during summer time in extreme cases. This space will hold phase changing materials (PCMs) in order to cool down the incoming air into the house, during the day, to provide cooling during the periods of excessive heat. During night time, if needed, pre-heated air can be expelled out or brought into the house while discharging heat from the PCMs, liberating them to be used for the next day. The incoming air temperature will be 24 ° C (For more info please refer to Fig. 5.4.34 Climate scheme for Versailles Summer Day time)

At this moment, the passive conditioned space changes and becomes a semi-passive conditioned space due to the need of a fan to drag air through the PCMs during daytime. Temperature of incoming air is lowered down by the absorption of latent heat into the PCMs. This ensures an air flow through the ventilation duct in the chimney that can be used for these purposes. According to our calculations, at 1.2 ACH, it takes approximately 30 minutes to cool the place to a set temperature. Since the conditioned space of the house is 130 [m^3], the maximum capacity of the ventilation should be 156 [m^3/h], based on the cooling load.

PCMs specifications:

Type	woningverkoeler (PCM23)
Flow rate	350 [m^3/h]
Design temp	28
Cooling Capacity	530 [Wh]

The system is improved by combining it with additional mechanical ventilation, where fans in the heat exchanger will drag out the hot air existing in the house, and prevent a mix between the incoming cool air and the outgoing hot air. Under these premises, the fan power needed is calculated based on all the pressure drops along the ventilation system (For more info please refer to Fig. 5.4.20 Fan power). The 160 mm diameter is the one with enough capacity to attain the requirement.

Heat exchanger specifications:

Type	HRU ECO-fan 3
Capacity	max 325 [m^3/h]
Efficiency	96%
Power	10-150 [W]

The space in the Skin is conditioned by passive means only, since calculations show that the average temperature in the glasshouse will be only 2.5° C higher (For more info please refer to Fig. 5.4.31 Temperature inside the glasshouse).

PCMs will probably not be used in Honselersdijk due to their high cost. However, even though PCMs have a high initial cost, due to their life time (they are expected to lose efficiency after 27 years), no maintenance, and no operation costs, they can be considered as a suitable passive system. They are part of the developed toolbox and can be taken into account for other situations where cooling is needed.

6.3.13 Exterior design

Prêt-à-Loger designed the garden of the house together with the well-known Dutch landscape architect, Nico Wissing. The design is made according to three principles: affordability, sustainability and functionality (figure 6.24).

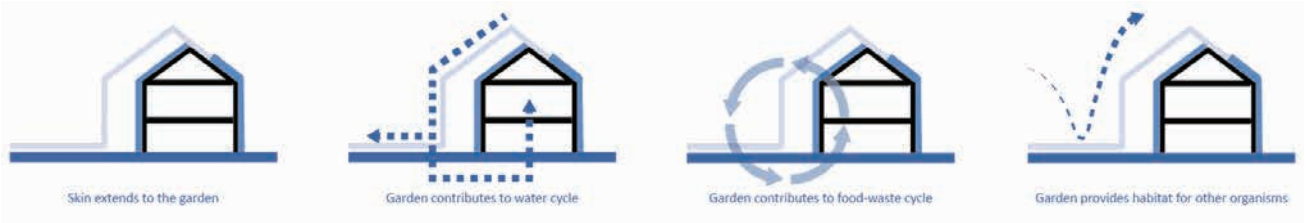


Figure 6.24 — *Exterior design adds benefits to the house and its surroundings*

The garden is constructed of local materials. The local materials are more affordable due to the lower transport costs. Also, the short transport distance helps to reduce greenhouse gas emissions and therefore contributes to the sustainability of the garden. Further, the garden offers room to grow vegetables and herbs (see chapter 5.2.1). By doing so, the family can save money on buying herbs and vegetables in the supermarket. Additionally, this will safe a trip to the supermarket or farmers market in The Hague and thus it safes emissions from the car. As well, the local origins of the plants, flowers and trees provide habitat for the organisms living in the area (see chapter 5.2.1).

Moreover, the materials, plants, flowers and trees evaporate water and reduce the reflection of sunlight (see chapter 5.2.1). Thereby, the exterior helps to improve the microclimate around the house. Together with the local plants, flowers and trees providing habitat for the organisms living in the area, the garden contributes to the local biodiversity. All these aspects of the garden help to increase the sustainability of the house (see chapter 5.2.1).

Along that, the garden also has a function in the water cycle of the house. Rainwater from the south-roof is harvested in the rainwater tanks and the permeable material reduces the effect from heavy rainfalls (see chapter 5.2.1). The water from the water tank is used for both watering the garden and flushing the toilets. By doing so, the garden adds functionality to the house.

What is more, the garden functions as the green extension of the house, which has a positive effect on the wellbeing of the family (see chapter 5.2.1). It also makes a contribution to the functionality, by offering solution for the food-waste cycle. The garden offers room to produce vegetables and herbs and there is also an option to compost the organic waste from the food production (see chapter 5.2.1 and 6.9.2).

6.4 Construction

The construction of the glasshouse and the adaptations to the house will be based on prefabricated elements. The outer layer of the north façade of the house will be removed and replaced with a prefabricated isolated façade, a glasshouse will be added to the south façade, and a green roof will be installed on the northern roof.

6.4.1 Current situation

One of the main advantages related to the Prêt-à-Loger approach is the fact that the existing building stock is used as a starting point. This results in a substantial reduction of material requirements, energy consumption and waste production during construction in comparison with the production of a new house from scratch, bringing with it a significant reduction of costs and environmental impact. Socially this approach also entails benefits, since residents can continue to live in their houses and do not have to move or make substantial changes to their lifestyles. In addition to that the construction time is substantially less in comparison to the demolition and construction time associated with a new house in the same location.

6.4.2 Prefabrication

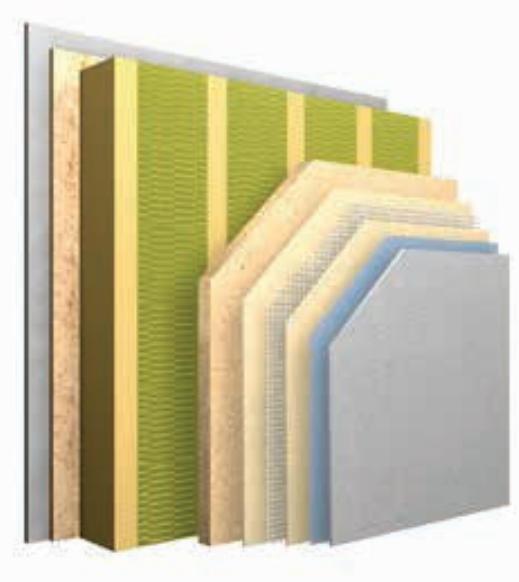


Figure 6.25 — *Prefabrication of STO Therm Wood Panel*

The use of prefabricated elements such as the north façade (fig. 6.25) has several social, economic and environmental benefits in comparison to in-situ construction. The most important social benefit is the reduction of construction time on site, since the elements are prefabricated on a separate location and can be assembled upon arrival at the construction site. Once on site this assembly can be done very quickly since the elements only have to be lifted and secured into place, further lightening the labour demand and reducing construction time. This will greatly reduce the inconvenience to residents and neighbours in terms of obstructions, dust and noise. (Adalberth, 1997; Jaillon & Poon, 2008)

Economically prefabrication also involves a lot of benefits and is generally cheaper than construction on site, especially when the elements are mass produced as is the case with Prêt-à-Loger. When mass producing the elements, the supply chain and installation work flow can be greatly improved. The construction workers in charge of the different stages of the production will have greater experience of their specific tasks, which means less errors are made and the elements can be produced faster, more efficient and with higher precision. This will also decrease the chance of accidents during production. (Adalberth, 1997; Jaillon & Poon, 2008)

The process of prefabrication is a continuous one, since prefabrication occurs indoors and is not influenced by wind, rain and other weather conditions, which speeds up the production. Waste and water use will also be greatly reduced due to this efficiency and the fact that reusing materials is easier with mass production. This is also an important environmental factor since less waste entails fewer losses and pollution. (Adalberth, 1997; Jaillon & Poon, 2008; Peng & Pheng, 2011)

The prefabricated elements do require transportation to the construction site, but the energy associated to these transportation requirements do not instigate significant increases in energy use compared to the energy requirements associated to construction on site. The energy saved by prefabrication is more significant than the energy required for transportation, resulting in a reduction of energy requirements for prefabrication as opposed to construction on site. (Adalberth, 1997; Jaillon & Poon, 2008)

6.4.3 Construction

The construction process itself is predominated by the demolition of the north façade, followed by the construction of the glasshouse and addition to the north façade. Additionally a green roof will be added for extra insulation and rainwater retention during heavy storms, which will also function as an aesthetic element, since it will introduce more vegetation and greenery into the neighbourhood.

The demolition of the outer wall of the north façade is necessary for social and environmental reasons, since simply applying the new façade as a Skin covering the outer walls would result in extremely thick walls. In addition, the cavity between the inner and outer walls of the original house would form a thermal bridge that is connected to the surrounding house cavities, rendering the added insulation on the outer wall useless. This means that economically the replacement of the outer wall is more beneficial than insulating the cavity, as has been calculated in chapter 1.6, since the energy savings will pay themselves back within the lifetime of the house/???years (source).

The construction of the glasshouse, which is based on the existing greenhouse production in the Netherlands, will take place on site with pre-formed aluminium beams. During construction of the individual elements and the glasshouse itself losses will occur, which add up to about 5% of the total material requirements (4). The same losses will occur during application of the bitumen and gravel to the northern roof as part of the new green roof. We estimate the prefabricated north façade and prefabricated polyethylene boxes for the glasshouse will only have losses which account for 1% of the total required material, since the prefabrication ensures more efficient use of material and labour (Adalberth, 1997; Formoso et al., 2002; Jaillon & Poon, 2008; Peng & Pheng, 2011).

Most elements making up the Skin and north façade arrive at the construction site ready for assembly and do not have to be constructed on site. This is also partly the case for the green northern roof, which mainly consists of the polyethylene boxes with soil and plants, but also contains bitumen which have to be applied manually. All elements will be lifted into place using a crane and will then be assembled by hand. The construction time is therefore mostly dependent on the assembly and is estimated to be only 10 days based on information from Groothuis, the main contractor of the project. For this construction the aim is to employ local contractors and materials, thereby saving transportation for both the workers and the materials.

Since most of the elements are lifted into position by crane, the energy requirements are also taken into consideration. According to Groothuis one lift will take proximately 12 minutes from start to finish. Using this information they estimate that during the construction of the glasshouse and north wall the crane will be operational for approximately 9 hours in total. Using a standard medium-sized crane that consumes approximately 6,080 Watt per hour (WCL, n.d.) this will entail a total energy consumption of 54.72 kWh. For the demolition of the outer north wall an additional precision drill will be used, which will consume approximately 1,050 Watt per hour (Fein, 2014). The demolition is estimated to take 6 hours, resulting in an energy consumption of 6.3 kWh.

The total energy consumption is therefore 61.02 kWh. With current diesel generators, about 160 grams of diesel is needed per kWh (Energy Efficiency Centre, 2014), resulting in 9.76 kg, or 11.49 litres of diesel that is needed during demolition and construction (Aqua-calc, n.d.). Assuming a full combustion, this will account for 30.44 kg of CO_2 that is produced during demolition and construction (EIA, 2013). Finally, during demolition and construction water is also consumed. Because most elements are prefabricated, much water is saved and it will mostly be used for cleaning and dust-prevention. It is estimated that about 500 litres of water will be needed during the whole process.

6.5 Materials

In order to keep track of all the construction materials and installations that will be used to retrofit the existing house, an extensive list was made. Due to the fact that Prêt-à-Loger relies on partners to provide certain materials, some decisions were undoubtedly biased. These considerations might turn out differently when trying to fully balance feasibility, sustainability, aesthetics and sobriety. As of now, the focus was mostly on materials that will be used during the competition. In the meantime, considerations, design choices and calculations were made to fit the solution to the house in Honselersdijk.

As a result, it was possible to calculate the incorporated energy and CO_2 from the Life Cycle Analysis and to develop a maintenance plan for the materials. After determining the materials used, they were entered into the Life Cycle Analysis software SimaPro 7.3.3, operating with the ecoinvent database version 2. This process will described more elaborately in chapter 6.10. For now it is sufficient to know that the software allows to carry out different assessment methods to obtain various environmental impact indicators. Before going into this analysis, it will be shown which materials were used and where in the house they are located. Moreover, it will be explained what the strategy for choosing those materials was and 'green' materials will be highlighted.

6.5.1 Utilised materials and their location in the house

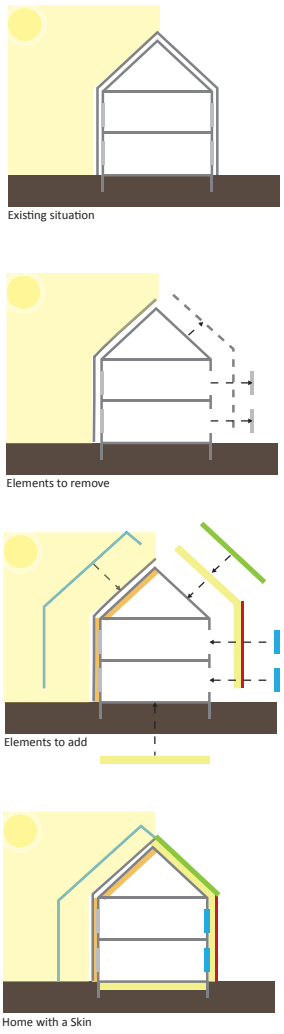


Figure 6.26 — *Removing and Adding Materials*

Table 6.1 and 6.2 give an overview of the array of utilized materials. For assessing whether or not materials are 'green', the materials that will be removed in the retrofitting process will be disregarded, as they will be described in the solid waste chapter 6.9.1. However, for the sake of completeness, they have been included in table 6.1. Moreover, in order to avoid confusion, it needs to be mentioned that there are some materials that were left out, because they will not be used in Honselersdijk. These materials are Solatubes, PCMs and steel footings. The Solatubes will not be utilized, because due to higher windows, the values for the light in the existing house are not as bad as in the prototype. Also, invasive means are meant to be avoided, but were utilized in the competition to get the best values as possible, see chapter 6.3.6 (daylight). This reasoning, of getting good measuring values, also applies to the PCMs. Finally, steel footings will not be required because of the already suitable underground in Honselersdijk.

In order to better understand which materials were used and why, they have been categorized according to their location in the installation of the house, see figure 6.26. As can be seen there, the main changes are made on the north (right side of the figure) and south of the building and hardly any changes are made in the interior, except for HVAC installations. In the north, the roof, existing brick layer, house door and windows are removed. After that, the house is equipped with new windows and a green roof. More importantly, it receives an upgrade through added insulation, along with brick slips for the walls, which will imitate the look of the original façade. In the south of the building, no elements need to be removed. Insulation is added from both the inside of the roof and in the cavity of the wall. Finally, the glasshouse is installed. In addition, rainwater bags and insulation are added in the crawl space.

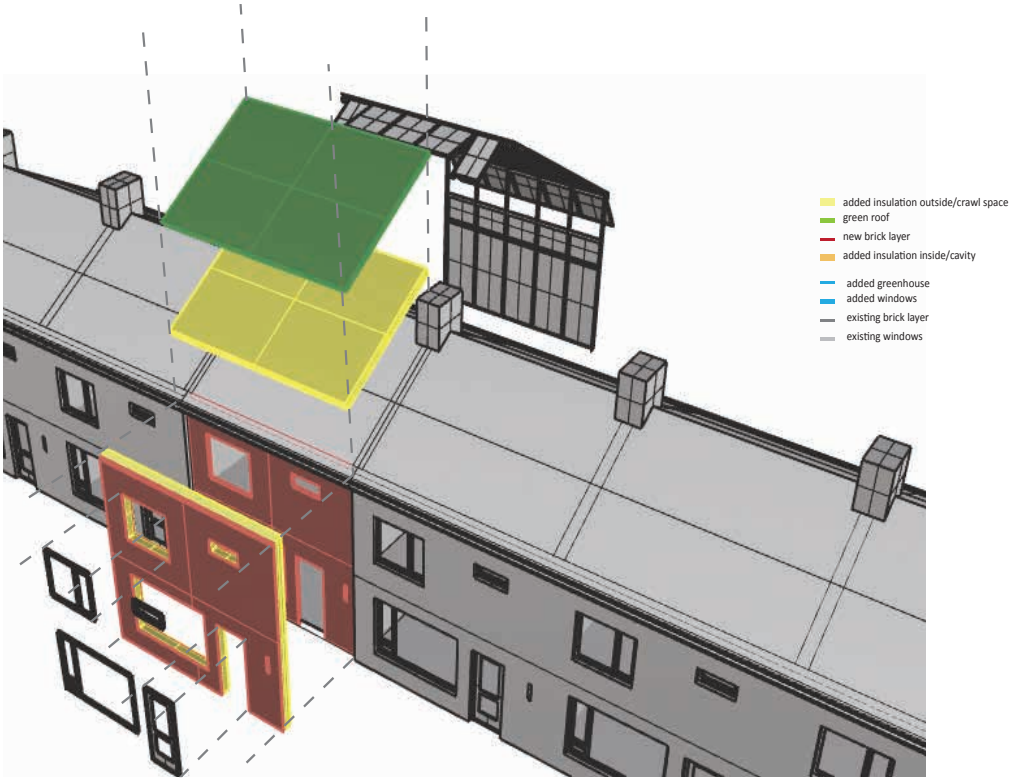


Figure 6.27 — *3D Model of Installed Materials*

6.5.2 Green materials

Procurement strategy

Generally, as a procurement strategy, the idea of preservation and reuse maximization was pursued, while destroying as little as possible (chapter 6.1.3). With this baseline, the next step was to choose durable materials that could extend the lifetime of the building and also persevere during this extension. Furthermore, it was aimed at deriving materials from renewable sources and/or using recycled materials. Finally, it was of great importance that they could be recyclable, so as to attempt to close the material loop.

'Green' materials used

Looking at the material list (table 6.1, 6.2), it can be seen that based on their weight over the lifetime of the house (50 years), the three most relevant materials are glass (1,962 kg), steel (1,036.2 kg), and wood (818.13 kg), used for the photovoltaic panels, the steel structure and the floor in the glasshouse respectively. All of these materials meet the above described criteria, where the long-lasting materials glass and steel are amongst the most recycled materials, following a cradle-to-cradle approach (Vlakglas Recycling 2014, Eco-metal 2014) and wood being a renewable resource.

Special attention should be paid to the window frames and the house door, which are made of 100% recycled material. Prêt-à-Loger's partner RecyStel is providing these components that are made entirely of plastic waste. It can either be from waste saw pieces of new frames or old windows that are replaced. They buy recycled granules mainly in the Netherlands, Germany and Poland, which results in comparably short transport distances. Moreover, they are fully aware of the cradle-to-cradle concept and are working on a LCA for their products to illustrate the environmental and other sustainable advantages of their product.

Table 6.1 — *Materials removed and added*

Assembly	Subassembly	Material	Material Lifetime (Years)	Mass on the Life Time (kg)
REMOVED				
Roofing	Old roofing	North: Remove clay tiles	75	1804.86
Exterior Joineries and Facade	Old Panelling	North: Brick cavity wall - one brick layer 100 mm	75	4244.05
	Old Windows/ doors	North: Double glass panel	50	155.2
		North: PVC window frame (~15% of total opening)	50	151.90
		North: PVC and glass doors	50	75
ADDED				
Foundations and Subsoils	Foundations	Glasshouse, Concrete foundation (Stelcon N-platen)	75	780
		Crawl space insulation (cellulose)	75	685.5
Roofing	Insulation and Tiles	North: Cellulose from inside	75	419.48
		North: Greenroof, Root resistant Derbigum SP WW	50	253.29
		North: Greenroof, packs (PE/PP recycled)	50	159.63
		North: Greenroof, gravel	75	76.1
		South: Cellulose from inside	75	209.74
Exterior Joineries and Facade	Panelling	North: HSB-Wooden skeleton system (about 5% of total wall area/volume)	75	166.95
		North: OSB frame support	75	203.71
		North: Insulation Glue (StoDispersionskleber)	75	32.45
		North: Expanded polystyrene (EPS)	75	343.27
		North: Mortar (StoArmat Classic)	75	74.90
		North: Mortar glue (Sto-Klebe-und Fugenmörtel)	75	47.43
		North: Fake brick (Sto-Flachverblender)	75	212.20
		North: Cellulose to avoid thermal bridge	75	7
		South: Cellulose in the cavity	75	87.90
	Windows/doors	Insulating glass panes HR++	50	232.8
		Insulated recycled plastic frame	50	151.90
		Doors from recycled plastic with PUR filling	50	75
	Glasshouse	Glass for Doors and Windows	50	297
		Glasshouse steel skeleton for skin support	100	1036.2
		Steel coating with zinc	100	47.06
		Aluminium frame for PVs and glass doors and windows	40	356.4
		Glasshouse, Polycarbonate side walls	75	619.92
		Glasshouse, wooden side walls (Douglas pine)	75	36.04
		Glasshouse, wooden floor	75	818.13

Table 6.2 — *Materials added continued*

Assembly	Subassembly	Material	Material Lifetime (Years)	Mass on the Life Time (kg)
HVAC	Heat Pump	Solar collectors (Thermboil E-series)	v	300.8
		Hot water system (heat pump)	25	0
		Hot water system (hot water tank)	25	0
		12x4 long, Hot Water Pipe, 3mm	75	77.81
	Ventilation	Demotica box	25	7
		34 m Ventilation pipe, 0.5 mm, diameter is 160mm	75	133.10
		Heat exchanger	25	50
		3 way motorised valve for air	50	1.02
		Air grates inlet (rectangular)	75	1.6
		Air grates outlet (round)	75	0.46
Sanitaries Facilities	PVC Pipes	20 meter PVC pipe 50 mm diameter	50	12.85
		10 meter PVC pipe 100 mm diameter	50	13.26
	Rainwater system	Three plastic storage tanks	50	30
		2 x 2,000 liter Plastic Water Bags in Crawl Space	25	69.12
		Rainwater pump	10	52.5
Energy Production	Photovoltaic Panels	PV Cell wafer	25	23.4
		Glass	25	1962
		SolarEdge SE5000 Inverter	25	43.4
	Electric Cables	4 mm² Copper Cable	25	124.8
		6 mm² Copper Cable	25	104
Other Equipment	Innovative Materials	4 LED lights	25	1
Disregarded Material		power optimizers for PVs, electric motors to open roof windows, electric sensors		

Another highlight in the material list is the green roof (figure 6.28). While the plastic boxes that form the basis for the green roof are not made from recycled materials (yet), the soil and plants can be reused or composted if not needed anymore. This process is described in detail in chapter 6.9.2. The green roof is not only 'green' in terms of its materials, but it also adds a function to the house, which has been discussed in chapter 6.1.3. Besides its aesthetic look, it creates a small habitat for animals and reminds people of nature, hopefully making them subconsciously more aware of what is worth preserving.



Figure 6.28 — *Green roof Derbisedum pack*

Finally, Prêt-à-Loger chose to use cellulose for insulation, whenever possible. As a result, old newspapers and wood shaving, which make up the insulation, are being reused and are subjected to the so-called cascade use: the material and energy recovery and the most favourable use of materials in terms of resource efficiency. This means that the material lifetime of these 'waste materials' can be extended and utilized for an intermediate step, before being discarded.

Toxic substances

At the other end of this spectrum are less favourable materials, such as toxic substances, which have to be mentioned here as well. These materials can have human and ecotoxic impacts, where terrestrial, freshwater and marine ecotoxicity are part of the latter. Using the LCA of the materials and the "ReCiPe Midpoint Method", the materials were analysed for these impacts, which are all measured in kg 1,4 dichlorobenzene (1,4-DB) equivalent. Usually, it is not possible to compare different LCA indicators amongst each other, saying that e.g. because the bar for climate change is higher than the one of freshwater, the environmental harms are bigger. However, since they all have the same unit, a comparison is possible.

Figure 6.29 — *Total toxicity of the materials*

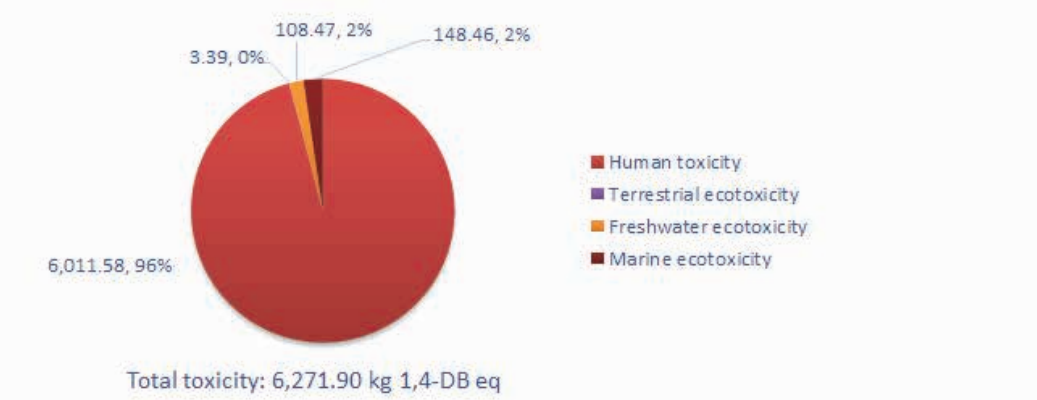
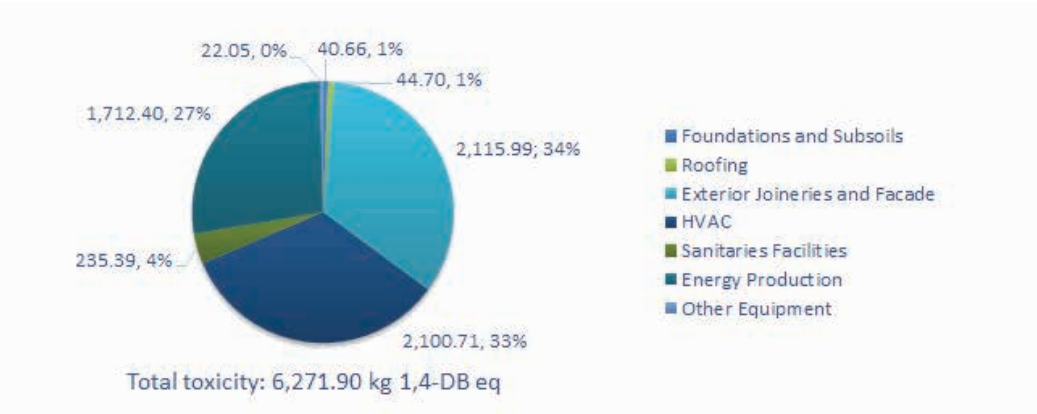


Figure 6.29 illustrates the characterisation of their toxicity contribution, with the total amounting to 6,271.90 kg 1,4-DB eq. It can be clearly seen that human toxicity is the biggest impact category, accounting for 96% of the toxicity. Figure 6.30x depicts the total toxicity split up into the installations, showing that the assemblies Exterior Joineries and Façade, HVAC and Energy Production have a more or less equal share of about a third each.

Figure 6.30 — *Total toxicity of the materials, split up in assemblies*



Looking into the analysis of the single indicators in more depth reveals the individual components that have the most crucial contribution to the toxicity. This step is needed to identify elements that can potentially be substituted for less harmful materials. In doing so, one would have to avoid a burden shifting, so that an overall decrease in environmental impacts can be achieved.

Figure 6.31 depicts the human toxicity levels broken down into assemblies. It shows that a total of 6,011.58 kg 1,4-DB eq is produced, where the assemblies 'Exterior Joineries and Façade' and 'HVAC' almost equally contribute with about 33% each. Taking a closer look on the process level (figure 6.32), it can be seen that for HVAC (figure 6.34) the production of copper and for Exterior Joineries and Façade (figure 6.33) steel are the biggest contributors to human toxicity.

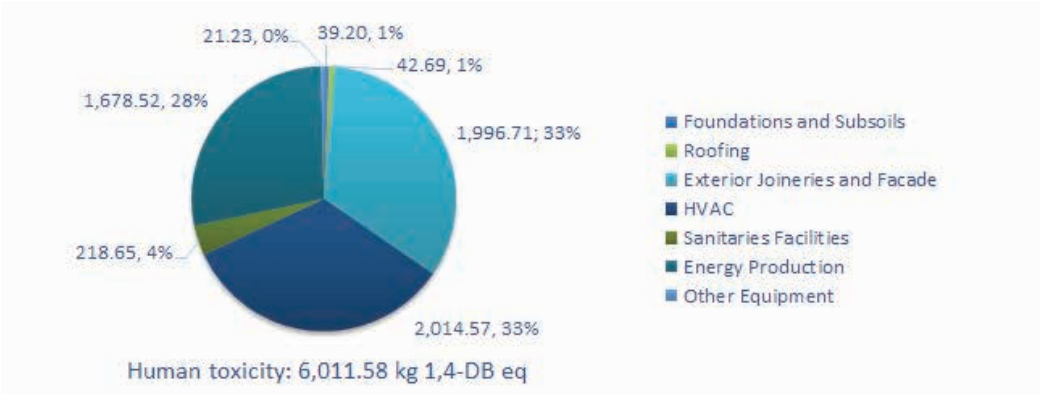
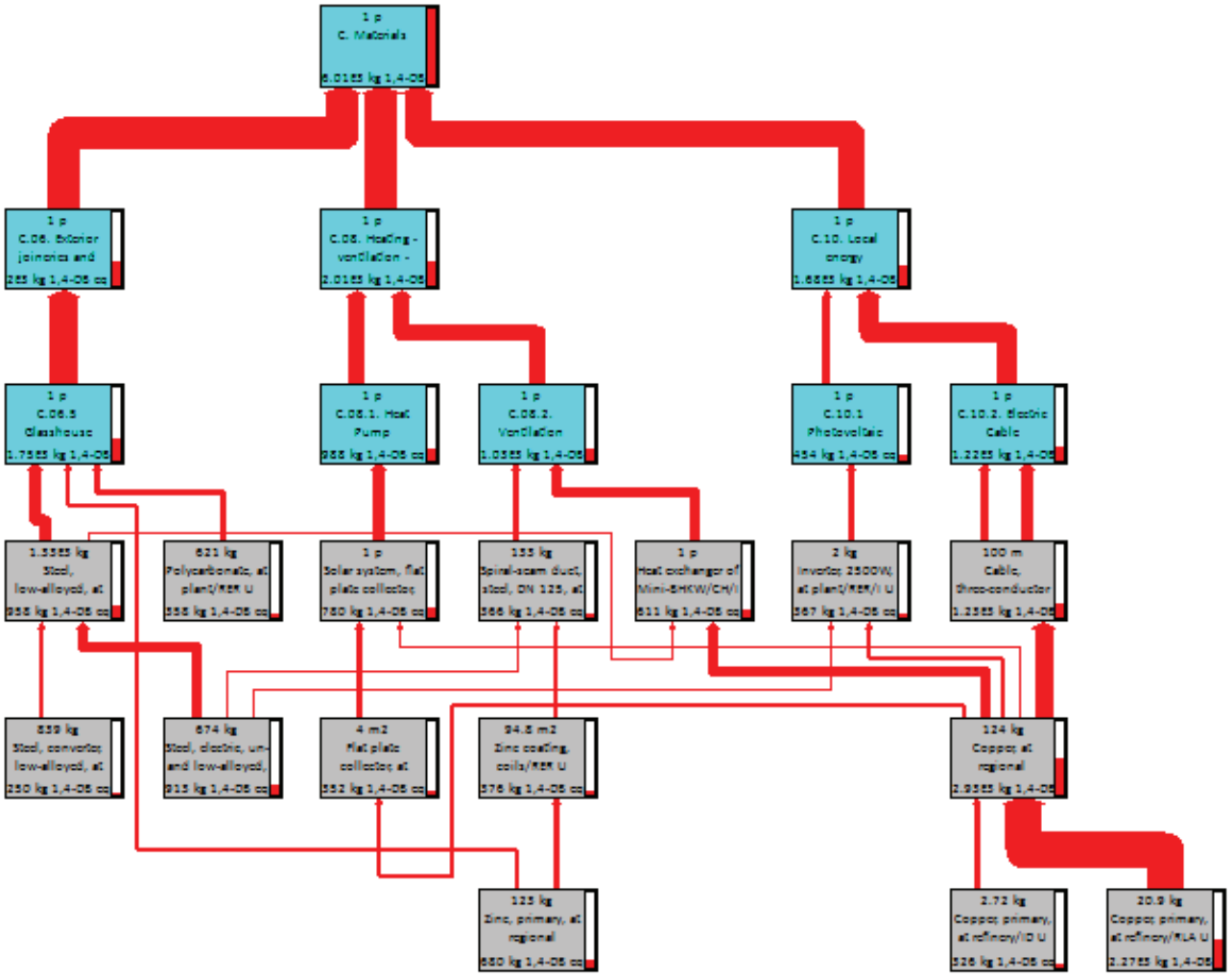


Figure 6.31 — *Human toxicity of the materials, split up in assemblies*

Figure 6.32 — *Process contribution to toxicity*



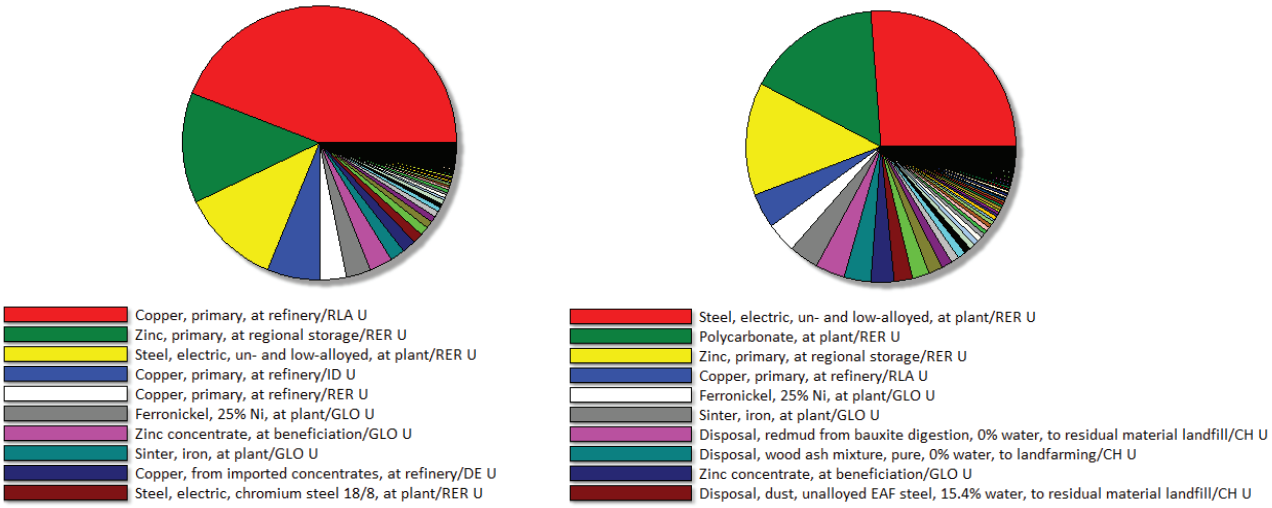


Figure 6.34 — *HVAC contribution shares*

Since the other three impact categories (terrestrial, freshwater, marine) combined only make up about 4% of the toxicity, they will not be analysed in as much detail. For the sake of completeness, their graphs are included (figure 6.35-6.37), showing that the assemblies Exterior Joineries and Façade, HVAC and Energy Production always belong to the main contributors.

Figure 6.33 — *Exterior Joineries and Facade contribution shares*

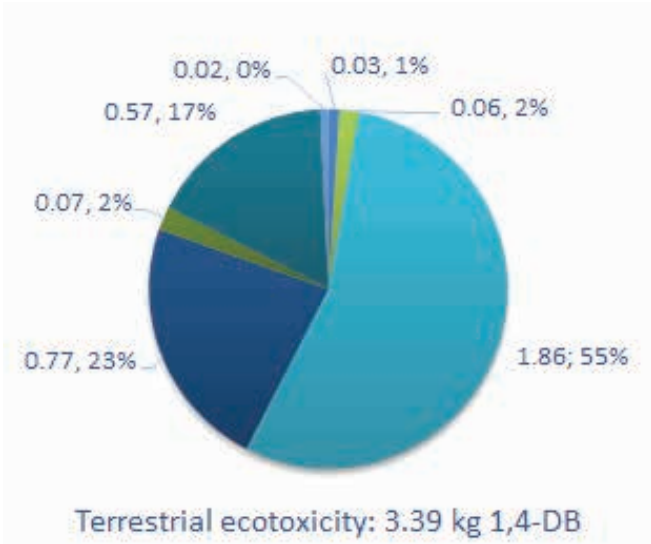
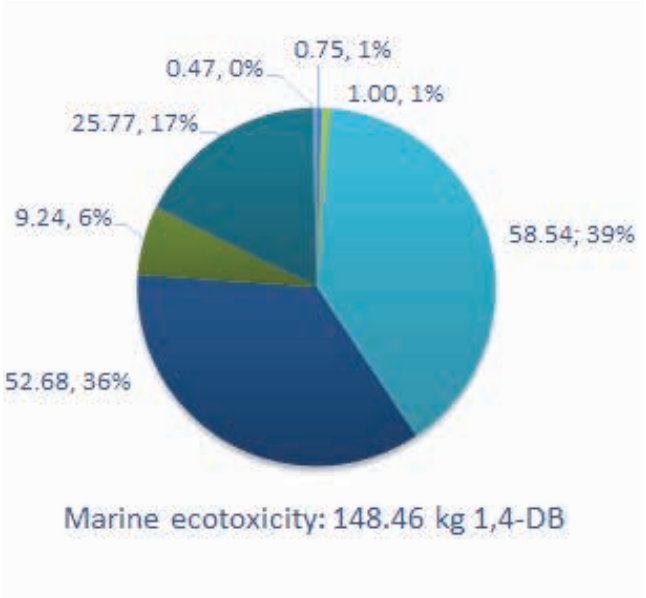


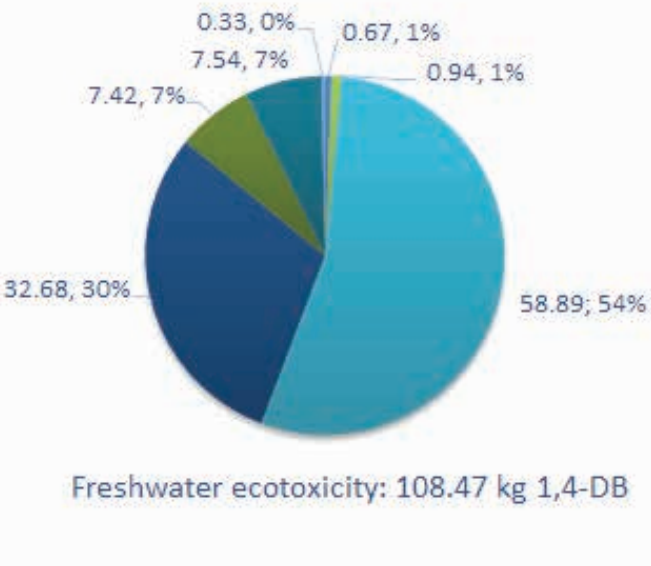
Figure 6.35 — *Terrestrial Ecotoxicity*

Figure 6.36 — *Marine Ecotoxicity*

Figure 6.37 — *Freshwater Ecotoxicity*







6.5.3 Incorporated Energy

After establishing the materials employed for the case study in Honselersdijk, the 'Cumulative Energy Demand V 1.05' (CED) method was applied in SimaPro to calculate the energy used for the production of the materials. The outcome is measured in 'kpt', which stands for kilo-points. These points represent the unit of one MJ eq.

As a result, the embodied energy of the materials was determined, which was needed to establish an energy per constructed square metre factor. The constructed square metre can be understood as 'Gross Measurable Area', being the sum of the area of each floor including all elements that are excluded from the measurable area, according to Solar Decathlon Europe 2014 rule 6.3, where decks and exterior elements are not included. Prêt-à-Loger's gross measurable area amounts to 62.70 m^2 in Honselersdijk.

It should be noted that the embodied energy is understood as the amount of energy that was required for the production of construction materials, which can also be understood as cradle to site stage. The energy needed is derived from various sources, which can be seen below. Originally, the focus was on the operational energy, as this is a factor that can be actively influenced during the use phase of the house. However, this perception experienced a shift towards the importance of embodied energy. This is because it later defines how much energy is required for the operation. Consequently, it is possible that a high energy investment can be useful in the cradle to site stage to minimize the operational energy (close to zero).

Figure 6.38 illustrates the outcome of the CED analysis. It shows that the total embodied energy of the materials is 363,108.87 MJ. Moreover, it depicts that 76% of this energy was derived from fossil fuels.

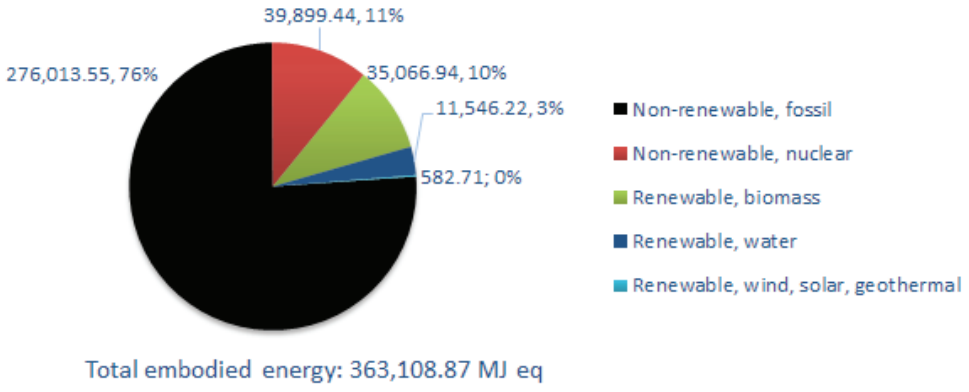


Figure 6.38 — *Total embodied energy of all materials*

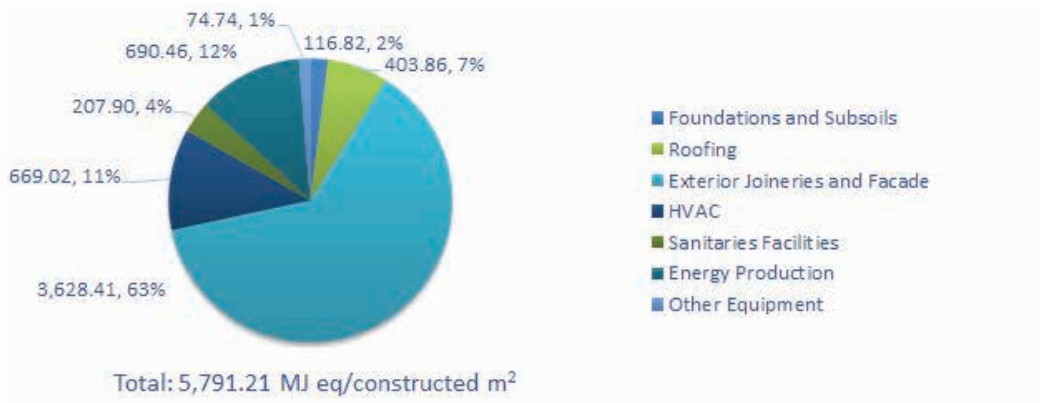


Figure 6.39 — *Embodied energy per constructed m^2*

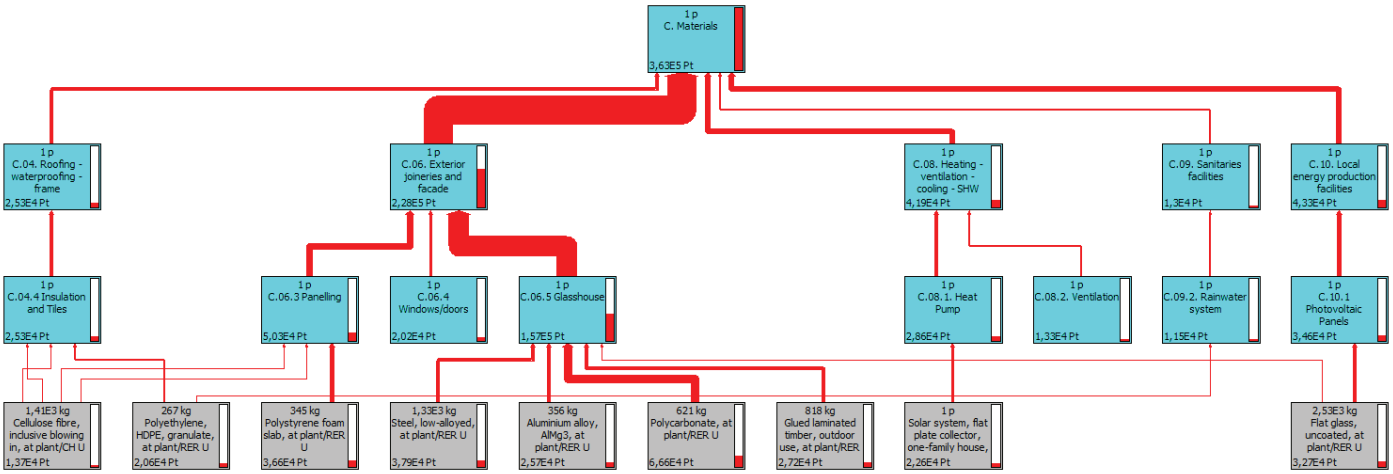


Figure 6.40 — *Embodied energy materials shared*

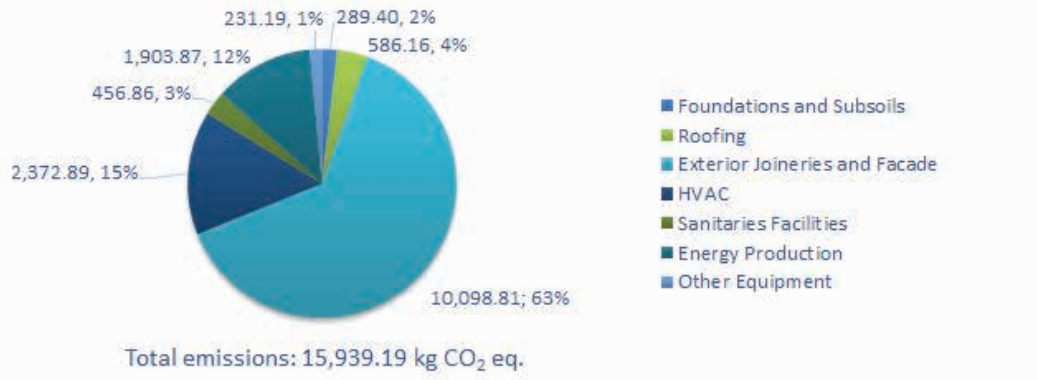
By dividing this amount with the gross measurable area (62.70 m²), an energy per constructed square metre factor of 5,791.21 MJ eq/m² is obtained. Figure 6.39 illustrates how this factor is distributed amongst the assemblies. Naturally, Exterior Joineries and Façade contributes with the biggest share of 63%. Going one level deeper into the sub-assemblies, it becomes quickly evident that the glasshouse embodies most of the energy in the polycarbonate and the steel (figure 6.40).

6.5.4 Incorporated CO_2

Another assessment method that was applied in SimaPro is the 'IPCC GWP 100a'. It is another single issue method that looks at the climate change factors developed by the IPCC. It considers a timeframe of 100 years and utilizes the unit kg CO_2 equivalent. Applying this method enabled to determine the amount of carbon dioxide incorporated in the materials of the project. As a result, it was then possible to establish a CO_2 eq/constructed m² factor.

Figure 6.41 depicts the outcome of the analysis. It can be seen that a total of 15,939.19 kg CO_2 eq were emitted in the cradle to site phase. The assembly Exterior Joineries and Façade account for the majority of the emissions (63%). Again, going into the network analysis to find out which components are responsible for the emissions, it becomes clear that polycarbonate and steel are the key players (figure 6.42).

Figure 6.41 — *Total CO_2 emissions*



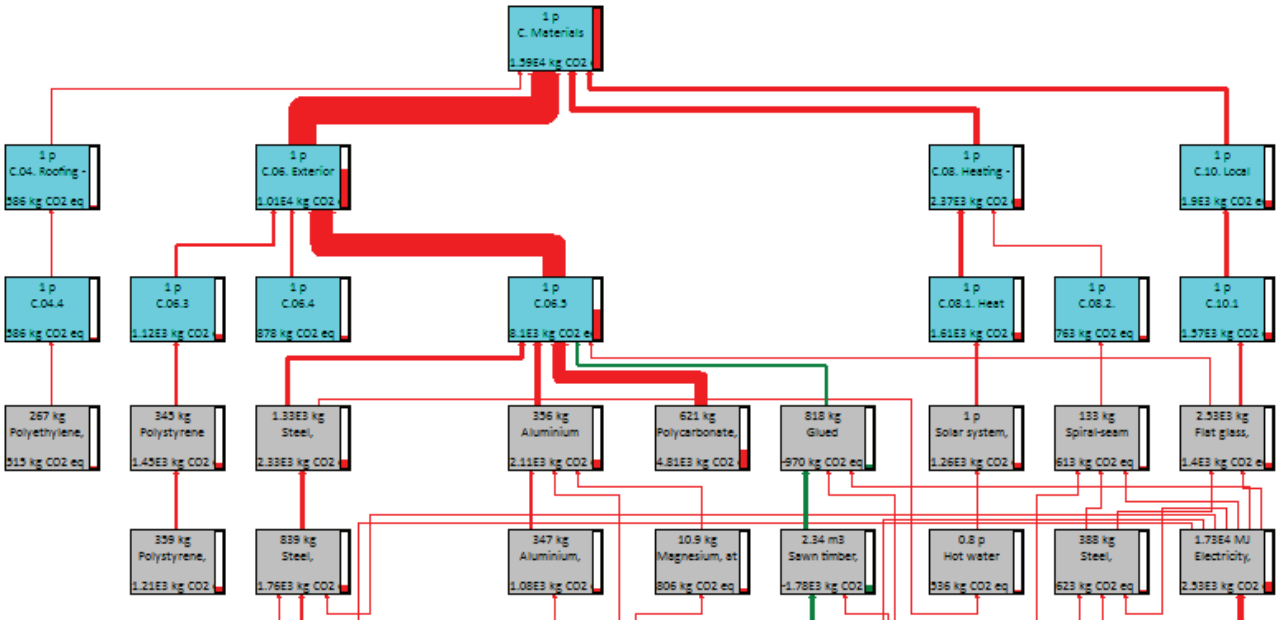


Figure 6.42 — *Amount of CO_2 in different assemblies*

Based on these values and with the gross measurable area, the CO_2 eq/constructed m^2 was calculated. In total, it amounts to 254.21 kg CO_2 eq/m^2. Figure 6.43 shows the distribution of different categories per constructed square metre.

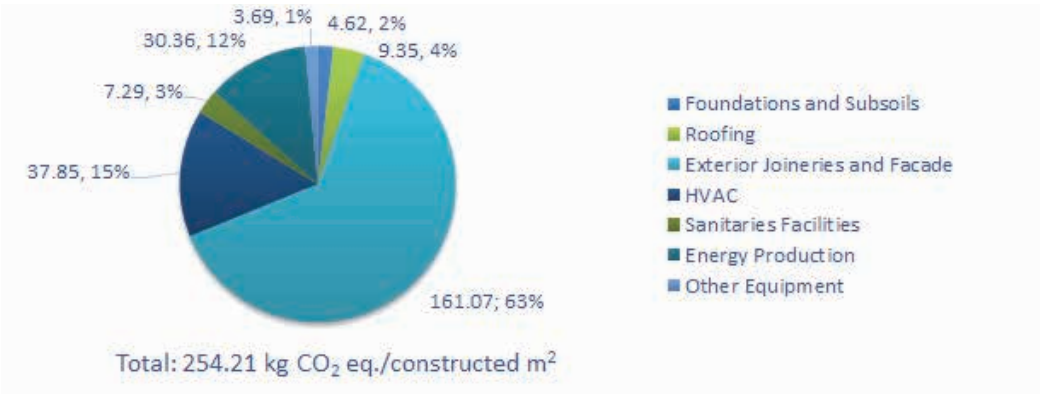


Figure 6.43 — *Amount of CO_2 per constructed m^2*

6.5.5 Maintenance Plan

In order to keep the house in a good condition and maximize its benefits, regular maintenance of some of its parts is required. An integral aspect of maintenance is also the replacement of components when they have reached their end of life. This topic is addressed in chapter 6.9.2, including table 6.3 that lists the materials and their replacement frequency.

The photovoltaic modules need to be regularly cleaned. This, along with their accessibility has been described in chapter 6.7.3. The HVAC only require light maintenance of the ventilation shafts and the filters in the house, which need cleaning every other year. The heat exchanger needs to be checked annually. The green roof requires a check-up for impermeability to make sure that it doesn't leak into the house. Furthermore, it should be regularly controlled whether it drains properly. Finally, little regular maintenance should be done for the glasshouse. There, windows need to be cleaned and the sidewalls need to be cleaned, just like any other surfaces in the house.

6.6 Active systems and equipment

6.6.1 General strategy

As has been described in Chapter 6.3, the “Home with a Skin” is mainly making use of passive systems to reach the goal of energy neutrality. Of course, it is still always possible to optimize a system or single functions. In this case, this is done by adding only a few installations.

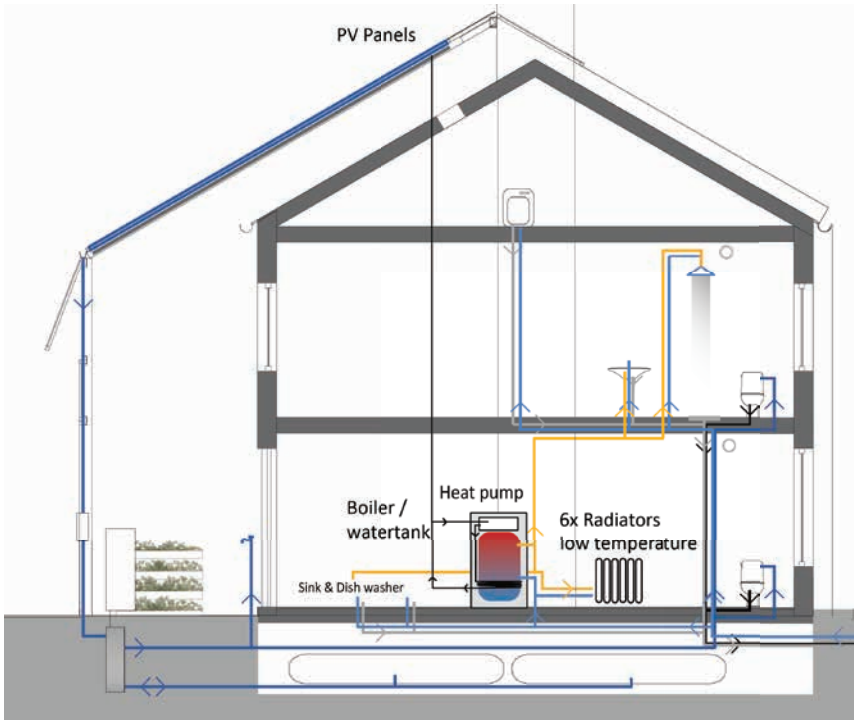
While Prêt-à-Loger is attempting to operate the house as passive as possible, a heat pump, heat recovery system in chimney, and a water tank are being used. An important aspect in the design choice was to install these active systems in such a way that will allow for the existing radiators to still be used.

But to make the house function in all situations there must be a backup system, which is comprised of and provided by active installations. Also the restrictions which comes with the refurbishment of a Dutch row house demands active systems to get the required comfort demands. The active systems can be divided in the active heating system, active ventilation system and active controlling systems.

As mentioned above, the house needs an active system to get the comfort demands and therefore a good controlling system is required. A smart controlling system gives you the comfort in the house you need and also enhances the efficiency of the active systems in the house. The active systems are only activated when the passive cannot do the work and are turned off again when there is no need for it, for example when there is no one home. Installations that are controlled are: sun shading systems, opening of the greenhouse, lights, appliances, ventilation, cooling by ventilation and heating by radiators.

Besides relying on natural daylight, as has been explained in chapter 6.3.6, artificial lighting installations exist as well. Prêt-à-Loger relies on energy efficient LEDs that are strategically placed in the house, after having analysed where lights would be necessary. This assessment and the justification for the choice of lights is described in much detail, together with calculation support of the Dialux and Ecotect program in chapter 2.3 Lighting design narrative.

Figure 6.44 — *The Solar Compleet system*



The heating system is based on the Solar Compleet system which provides the house with hot tap water and heating (figure 6.44). The radiators and hot-cold water circuit, which are in almost all Dutch row houses already present, can be easily plugged into this system system (see chapter 3.7 Solar Thermal Design).

The ventilation system is an addition to the existing building, which in most situations do not have an active ventilation system. By making the house air tight to reduce energy loss there will be less infiltration and an active ventilation system is required to comply with the air comfort and health demands. The appli-

cation of a heat recovery system will reduce the heat losses to a minimum (see chapter 2.1.4 Influence of the energy analysis in the project design).

6.6.2 'Solar Compleet' system

The Solar Compleet system in the "Home with a Skin" consists of energy panels, two heat pumps, a hot water tank, a backup electrical heater and a heat exchanger spiral for the central heating. The system is explained in detail in chapter 3.7 Solar Thermal Design.

The energy panels are used beneath the building-integrated photovoltaic modules with the aim to extract the heat and turn it into useful energy for the house needs. That can be considered a win-win situation, because we have at the same time the increase of the efficiency of the PV modules (0.45% per °C above 25°C) and the provision of hot water to the house. In parallel, except from the heat extraction from the PV modules, this system works also with solar radiation that passes through the transparent BIPV modules and the heat extraction of the air in the greenhouse.

The Solar Compleet system is well integrated into the skin, it has a double function, it provides the house for hot water and is very efficient with a COP of 5-7 during the summer. The function of hot water production, increasing the electricity production and the integration into the skin makes it the best option for the "Home with a Skin". Thereby it is also affordable and easy to apply in the refurbishment of a Dutch row house.

6.6.3 Heat recovery

The heat recovery unit is installed to reduce the energy losses of the house. In chapter 6.3.8 the passive systems are described, which reduce the energy loss by improving the envelope of the row house, such as wall insulation, improving the glass and giving the row house a better air tightness. The heat recovery unit also contributes to minimize the heat losses by extracting the heat from the outlet air to the inlet air in the winter situation. Thereby, it also takes in inlet air from the greenhouse, which is already pre-heated.

In summer an integrated bypass in the heat recovery unit will skip the heat exchanger when the inlet air is cooler than the outlet air. The heat recovery unit has three settings with different velocities and is controlled by the Comfilux system which determines the velocity by the need of fresh air (see chapter X.X). In all times the passive systems are primarily used and as backup the active systems come in action. So in most time of the year natural ventilation is used for fresh air and when it is too cold or too hot outside the system switches to the active heat recovery system.

By reducing the heat loss in winter the Solar Compleet system needs less capacity to heat the house, also the existing radiators can function on a lower temperature. In this way the active systems work together and are integrated by the controlling system in the "Home with a Skin" and are an important part in making the Dutch row house energy neutral.

6.7.1 Energy recovery time

Energy Production

Besides having active systems and equipment, the solar systems form probably the most essential part of the skin, as has been described extensively in chapter 3.5 Again, Prêt-à-Loger employs a number of monocrystalline silicon photovoltaic modules that generate electricity for the house. While it is desirable to have a decentralized electricity system, enabling the homeowner to be fairly independent of the grid, those PVs have to be produced upfront – a process that consumes materials and energy in itself. Therefore, it has to be calculated how long it will take to recover the energy and the linked CO_2 emissions that are associated with the manufacturing of the system.

These calculations were performed using the local solar radiation and air temperature, taking into account the situation of the house in Honselersdijk. Hence, annual calculations for the PV system were assessed based on its 21° inclination and south-rest orientation (azimuth 138°). Under these conditions, it was calculated in chapter 3.5 that the installed PV system will produce 3,753 kWh on a yearly basis.

However, it has to be kept in mind that the efficiency of the individual mono-crystalline cells decreases over time. According to the supplier of the PV cells, DMEGC, the efficiency of the cells will decrease to 90% of the declared power after ten years, 80% after twenty years and 60% after 25 years. As a result, after about twenty-five years, the cells will have to be replaced. This means that the whole PV installation system will have to be replaced once during the building's proposed lifetime of fifty years.

Based on the above described presumptions, the PV system will produce 35,653.5 kWh during the first ten years, 31,900.5 kWh during the second ten years and 13,135.5 kWh during the last five years, which accumulates to 80,689.5 kWh produced during the life time of the system. Since the system will have to be replaced once, the total production over a fifty year time period will be 161,379 kWh or about 161.5 MWh.

Energy and CO_2 Recovery

With the generation of electricity from PV systems, it is possible to refrain from using finite fossil fuels and to avoid the emissions of greenhouse gases and any type of solid, liquid or gaseous by-products that are commonly associated with the production of electricity (National Renewable Energy Laboratory, 2004). However, during other stages of the life cycle of the solar cell, like manufacturing, transportation, installation and decommissioning, emissions and energy consumption are involved. Consequently, it should be assessed what both the energy and the CO_2 recovery rate are, also known as payback time.

According to the Fraunhofer Insitute (Fraunhofer, 2013), the energy payback time for monocrystalline silicon solar cells is about two and a half years, for countries in Northern Europe. This will result in 22.5 years, or 71,382 kWh that will contribute to the net energy savings during the lifetime of the system. Since the system will be replaced once the total pay-back time will be five years and the total net energy savings will be 142,764 kWh during the lifetime of the house, or about 143 MWh.

The emissions involved in the whole life-cycle of PV systems are estimated between 0.03 and 0.08 kg CO_2 per kilowatt-hour (Edenhofer, Madruga, & Sokona, 2012). Based

on this information, the CO_2 emission for the production of the PV system for 50 years of use, should be roughly between 4,841 and 12,910 kg, with a midpoint of 8,875.5 kg. The payback time can be assessed by calculating the amount of CO_2 that is prevented during the use of the PV modules.

6.7.2 CO_2 emissions

To calculate the CO_2 emission savings the energy mix of consumer energy in the Netherlands must be taken into account. In the Netherlands, this energy mix is a combination of Dutch and foreign imported energy. This mix is issued by the Dutch 'Autoriteit Consument & Markt' (ACM) for all individual energy suppliers in the Netherlands in the form of a 'stroometiket' – an energy label that has then to be communicated to the consumers (ACM, 2005). This data is made available to consumers through different websites like 'http://www.consuwijzer.nl/', 'http://www.groenestroomjagraag.nl/', 'http://www.energieleveranciers.nl/' and 'http://www.vergelijkgroenestroom.nl/'.

Since the Dutch consumer is free to choose which energy supplier to contract, the exact CO_2 emission savings cannot be established for houses in Honselersdijk. Different values will therefore be presented for the suppliers with the lowest and highest CO_2 emission factor in 2012. These CO_2 emissions are related to the share of renewable and non-renewable energy supplied.

According to the data provided by ACM on the different websites, there are several sustainable energy suppliers in the Netherlands who solely deliver energy from renewable energy sources, e.g. Greenchoice and Windunie. Since the CO_2 emissions of these suppliers is 0 g/kWh, the minimal CO_2 emission savings that can be reached are 0 grams.

As an alternative to determine CO_2 savings, other suppliers in the Netherlands were looked into. The supplier with the biggest share of renewable energy supply (89.2%) that also uses non-renewable energy sources, is Oxxio (Fig. 6.45). Oxxio produces 46 g of CO_2/kWh (Wise, 2014). Multiplied with the prevented electricity consumption from the grid, because of having own PVs, this would entail total CO_2 emission savings of approximately 6,550 kilograms during the lifetime of the house.

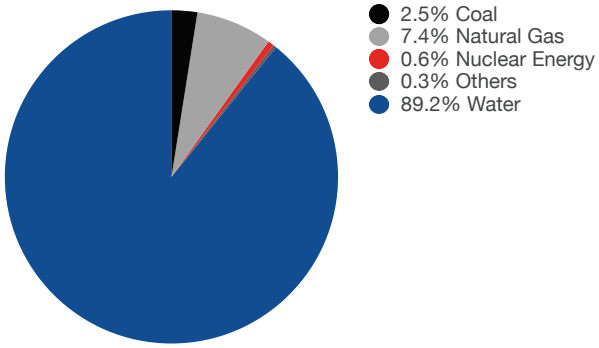


Figure 6.45 — *Oxxio energy label*

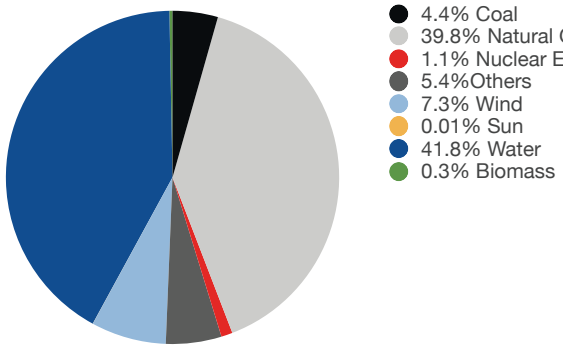


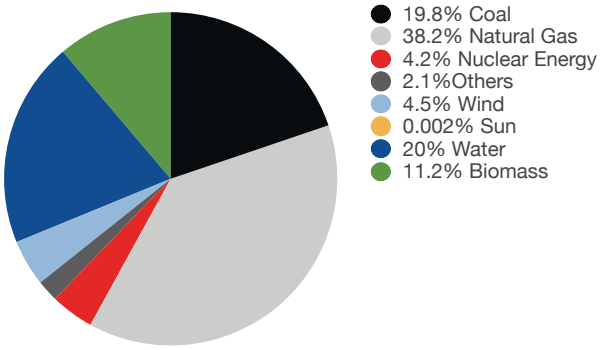
Figure 6.46 — *Oxxio (Eneco) energy label*

The purchase of energy by Oxxio is directly linked to the purchase of energy of its parent company Eneco, which has a CO_2 emission factor of 184 g/kWh and is considered as one of the most sustainable energy suppliers of the Netherlands – for energy mix, see Fig. 6.46. (Wise, 2014).

Here, it is important to note that the supplied energy from Oxxio and Eneco is still separate. The CO_2 emission savings linked to Eneco is therefore different and would be approximately 26,250 kilograms during the lifetime of the house.

The least sustainable energy supplier in the Netherlands belongs to the RWE concern. Essent is the company within this concern who has the task to supply electricity to the

Figure 6.47 — *Essent energy label*



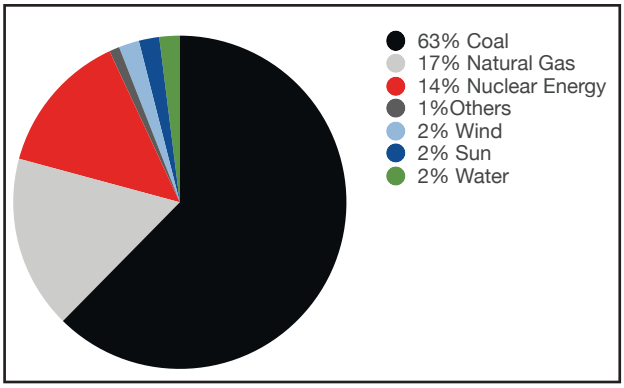


Figure 6.48 — *RWE energy label*

Benelux. In itself, Essent has a relatively average CO_2 emission factor of 307.9 g/kWh and a fairly large share of renewable energy supplied, see Figure 6.47 (Wise, 2014b). When this supplier is chosen, the CO_2 emission savings would amount to approximately 43,950 kilograms during the lifetime of the house.

However, when looking at the covering organisation RWE, which actually supplies the energy, the CO_2 emission factor is more than twice as much, 792 g/kWh, which is the highest in the Netherlands. This becomes evident when looking at their energy mix, which consists mainly of energy derived from coal and gas (Fig. 6.48) (Wise, 2014c). So in actuality, the CO_2 emission savings when using electricity from Essent, and therefore from the RWE concern, would be approximately 113,050 kilograms during the lifetime of the house.

In summary, it can be said that with having a sustainable energy supplier providing 100% renewable energy, there would be no CO_2 savings. Through using the PV modules in Honselersdijk, there could be a maximum CO_2 emission savings of 95.500 kg. The CO_2 savings would be along the range of 6,550 to 113,050 kg of CO_2, depending on the energy mix it is compared to. However, since CO_2 is also emitted during the manufacturing of the PV modules, which is calculated to be roughly 8,875.5 kg. This means the CO_2 will not be paid back when it is compared to the most sustainable energy distributor Oxxio, but has the potential to be paid back within 4 years when it is compared with the least sustainable energy distributor RWE (and Essent).

Figure 6.49 — *Cleaning of PVs and skin*



6.7.3 Accessibility

In order to guarantee a proper functioning of the PVs, necessary maintenance has to be carried out, as has already been described in detail in chapter 3.5. Aside from making sure that the electrical system operates well, it has to be well taken care of. That means that in periods of drought, the panels need to be cleaned regularly. This can be done from the ground using an extended window mop (see Fig. 6.49). In Honselersdijk this would probably only have to be done a few times a year, since rainfall is usually heavy and frequent enough (KNMI, 2013).

Moreover, when panels are damaged they can be replaced individually by unbolting them. This is bound to happen over time, but will have to be done at latest after 25 years of use, when all modules need to be replaced. The aluminium frame is designed in such a way that it is able to support maintenance work of this sort and flexible enough to exchange modules.

6.8 Water

Water is a very complex topic that concerns everyone on this planet. It addresses issues that are as basic as having water available for drinking and basic hygiene, to pressing concerns such as water scarcity and accessibility. Moreover, there are other big subjects such as the production of clean water, consumption of water in various industries and in a private households. With all these problems the reduction of consumption is a main topic. Prêt-à-Loger is also striving to achieve this in the “Home with a Skin”.

6.8.1 General water use, management and conservation concept

As described above, the skin of the house will have several functions, but its main functions will be aimed at the reduction, production and reuse of energy and water. A large part of the research approach and corresponding interventions stem from the existing patterns of homes and their users. More specifically, this equates to the use of space with relation to heating & cooling, energy & water use and usage in terms of time. Having access to this information will allow for optimisation of the water production and consumption for individual homes, and by extension for whole neighbourhoods.

For the house in Honselersdijk the aim is to integrate and synchronise the key cyclical processes of the water flows. The fresh water and greywater cycles will be differentiated and optimised for the amount of water flowing in the house and the heating system will work in close synchronisation with these water cycles. By appropriate handling of these two flows, a better energy consumption performance can be achieved.

Figure 6.50 — *Water cycles in Honselersdijk*

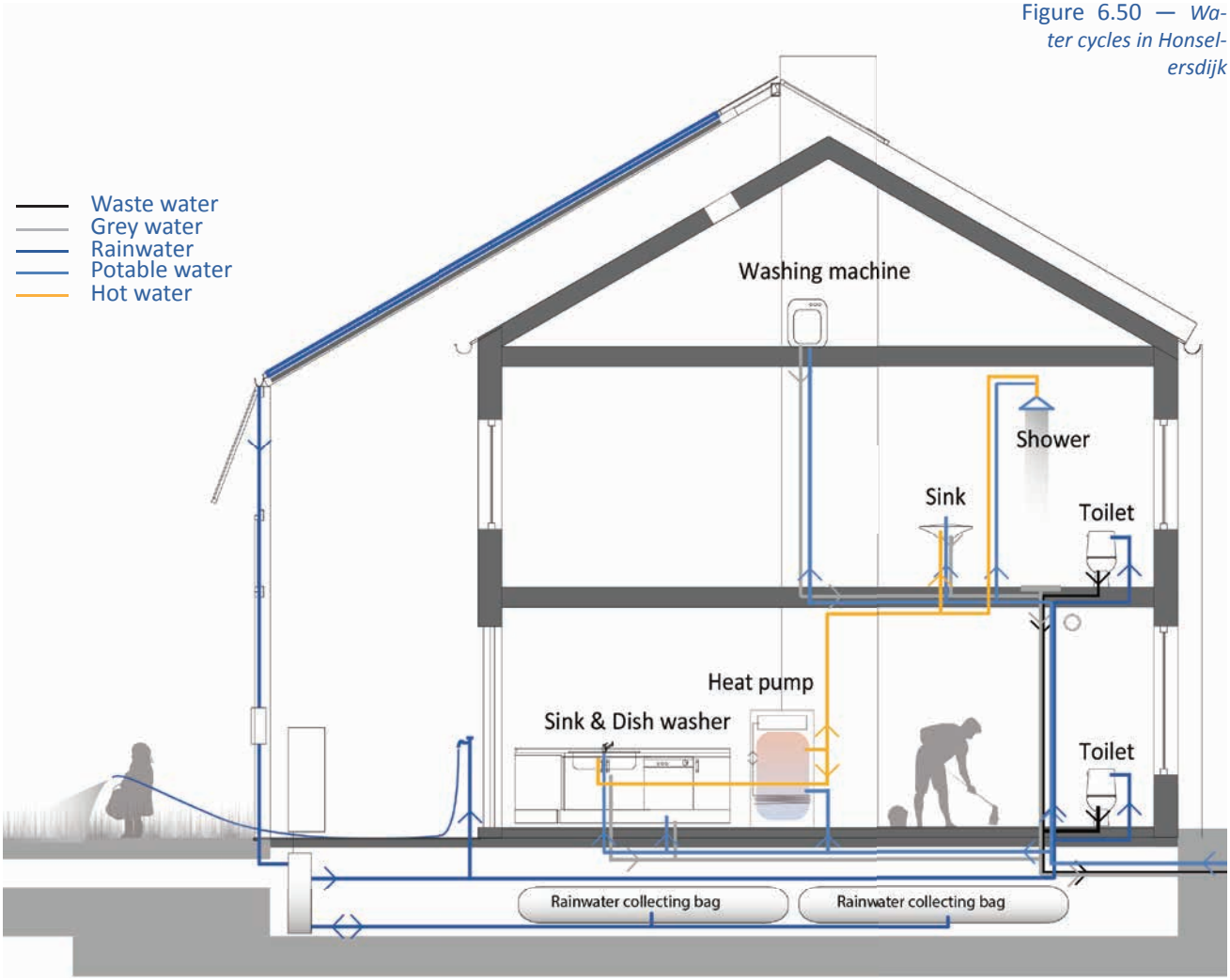


Figure 6.50 depicts the water cycles in the house. There, three flows can be distinguished: potable drinking water (light blue lines), rainwater (dark blue) and grey and black waste water (grey and black). Furthermore, yellow lines indicate heated water that flows from the heat pump. Most of the water coming into the system is potable water, which is used for all appliances in the house except for the toilet, which makes use of rainwater. This rainwater is captured on the roof and is transported to rainwater collecting bags in the crawl space of the house. From there it travels to the toilet and to outside appliances for use in the garden. Drinking water is fed to the heat pump, where it is heated up for use in the sink and shower. (For clarification, there is no greywater flow from the heat pump. The heat pump is located in the wall behind the dishwasher. That is why the line of the greywater coming out of from this area might be confusing, but it actually comes from the dishwasher.) The grey line indicates the flow of greywater from the kitchen appliances to the sewage system, since all water used in the house is discharged to the sewage system and transported to a centralised sewage treatment plant. In the future, the greywater could be collected and subjected to a greywater treatment system.

6.8.2 Strategies for the reduction of consumption

Even though the Netherlands is not a country affected by water scarcity, it is still desirable to reduce the consumption of water (UNESCO, 2012), since there is a clear correlation between water and energy. On a large scale a lot of water is required to cool of power plants producing energy and an a smaller scale energy is consumer by producing hot water for cooking, making hot beverages, showering, etc. This means a reduction in water consumption will also entail a reduction in energy usage.

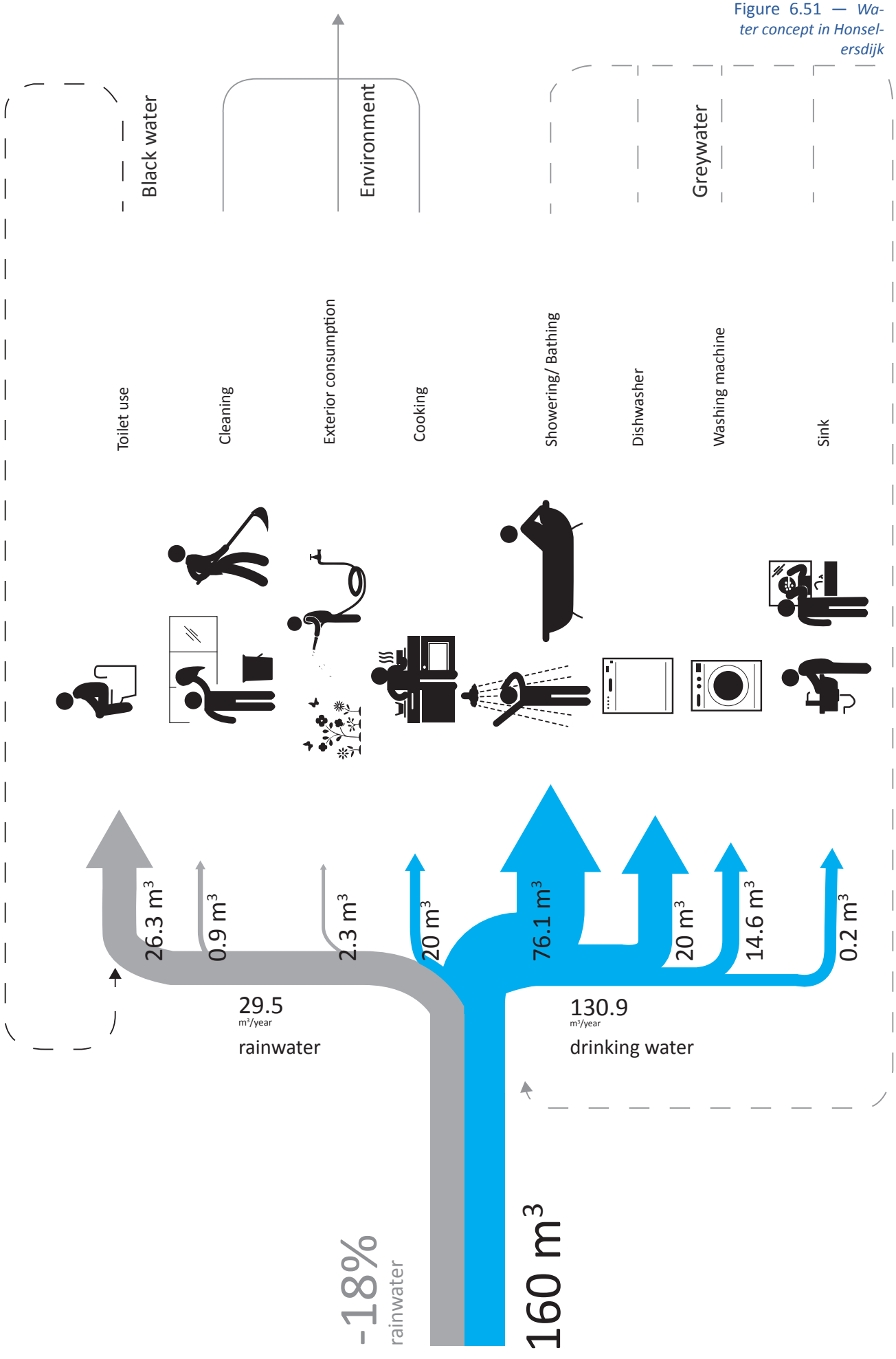
The water production can be reduced by installing water-saving appliances such as toilets, showerheads and washing machines, but to an even bigger extent by conscious use of water (Hoekstra et al., 2011). Since Prêt-à-Loger is dealing with an existing house and aims at implementing a non-invasive approach, new highly-efficient sanitary installations cannot be easily installed. Instead, small, simple, but smart techniques will have to be employed in the plumbing system and the water cycles. This will include a dual-flush device for the toilets, a water-saving shower head, and it can extend to a water-saving washing machine and dishwasher. However, it needs to be understood and is therefore recommended that much bigger savings could be achieved with high-efficiency toilets and other modern sanitary devices. In the future the aim is to implement a vacuum toilet, with which the water-use can be reduced by 22% and reduce the outflow of (highly) contaminated black water by 77.7%. The vacuum toilet only uses 1 litre per flush. The contamination in the remaining 7.5 litres of black water is then far more concentrated and makes is therefore suitable for fermentation into biogas or fertilizer. Unnecessary use of potable water should be restricted.

To increase the conscious use of water by the residents sensors will be installed which visualize the consumption of water on a monitor. Besides tracking the consumption, these sensors will also serve as a tool to directly estimate and predict fees for the water bill, thereby increasing the incentive to use less water. The sensors can also be used as an educational tool, especially for children, to learn about water consumption from an early stage.

6.8.3 Treatment of wastewater

Wastewater in the Honselersdijk area is treated in a central plant connected to a network of sewers. All homes are required to connect to the public sewer system if it is provided and an inspection of the drainage system on the private property is required. However, depending on the site additional provisions may apply (e.g. the application of

Figure 6.51 — *Water concept in Honselersdijk*



a septic tank) which are included in the building code or in the environmental permit (Overheid 2007).

To reduce the amount of run-off during high rains thereby reduce the pressure on the sewer systems green roofs are installed, which have high rainwater retention and can therefore serve as buffers during storms. Special types of plants for grey and black water treatment can also be installed on the roof to clean the rainwater, which can subsequently be collected and used in the greywater system of the individual houses. Besides retaining and cleaning water the green roof also functions as an aesthetic element, since it will introduce more vegetation and greenery into the neighbourhood.

6.8.4 Greywater system

Greywater is defined as wastewater generated from the usage of showers, baths, washing machines, dishwashers and kitchen sinks. This type of water can be recycled on-site for reuse of the water in applications such as toilet flushing, garden irrigation and cleaning of premises. It differs from the discharge of toilets which is designated sewage or black water, which needs to be treated further. (LetsGoGreen.com, 2014)

Domestic wastewater is usually combined at the sewer in order to remove grey and black water together using a shared sewerage system in a process called elimination. Sewage water can then be treated to limit pollution and health risks, before being returned to the environment at large. Most greywater ends up as effluent in rivers and oceans in this way. (RIONED, 2009)

There are other alternatives to eliminating greywater that allow for efficient use, of which using it to irrigate plants is a common practice. The plants use contaminants of greywater, such as food particles, as nutrients in their growth. However, salt and soap residues can be toxic to microbial and plant life alike. These substances can be absorbed and degraded through constructed wetlands and aquatic plants such as sedges, rushes, and grasses. Most greywater is easier to treat and recycle than black water, because they contain low levels of contaminants. (RIONED, 2009, Greywater Action, n.d.)

Domestic greywater can be recycled directly within the home, garden or company when it is collected using a separate plumbing system and can either be used immediately or be processed and stored. If stored, it must be used within a very short time to prevent petrification caused by the organic solids in the water. Recycled greywater of this kind is never safe to drink, but a number of stages of filtration and microbial digestion can be used to provide water for washing or flushing toilets. Some greywater may be applied directly from the sink to the garden or container field, receiving further treatment from soil life and plant roots. Given that greywater may contain nutrients, pathogens, and is often discharged warm, it is very important to store it before use for irrigation purposes, unless it is properly treated first. (LetsGoGreen.com, 2014, Greywater Action, n.d.)

In Honselersdijk rainwater will be collected through the green roof and greenhouse, which will be stored in water bags under the house. This rainwater will be used as greywater, which will be extrapolated in chapter 6.8.6. A greywater treatment system for the waste water coming from the sink and shower is currently not installed, but is an option that could be implemented in the future.

6.8.5 Recycling and reuse

In Honselersdijk, water is not being recycled or reused due to lack of space on the plot and the abundance or water in the Netherlands.

6.8.6 Rainwater use

As mentioned before, rainwater will be stored in water bags of 2 x 2,000 litre, which consist of a shaft and a storage bag and will be coupled via a bottom connection to create one storage unit. The storage bags are connected to the water shaft by a pipe and are connected to an overflow which ensures the bags cannot be filled above a maximum level. Such a water bag in the rainwater system is especially useful for houses like the Prêt-à-Loger house, since it can be positioned in the crawl space, thereby eliminating the need for an underground tank.

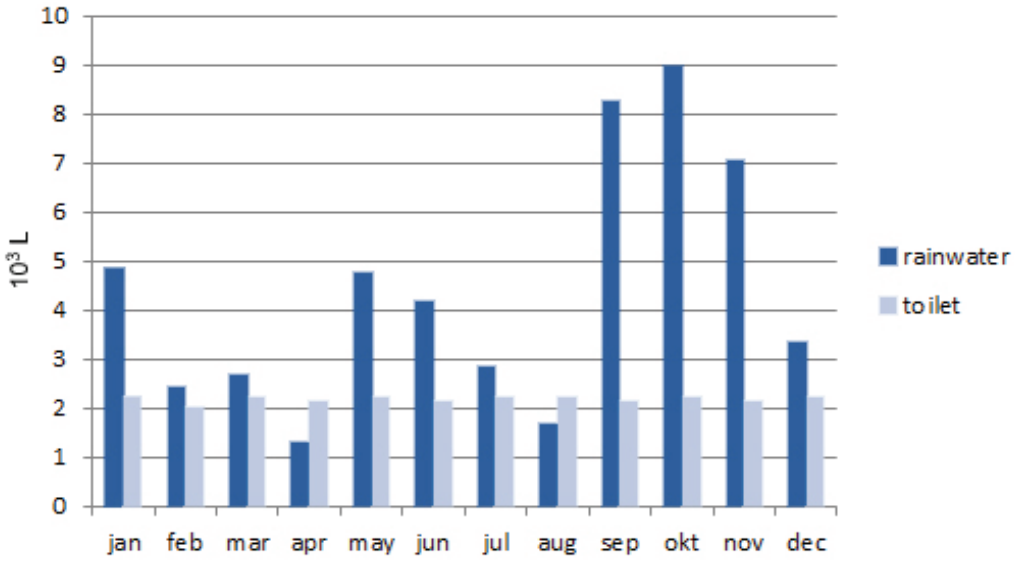


Figure 6.52 — *Average rain fall and toilet water consumption in Honselersdijk*

Due to the high rainfall in spring and autumn and low rainfall in summer it is important the water bags can store enough water for toilet use during all seasons. A difference between rainfall and usage of about 2,000 litres can be observed during August, as shown in figure 6.52 (KNMI, 2014), during which the water supply will decrease. For this reason the capacity of 4,000 litres has been chosen, which will be able to supply enough water throughout the year (KNMI, 2014).

There is an average rainfall of 83.7 mm (KNMI, 2014) in Honselersdijk that can be collected via the roofs roof in a storage tank, after which it will be collected in the rubber water bags located in the crawl space of the house. This water will be used as part of the greywater system in the house and will be mainly implemented for toilet flushing, car washing and gardening as can be seen in figure 6.51.

As a result, according to the water consumption calculations, 28.3 m^3 rainwater per year will be used for flushing the toilet. This results in 18% freshwater savings (compare chapter 6.1 and chapter 6.10), as shown in Fig. 6.51. In total, there are 68.3 m^3 rainwater is available per year. The rest of the rainwater can be used for cleaning premises and irrigation.

6.8.7 Expected final consumption

The average yearly water consumption of Honselersdijk's household is 160.3 m^3. Almost 18% of the water is used for flushing the toilet. Figure 6.51 further depicts the rainwater and drinking water consumption. The sum of this consumption is the total water consumption. In green, the savings on water by the rainwater consumption is shown. The output or the wastewater consist of 132.9 m^3 greywater and 26.3 m^3 black water

per year. This picture shows that the water management is not a closed cycle, yet. The scheme shows only the input and the output of the water consumption. In the future this cycle can be closed.
In comparison to normal houses without a skin using the same principles the water reduction can be higher than 20%.

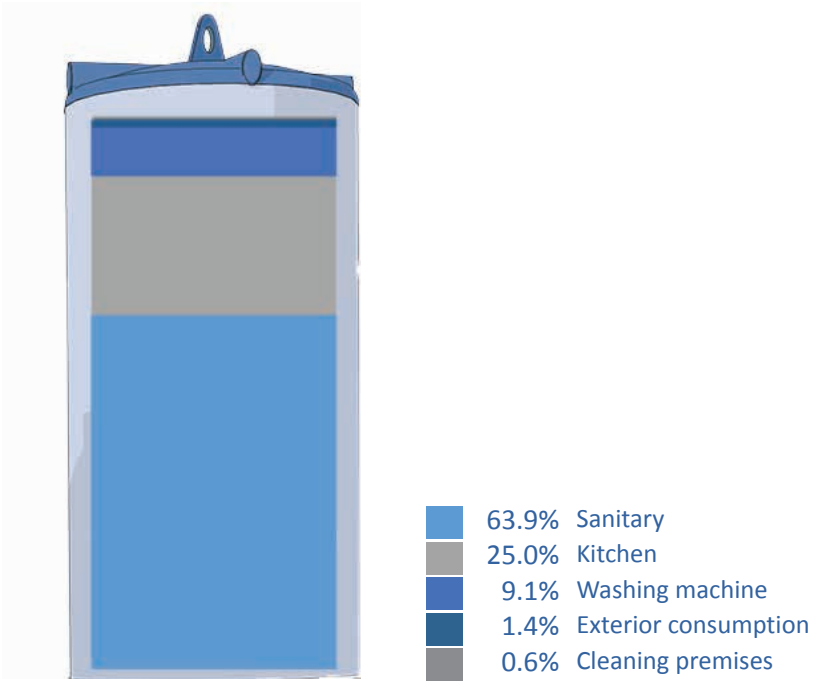


Figure 6.53 — *Excpected water consumption in Honselersdijk*

6.9 Solid Waste

The materials which are used in the Skin have to fulfil certain criteria. The criteria relevant for this chapter are that materials need to extend the lifetime of the skin (50 years) and materials need to be recyclable. Before these materials of the skin can be applied, certain parts of the house need to be demolished. After the demolition phase, the skin is constructed, which also produces waste. The types of wastes created during the construction phase will also be displayed in this chapter. Furthermore, the materials need to be maintained and certain materials need to be replaced over the building's lifetime. The materials that belong to this category and the waste that is created during this demolition phase are displayed in this chapter as well.

6.9.1 Construction phase assessment

Demolition of materials

During construction, a small portion of the northern wall of the house in Honselersdijk will be demolished. This wall contains 437.92 kg of bricks, windows (2674 kg of glass and 8.66 kg of PVC plastic frames) and a PVC plastic and glass door of 33.07 kg. The demolished bricks have a high reuse potential of 64.3%. Of the remaining material, 33.9% will be landfilled and 1.9% will be incinerated. The glass from the windows has an even higher reuse potential and can be recycled completely (100%), but the window frames holding the glass are barely recyclable (0.1%) and 95% of the frames will be incinerated, leaving 4.9% to be landfilled. The PVC and glass door is also barely recyclable (0.9%) and 94.2% will be incinerated, with 4.9% of the door materials landfilled.
This means that during the demolition in the construction phase, 41.32% of the materials will be reused. A slightly larger proportion (47.77%) will be incinerated, leaving 10.92% of the materials to be landfilled.

Construction waste

During the construction of the north wall and the greenhouse, small portions of materials will be wasted, due to chipping and corrections. The greenhouse frame will be prefabricated. This will significantly reduce the amount of waste materials during construction and might even reduce the waste materials by 100% (Use of Prefabrication to Minimize Construction Waste – A Case Study Approach, 2012). During assembly, however, there will be some losses due to cut electric cables and minor adjustments to the frame itself (like chipping or widening holes). Also, there will be little losses due to the prefabricated bricks and insulation. Losses that will occur will probably be mostly at the mortar application, since this is done by hand. We also expect slight losses with the application of the insulation due to measuring adjustments made to the material. Losses are also expected during the application of blown-in cellulose in the southern wall. The exact amount of all construction losses is at this point unknown (Tam et al., 2005).

6.9.2 Project use and maintenance

Solid waste

In the Netherlands, every citizen produces 550 kg of waste per year (CBS 2014). Residents of the municipality of Westland, the municipality to which Honselersdijk belongs to, produced an average of 553.8 kg of waste per year, during the last couple of years, see figure 6.54 (CBS 2014). A household of three, living in Honselersdijk, produces an average of 1373.67 kg of waste between 2004 and 2012. This waste consists of residual-, plastic and plastic packaging-, vegetable, fruit and garden- and bulky waste. Further-

more, the family produces waste in the form of old paper, cardboard, glass, clothing, textiles and footwear, electrical appliances, hardware and small chemical waste (CBS 2014). The costs of the collection of all the waste is covered in the waste tax (Gementee Westland, 2014), of which the amount depends on the number of residents in the house and on the amount of waste produced by the municipality (Gementee Westland, 2014). For 2014, this fee is €222.84 per year for a household of three persons or more (Gementee Westland, 2014).

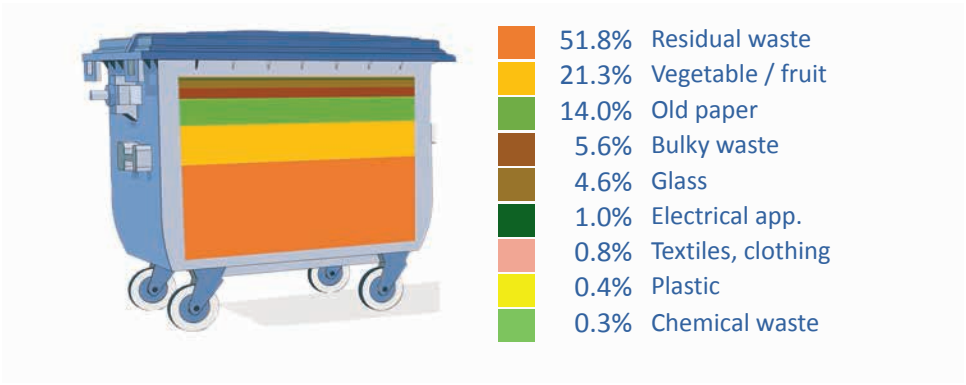


Figure 6.54 — *Waste composition in Honselersdijk*

Residual waste and vegetable-, fruit- and garden waste

Residual waste and vegetable, fruit and garden waste are the two largest components of household waste (CBS, 2014). A household in Honselersdijk produced between 2004 and 2012 an average of 712 kg of residual waste and 292 kg of vegetable, fruit and garden waste (CBS, 2014). Residual waste and organic waste are separately collected in mini-containers of 240 litres (Gemeente Westland, 2014). These mini-containers are given to every household in the municipality of Westland and are being picked up once a week with garbage trucks by the municipality (Gemeente Westland, 2014).
After collection, all the parts in the residual waste that can be recycled, are removed from the non-recyclable parts (Gemeente Westland, 2014). Furthermore, the high calorific waste in the residual waste is processed into pallets (Van Vliet Contrans, 2011). These pallets are used by the energy companies to generate electricity (Van Vliet Contrans, 2011). Moreover, the remaining waste is burned in the incinerators (Gemeente Westland, 2014).

Municipal Composting



The vegetable, fruit and garden waste is degraded and fermented into compost (Gemeente Westland, 2014). This compost is then sold and used as a soil conditioner (Van Vliet Contrans, 2011). The municipal composting site creates per 1,000 kg of vegetable, fruit and garden waste, 400 kg of compost (Gemeente Westland, 2014). This means that a household of three people is responsible for generating 116.8 kg of compost per year. Compost made from vegetable, fruit and garden waste contains 150 kg carbon/ton or 550 kg/ton CO_2 (Elferink & Vlaar 2010). After one year, 70% of the carbon is converted into effective organic matter, which means that after one year there are 385 kg CO_2 left (Elferink & Vlaar 2010). This material has a rate of degradation of 2% (Elferink & Vlaar 2010). The compost created at the municipal plant of the household would be responsible for 64.24 kg of CO_2 per year.



Furthermore, there are also CO_2 emissions during the production of the compost that sum up to around 25 kg CO_2-eq and some more during the transport (Elferink & Vlaar

2010). To be exact, an average garbage truck in the Netherlands travels 20.4 km and an average truck uses 1,010 kg CO_2-eq per km, which adds up to 20,604 COv_2-eq (SenterNovum 2008; Milieubarometer 2011).

Garden Composting

The emission of the transport could be avoided by composting the vegetable, fruit and garden waste in the garden of the house (Zelf composteren 2014). Moreover, there are other benefits to garden composting, these, as well as the difficulties of garden composting are listed below:

Benefits:

- The compost from the garden can reduce or eliminate the need for chemical fertilizers in the garden or other (US EPA 2013; Gemeente Westland 2014).



Figure 6.55 — *Vermicomposting finds even in small gardens a place*

- There are three types of composters, so there is some flexibility in the choice (US EPA 2013): Vermicomposting: A vessel filled with worms, which compost the waste (figure 6.55); Compost vessel; Compost bin

- The vermicomposting is the best solution for the small garden (11.63 m^2) of the household in Honselersdijk, because it uses little amount of space and composts quickly (around 10-12 weeks) (Milieucentraal 2014). Besides, it is low in cost between 25 and 75 Euro.

Difficulties:

- Feedstock and nutrient balance: In order to achieve controlled composition, it is necessary to balance the feedstock and nutrients (US EPA 2013). This means that there should be a balanced amount of 'green' organic material, with a high amount of nitrogen (US EPA 2013). Organic material like grass clippings, food scraps and manure contain these amounts of nitrogen (US EPA 2013). This kind of material should be brought into balance with 'brown' organic material (US EPA 2013). 'Brown' material can consist of dry leaves, wood chips and branches, because this material contains high amounts of carbon and are low in nitrogen (US EPA 2013). Acquiring the right balance between the 'green' and the 'brown' material requires experimentation and patience (US EPA 2013). This makes garden composting in a social feasibility sense difficult to apply in an average household.

- Compost accelerator: Moreover, in order to speed up the composting, a compost accelerator needs to be added to the pile (Milieucentraal 2014).

- Type of waste: Not every type of waste can be thrown onto the compost pile, for example coffee pads cannot be converted into compost on a domestic compost pile (Milieucentraal 2014).

- Particle size: Besides balancing organic materials, the size of the material is also important (US EPA 2013). Small areas make it easier for organisms to feed on the surface (US EPA 2013). The small particles also improve the homogeneity of the compost, improve the insulation of the pile and remain the optimum temperature (US EPA 2013). However, when the particles are too small they prevent free air flow in the compost pile (US EPA 2013). Therefore it is important to shred the organic material at the right size and this could be an area to enter for households.

- Moisture content: Next to these two barriers, the moisture content of the compost pile also affects the composting (US EPA 2013). The moisture content should be at a rate that the compost pile is accessible and liveable for microorganisms and microbes and survive (US EPA 2013). The right amount of moist is also necessary to facilitate the transport of substances among the pile (US EPA 2013). In a period of drought it could be hardier to maintain the right amount of moisture within in the compost pile and this could lead to slow composting.

- Oxygen flow: Alongside the barriers that occur during the maintenance of the composting, there are also barriers when building the compost pile. In order for the pile to compost faster, aerobic conditions need to be created and maintained, which requires a sufficient amount of oxygen (US EPA 2013). This can be achieved by placing the pile on a series of pipes or wood chips and shredded newspaper (US EPA 2013). Though this is an easy chore, the flow of oxygen still needs to be controlled, because too much oxygen can dry out the pile and thereby slow the composting process (US EPA 2013).

- Temperature: The last barrier that should be taken into account is controlling the temperature of the compost pile. The microorganisms in the pile only function optimal at a certain temperature (US EPA 2013). This temperature is needed to create aerobic digestion, below this temperature only anaerobic digestion takes place, which will lead to rotting (US EPA 2013). Due to the activity of the organisms heat is produced (US EPA 2013). This can lead to temperatures of 60°C (US EPA 2013). Controlling the temperature of the pile is thus important to maintain the process of composting, but is also necessary to prevent fires in the garden. The activity with is corresponding increase in temperature can lead to smouldering of the pile and this could lead to fire. A compost pile could therefore be perceived as dangerous.



Plastic and plastic packaging waste

Since 2007, the municipality of Westland has been offering to its inhabitants that plastic packaging can be collected separately from the rest of their residual waste (Plastic Heroes, 2014). Since 2010, it is also possible for the inhabitants to separate the rest of the plastics (Plastic Heroes, 2014). A family disposes of around 20 kg of plastic and plastic packaging per year (Gemeente Westland, 2014). The plastic packages and plastic can be collected in special 'plastic hero'- bags or other transparent plastic bags and then brought to the nearest container (Plastic Heroes, 2014). For a family, this container is approximately eight minutes of walking away. After the municipality collected all the plastic waste, the largest part of it is shredded or melted into raw material for new plastic products (Gemeente Westland, 2014).



Old paper, cardboard and glass

A family in Honselersdijk produces an average of 193 kg of old paper and cardboard per year (CBS, 2014). In order to collect this, a family is provided with a mini-container from the municipality (Gemeente Westland, 2014). The municipality is also responsible for emptying the mini-container, which is done once a month (Gemeente Westland, 2014). The old paper is shredded and made into raw material for new paper and cardboard (Gemeente Westland, 2014).

The glass that the household produces is around 63 kg per year (CBS, 2014). The glass is collected in containers which are some eight minutes walking distnace away from the house (Gemente Westland, 2014). After collection, the glass is recycled and used to make new glass (Gemente Westland, 2014).

Clothing, textile and footwear



The 11 kg per year of clothing, textile and footwear waste of the family, is also collected in the containers eight minutes away from the dwelling (Gemeente Westland, 2014; CBS, 2014). Most of the clothing and footwear is send to charity, the rest of the worn-out clothing, is recycled into rags (Gemeente Westland, 2014).

Electrical appliances, hardware and small chemical waste



The case study family produces around 14 kg of small electrical appliances and hardware waste per year (CBS, 2014). The small electrical appliances and hardware can either be collected in the container eight minutes away, or brought to the municipal waste site (Gemeente Westland, 2014; Gemeente Westland, 2014). The appliances which can be repaired, will be mended and reused, the rest of the appliances will be demolished and the materials will be recycled (Gemeente Westland, 2014).



Small chemical waste makes up 4 kg of the family's total waste (CBS, 2014). Due to its toxic content, this type of waste needs to be brought to the municipal waste site (Gemeente Westland, 2014). Here, part of it is recycled and the parts which cannot be recycled are burned (Gemeente Westland, 2014). The burning happens in special incinerators, in which they make sure that the toxic parts are destroyed (Gemeente Westland, 2014).

Maintenance

Although the team has tried to find materials which fulfil all of the above described criteria, during the lifetime of the house, certain materials need to replaced and maintained. In table 6.1 and 6.2 in chapter 6.5 the materials that need to be replaced within in the lifespan can be found. These materials are presented in table 6.3.

Table 6.3 — *Expected water consumption in Honselersdijk*

PLACE IN HOUSE	Material	Replacement Frequency over Lifetime
Glasshouse	Aluminium frame for PVs	1
	Glass doors and windows	1
	LED lights	1
HVAC	Solar collectors	1
	Heat pump	1
	Hot water tank	1
Ventilation	Demotica box	1
	Heat exchanger	1
Rainwater System	Plastic water bags	1
	Rainwater pump	5
PV Panels	PV cell wafer	1
	Glass	1
	SolarEdge SE5000 inverter	1
Electric Cables	Copper cables	1

The old aluminium frame, the glass doors and windows can be reused for 63%, while 32% go to the incineration and 5% ends up at the landfill. The solar collectors, the heat pump and the hot water tank can be reused for 78%, 18% goes to the incineration and 4% goes to landfill. When the Demotica box needs to replaced, the old box can be re-

used for 86%, 10% goes to the incineration and 4% ends up at the landfill. The old heat exchanger has the same percentage that ends up at the landfill. Further, the percentage that goes to the incineration is 18% and 78% of the exchanger can be reused. The plastic water bags can be reused for 100%. The rainwater pump for 78%, the percentage that goes to the incineration is 18% and the part that goes to the landfill 4%. Of the old PV cell wafer and the glass, 85% can be reused and 15% goes to landfill. The SolarEdge has different numbers. The part that goes to landfill is 4%, the part to incineration 18% and the part that can be reused is 78%. The copper cables are completely reused and the LED lights can be reused for 94%. The rest of the LED lights, goes to the incineration (2%) and landfill (4%). How these materials must be collected will be explained in the next paragraph 'bulky waste'.

Bulky waste



The materials of the skin that need to be replaced, belong to the category bulky waste. The owners of the house can either choose to bring the waste away themselves, or arrange a pick-up with the municipality (Gemeente Westland, 2014). If they bring it away themselves, they have to take it to the municipal waste site (Gemeente Westland, 2014). The family is allowed to drop 3 cubic meters of bulky waste, with a maximum of once a month (Gemeente Westland, 2014). If the family chooses to arrange a pick-up, the costs are €12.50 for a maximum amount of waste of 3 cubic meter (Gemeente Westland, 2014). After the bulky waste is collected, either at the municipal waste site or at the house, the materials that can be recycled are separated from the appliances that can be repaired (Gemeente Westland, 2014). After reparation, the appliances are sold in a thrift shop (Gemeente Westland, 2014).

6.9.3 End of life assessment

For the end of life assessment, only the outer shell (glasshouse) that was added to the house will be considered, as it is uncertain which types of waste prevail in the existing house. Since Prêt-à-Loger's solution is applicable to many different kind of houses, a number of different combinations of existing materials exist in theory. Therefore, it would be difficult to include the house itself, which is why only the end of life of the Skin will be assessed. Further, materials added to the current structure (like the north wall or insulation) will also not be taken into account, since they now form an inherent part of the basic structure. Part of the reason Prêt-à-Loger took this approach is because this concept was designed in a way to make the house more sustainable for the forthcoming future. The goal is to preserve and retrofit current housing structures, instead of demolishing them, so it is assumed that the basic structure of the house will be preserved in the future as well. In summary, demolished materials from the original house have been evaluated in the construction phase assessment and further materials that are present in the old structure will not be taken into account.



The concrete (780 kg) used for the glass house foundation can be reused in its entirety. The glass used in the greenhouse (297 kg) can also be 100% reused and the basic structure of the greenhouse, containing the steel skeleton (1036.20 kg) and coating (47.06 kg), can be reused for a great part, namely 97.5%. 2.2% can be landfilled and 0.3% is suitable for incineration. The floor of the glasshouse (818.13 kg) cannot be reused (only 0.2%) and 93.6% of it will be incinerated, with 6.3% landfilled. The aluminum frame holding the PV panels in the glasshouse (356.40 kg) can be reused for 63%, with 32% incinerated and 5% landfilled. The PV cells (23.40 kg) themselves (including the glass weighing 1962 kg) are more sustainable and can be reused for 85%. The remaining 15% will have to be landfilled together with the inverter (43.40 kg), which cannot be reused nor incinerated. Altogether, 72.82% of the greenhouse can be reused when disassembled. 12.62% can be incinerated, leaving 14.56% that will have to be landfilled.

6.10 Life Cycle Analysis

A Life Cycle Analysis (LCA) is a tool that can measure the different environmental impacts of a product or a whole system over its life cycle. The goal of this LCA was to carry out such an assessment for the house in its local context, Honselersdijk, for a lifespan of 50 years. Moreover, the analysis was done from cradle-to-grave, meaning that all stages, from mining of materials, to manufacturing them into goods, installing them in the house and finally discarding them at their end of life are included. In addition to that, all the impacts from transportation (of materials and users of the house) and the consumption of water and energy during the construction and the use phase were accounted for.

The LCA was carried out using the LCA software SimaPro 7.3.3 in combination with the ecoinvent database version 2. After including all the relevant data into SimaPro, three methods were utilized for the analysis of different indicators, as will be described below. Before presenting the results, the structure of the LCA set-up with its various assemblies will be introduced.

6.10.1 Structure and description of main assemblies

There are five main contributors (A, B, C, D, E) that form the main assembly 'F', the building. A, B, C, D, E can be understood as contributors and represent construction, transport of materials, materials, use phase, and transport of users, respectively (figure 6.56).

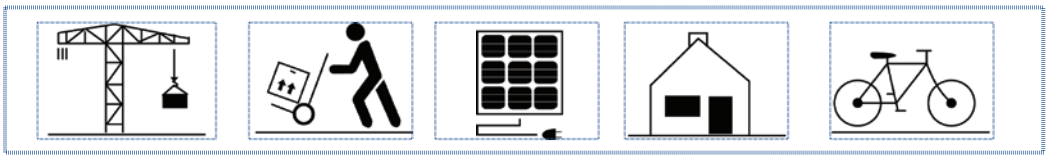


Figure 6.56 — *A, B, C, D, E (from left to right)*

A Construction

The construction system, together with its various resource consumptions, has already been described in chapter 6.4. Prêt-à-Loger looked into engine, water and electrical consumption and the fall of materials (waste 6.9.1). Moreover, the materials that need to be demolished in the retrofitting process are taken into account at this stage. All the materials and processes that were included in this stage are shown in figure 6.57. Summarized it can be said, that it is estimated that 500 kg of water will be used and about 412.03 MJ of diesel. The electricity consumption is 0 kWh, because it is assumed that electricity is produced with a generator that runs on diesel. In total 11.49 L of Diesel with 35.86 MJ/L (= 412.03 MJ) are consumed. Moreover, the old roof, the outer layer of the North brick wall and windows and door in the North are demolished as has been explained before.

Figure 6.57 — *Assembly A*

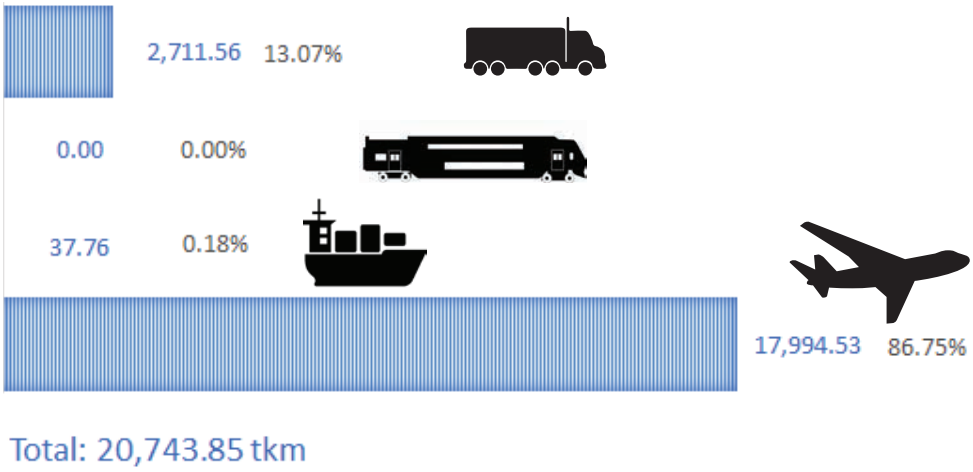
Materials/Assemblies	Amount	Unit	Distribution	Comment
Tap water, at user/RER U	500	kg	Undefined	estimate for water consumptions on construction
C.04.2 Old Roofing (demolition)	1	p	Undefined	partial demolition of north roof
C.06.1 Old Panelling (demolition)	1	p	Undefined	demolition of old panelling to improve house
C.06.2 Old windows/doors (demolition)	1	p	Undefined	demolition of old windows and doors and replace with new ones
(Insert line here)				

Processes	Amount	Unit	Distribution	Comment
Electricity, low voltage, at grid/NL U	0	kWh	Undefined	electricity consumptions on construction site
Diesel, burned in building machine/GLO U	412.03	MJ	Undefined	e.g : drill and crane consumption from generator
(Insert line here)				

B Transport of materials

The transport of materials assembly considers the different transportation values of the single categories. Three different processes are identified: transport with a lorry, a freight ship and an aircraft. Figure 6.58 depicts assembly B that is measured in tkm, transport impact. It can be seen that the aircraft transportation has the biggest share with about 86% and a total of 17,994.53 tkm (figure 6.58).

Figure 6.58 — *Impact of Transportation of Materials (tkm)*



C Materials

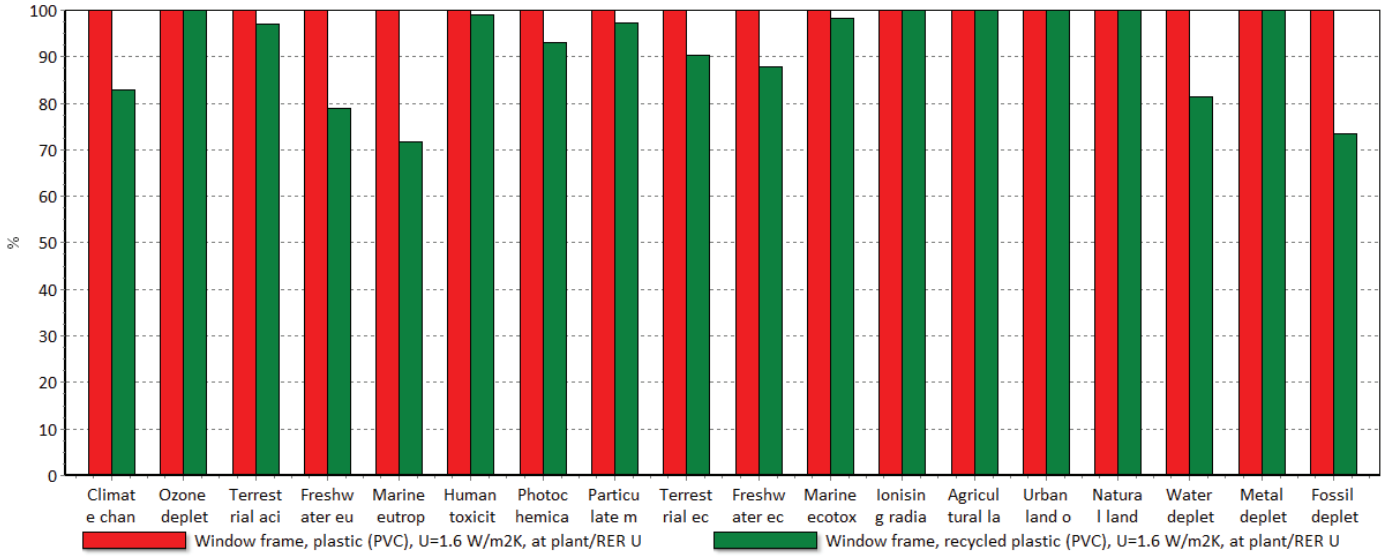
Assembly C, contains all the materials. Chapter 6.5 lists all of them in table 6.1 and 6.2 and describes them extensively. Moreover, the most updated Construction Material (CM) excel spreadsheet was submitted together with the latest Thermal and Environmental Evaluation (TEE#3).

It has been previously mentioned that some of the materials are left out, because they are not in SimaPro. These materials had to be disregarded, because of lack of information, even after conducting extensive research. However, they are also listed in table 6.2.

One of the highlights of the materials are the recycled window frames. Here the attempt was made to model recycled plastic. This was done on the basis of a paper called "VinyLoop: Smart Recycling – Low Footprint" (VinyLoop, 2012). Figure 6.59 shows the difference in the environmental impact categories for conventional PVC and VinyLoop. These values were used to alter the "Polyvinylchloride, at regional storage/RER U", as the major plastic component of the "Window frame, plastic (PVC), U=1.6 W/m2K, at plant/RER U" entry in the ecoinvent database. A comparative analysis showed that, not surprisingly, the recycled window frames perform better (figure 6.60). It has to be noted

Figure 6.59 — *Recycled Plastic has lower environmental impacts*

IMPACT CATEGORY	PVC CONVENTIONAL ROUTE	VINYLOOP®	UNIT	DIFFERENCE
Global Warming (GWP 100a)	3,36E+00	2,06E+00	kg CO_2-Eq	- 39%
All Primary Energy Resources	4,83E+01	2,60E+01	MJ	- 46%
Water Consumption	2,49E - 01	6,92E - 02	m^3	- 72%
Depletion of Abiotic Resources	1,89E - 02	1,21E - 02	kg Sb	- 36%
Acidification	6,82E - 03	1,67E - 03	kg SO_2-Eq	- 76%
Eutrophication	6,13E - 04	-1,84E - 03	kg PO_4-Eq	- 400%
Ozone Depletion	-2,69E - 08	1,74E - 07	kg CFC-11-Eq	n/a
Photochemical Oxidation	4,55E - 04	1,27E - 04	kg ethylene	- 72%



Comparing 1 kg 'Window frame, plastic (PVC), U=1.6 W/m2K, at plant/RER U' with 1 kg 'Window frame, recycled plastic (PVC), U=1.6 W/m2K, at plant/RER U';
Method: Recipe Midpoint (H) V1.07 / World ReCiPe H / Characterisation

Figure 6.60 — *Recycled plastic frames (green) perform better than conventional ones (red)*

though that the differences could be even higher had this alteration of the data been done with more knowledge. This way, only the PVC values were changed, but not the other elements of the window frame assembly, which could have significantly more negative environmental impacts.

D Use phase

In order to determine the environmental impacts that occur during the use phase of the house, various consumption and production values were considered. The numbers were estimated and calculated for a year and then multiplied by 50, to account for the lifetime of 50 years of the building. This seems like a simplified approach, as situation in house might change: from very easy changes in occupation to hard to predict changes in technology. Yet, at this point, this is the most straightforward approach and it was recommended to do so to all teams of the competition, which will allow for a fair comparison in the end.

Figure 6.61 lists the heating, cooling, lighting, sanitary hot water, ancillaries and specific electricity consumption and the energy production for one year. The water consumption is described in chapter 6.8.

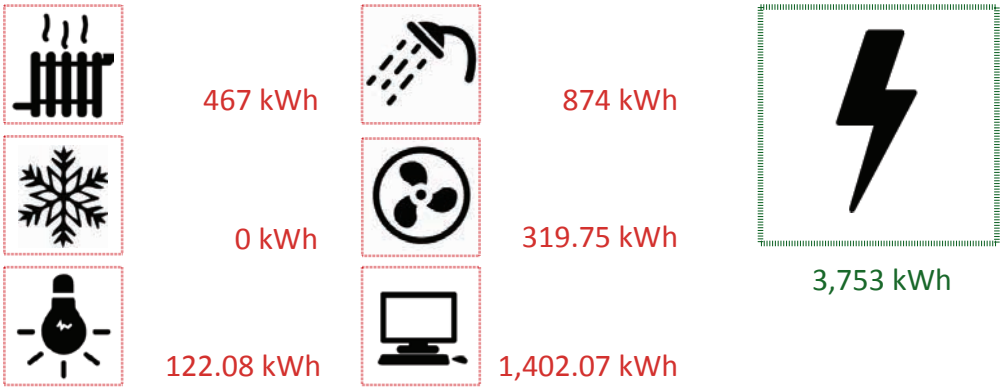
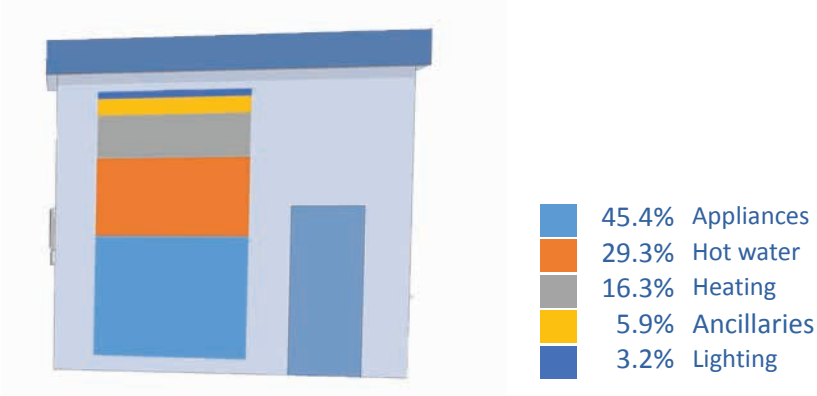


Figure 6.61 — *Energy production (green) outweighs energy consumption (red)*

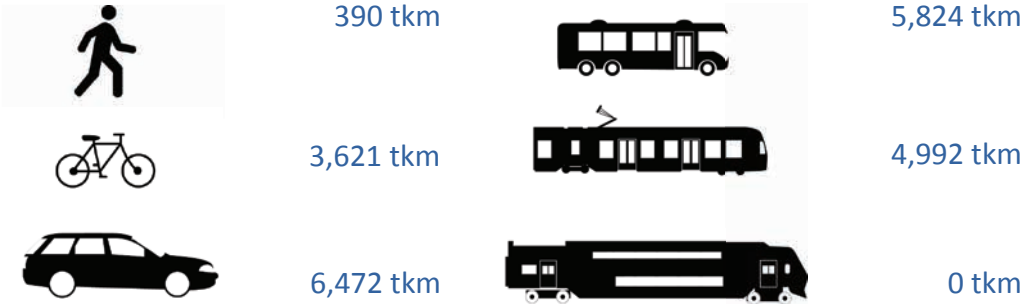
Figure 6.62 — *Energy consumption shares*



E Transport of Users

In order to integrate the transport of users, a family persona for the case study was developed that was used in other parts of Prêt-à-Loger's assessments as well, e.g. lighting analysis. This family persona incorporated the residents of the house as well as occasional users, such as relatives and friends of the family. Figure 6.63 illustrates the distances travelled for walking, biking, car, tram, train, bus in pkm per year. Unfortunately, the "operation of a bicycle" is not in the utilized ecoinvent database, which is why it could not be included in SimaPro.

Figure 6.63 — *Users transported with different means*



6.10.2 Findings

While the above presented information and figures already provide a good insight into the contributors of environmental impacts, more specific analyses were carried out to quantify the impacts. In fact, three different methods were utilized in the SimaPro programme. Two of these methods 'Cumulative Energy Demand' (CED) and 'IPCC GWP 100a' were already explained, along with an analysis of the materials in chapter 6.5. Here, these methods were applied to the building, assembly F, as a total. In addition the ReCiPe Midpoint method was conducted.

ReCiPe Midpoint Method

The ReCiPe Midpoint method, with multi score indicators, was conducted for assembly F, the house, for the lifetime of 50 years. Not all of the single indicators are directly comparable with each other, since they are measured in different units. Therefore, all of them are presented without claiming that one is worse than the other just because their bar is higher. Figure 6.64 depicts the findings of the analysis with the 18 indicators. Looking more closely at one the indicators, namely climate change, it becomes evident that the influence from operating a personal car, really is the biggest contributor in the case study (figure 6.65).

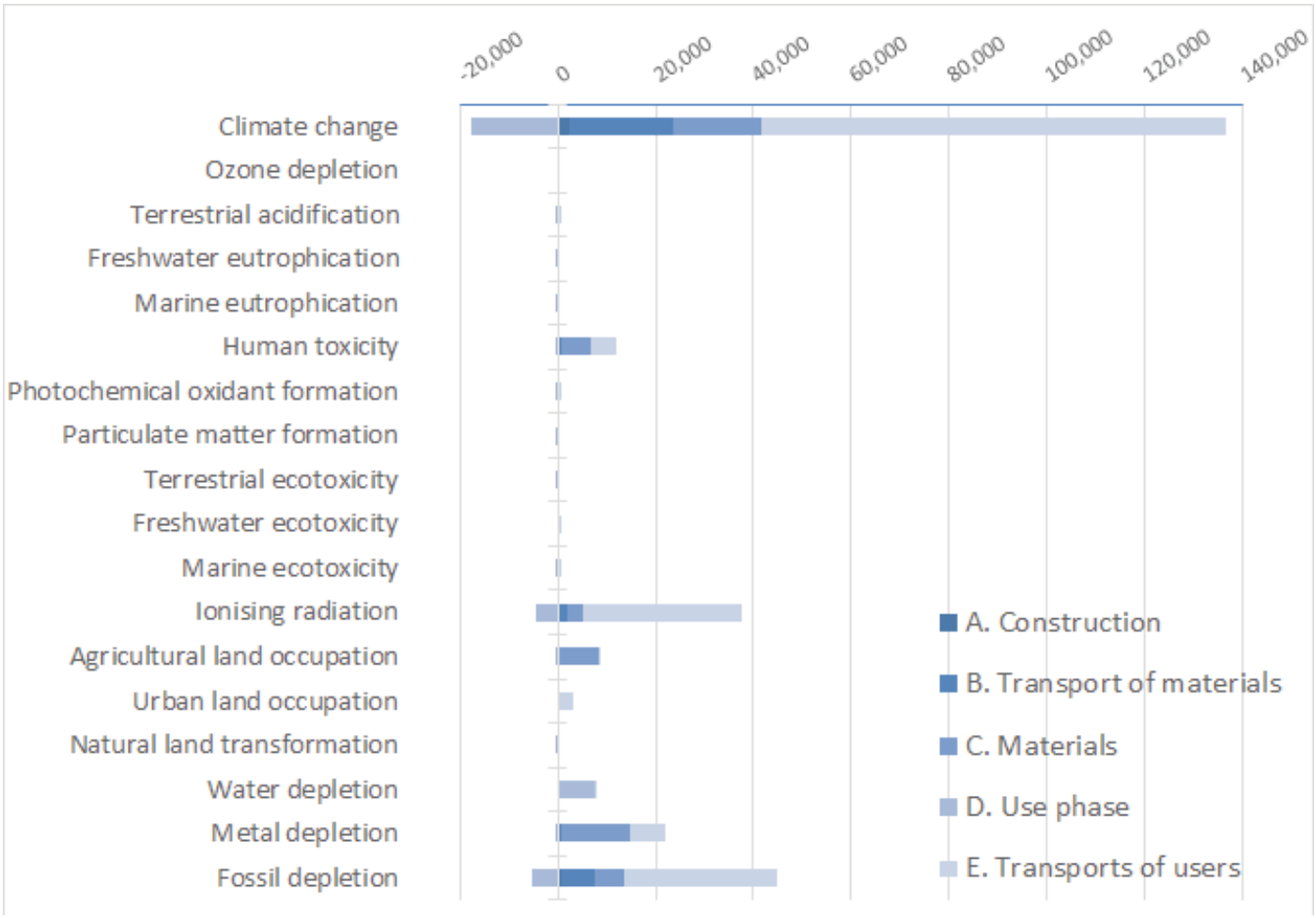
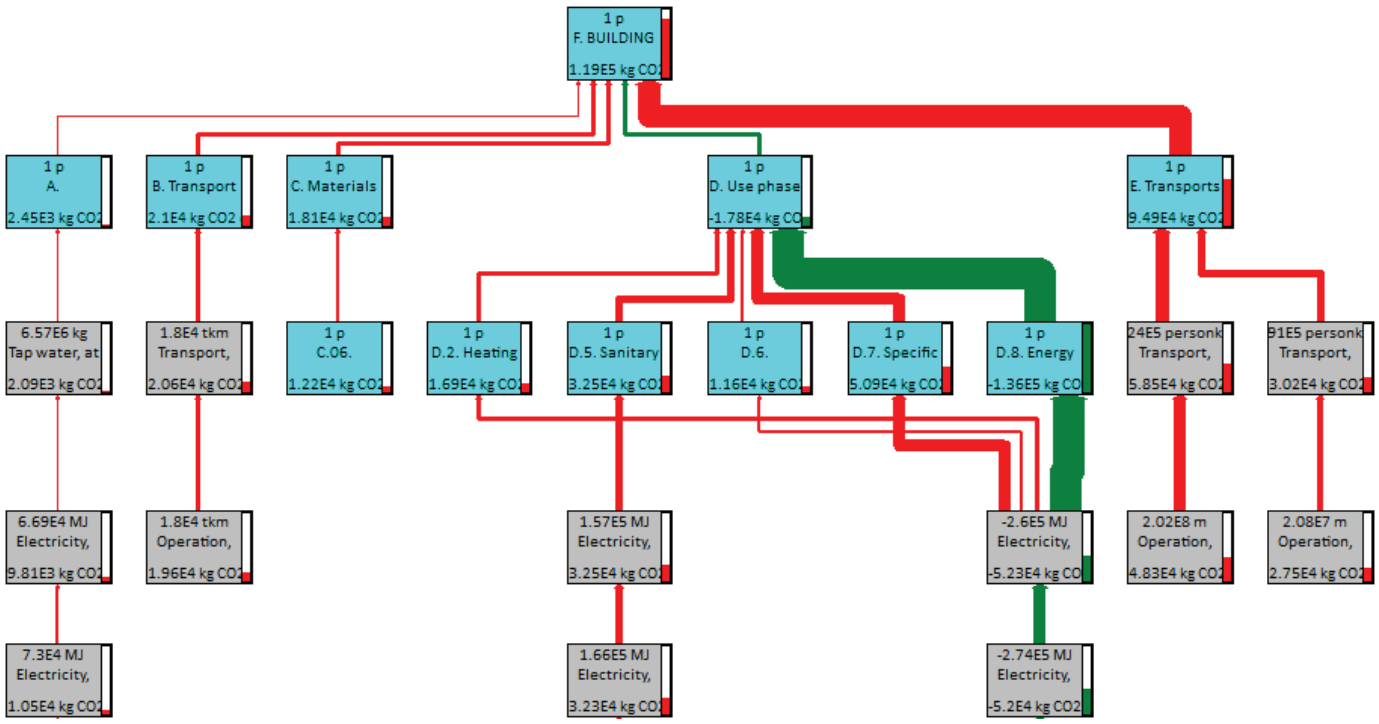


Figure 6.64 — *The 18 indicators of ReCiPe Midpoint method*

Figure 6.65 — *Climate change indicator*



Again, the CED was already performed for the materials (assembly C), see chapter 6.5. Figure 6.66 depicts the CED for the total building, from cradle to grave over the lifetime of 50 years. It can be seen that the total energy demand is 2,201,677.62 MJ eq. Transport of users accounts for the biggest share with 80.6%. The second biggest contribution is from the materials with 16.5%. The negative value of -301,662.12 MJ eq that can be seen in the use phase, represents the energy generation from the photovoltaic panels. Clearly, the energy produced over 50 years balances out the energy needs in the use phase. Moreover, it almost makes up for the energy that went into producing the materials.

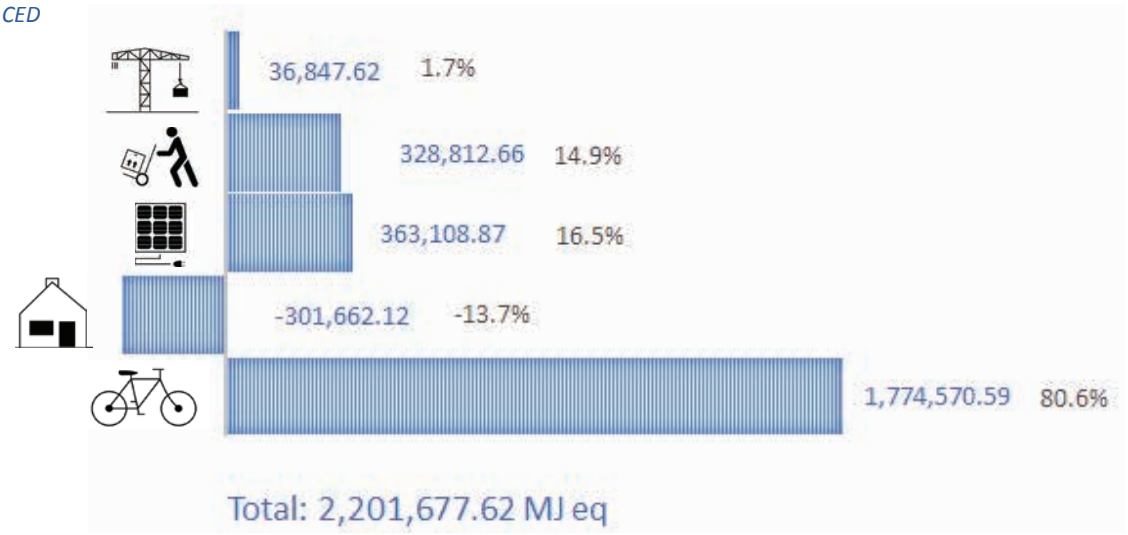
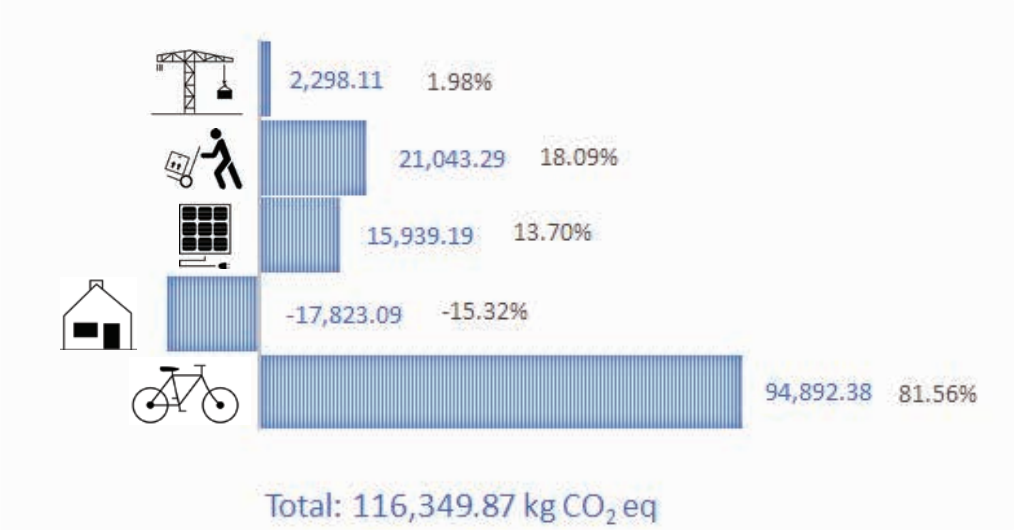


Figure 6.66 — *CED analysis*

IPCC GWP 100a

The other single score indicator that was considered is the IPCC GWP 100a. Looking only at the CO_2 eq emissions, it was found that 116,349.87 kg CO_2 eq were produced for F, figure 6.67. Clearly, the biggest contributor comes from the transport of the users (81.56%). There, personal car use would have to be reduced in order to decrease the emissions and the energy demand (previous paragraph). Alternatives for transport have been described in chapter 6.2, suggesting that taking an electric car or car sharing are viable options. Lastly, it could be argued again that the emissions avoided in the use phase balance out the CO_2 emissions of the materials.

Figure 6.67 — *IPCC GWP 100a analysis*



6.10.3 Conclusion

After conducting this extensive assessment, the various environmental impacts of the house can now be better understood. Furthermore, it is possible to conduct a comparative analysis with similar solutions or even houses. Here, a comparison was made between the average Dutch family consumption numbers that have been presented in chapter 6.1 and the improved situation (figure 6.68).

Finally, the close the loop of information and to summarize the findings, it can be said that even though Prêt-à-Loger attempted to strive for the best and most feasible solutions on all levels of sustainability – while maintaining a balance between these – there is still room for improvement. This is inevitable as interests, preferences and technologies change over time. However, compared to the existing situation that the house is in now, Prêt-à-Loger's 'Home with a Skin' makes many good steps in the right direction towards a sustainable future.

Figure 6.68 — *Consumption of 'Home with a Skin'*





1,374 kg/year

- 51.8% Residual waste
- 21.3% Vegetable / fruit
- 14.0% Old paper
- 5.6% Bulky waste
- 4.6% Glass
- 1.0% Electrical app.
- 0.8% Textiles, clothing
- 0.4% Plastic
- 0.3% Chemical waste



160.3 m^3/year

- 63.9% Sanitary
- 25.0% Kitchen
- 9.1% Washing machine
- 1.4% Exterior consumption
- 0.6% Cleaning premises



3,185 kWh/year

- 45.4% Appliances
- 29.3% Hot water
- 16.3% Heating
- 5.9% Ancillaries
- 3.2% Lighting

ACM. 2005. DTe: Verplicht stroometiket op elektriciteitsafrekening. https://www.acm.nl/nl/publicaties/publicatie/5681/DTe-Verplicht-stroometiket-op-elektriciteitsafrekening/. [Accessed 01 March 2014].

ADALBERTH, K. 1997. Energy use during the Life Cycle of Single-unit dwellings: Examples. *Building and Environment,* 32**,** 321-329.

Afval | Omgeving en Veiligheid | Wonen en Leven | Gemeente Westland. 2014. Afval | Omgeving en Veiligheid | Wonen en Leven | Gemeente Westland. https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/. [Accessed 25 February 2014].

AGRIHOLLAND. 2013. *dossier Kassenbouw* [Online]. Available: http://www.agriholland.nl/dossiers/kassenbouw/home.html [Accessed 14 April 2014].

Almusaed, A. 2011. Biophilic and Bioclimatic Architecture. 431pg. http://www.scribd.com/doc/51220249/Biophilic-and-Bioclimatic-Architecture. [Accessed 25 April 2014].

AQUA-CALC. n.d. *Volume to Weight conversion* [Online]. Available: http://www.aqua-calc.com/calculate/volume-to-weight [Accessed 14 April 2014].

Biobase Westland, 2011. Biobase cluster van de Westland Agenda 2011. [Online] Available at: http://www.gemeentewestland.nl/fileadmin/files/Typo/Wonen%20en%20leven/Duurzaamheid%20en%20milieu/Visiedocument_Biobased_Westland.pdf. [Accessed 1 March 2014].

Bosschaert, T. 2009. Energy and cost analysis of double and triple glazing. http://www.except.nl/consult/TripleGlazingStudy/Energy%20and%20cost%20benefit%20analysis%20of%20double%20and%20triple%20glazing.pdf. [Accessed 26 February 2014].

CBS. 2011. Press release. http://www.cbs.nl/NR/rdonlyres/C1E3428E-C8DE-4D3B-A81F-8420F5ECDCB0/0/PB11e057.pdf. [Accessed 22 April 2014].

CBS, 2014. Huishoudelijk afval per gemeente per inwoner. [Online] Available at: http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=80563NED&D1=0&D2=499&D3=a&HDR=G2,T&STB=G1&CHARTTYPE=1&VW=T. [Accessed 1 March 2014].

CBS - Hoeveel huishoudelijk afval wordt er jaarlijks per inwoner geproduceerd? - Vragen over dit thema. 2014. CBS - Hoeveel huishoudelijk afval wordt er jaarlijks per inwoner geproduceerd? - Vragen over dit thema. http://www.cbs.nl/nl-NL/menu/themas/natuur-milieu/faq/specifiek/faq-vraag-huishoudelijk-afval-pub.htm. [Accessed 01 March 2014].

CBS StatLine - Huishoudelijk afval per gemeente per inwoner. 2014. CBS StatLine - Huishoudelijk afval per gemeente per inwoner. http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=80563NED&D1=0&D2=499&D3=a&HDR=G2,T&STB=G1&CHARTTYPE=1&VW=T. [Accessed 01 March 2014].

CBS StatLine - Huishoudelijk afval per gemeente per inwoner. 2014. CBS StatLine - Huishoudelijk afval per gemeente per inwoner. http://statline.cbs.nl/StatWeb/publication/default.aspx?DM=SLNL&PA=80563NED&D1=1-2%2c4-8%2c10-12%2c14%2c24&D2=499&D3=a&HDR=G1%2cT&STB=G2&VW=D. [Accessed 01 March 2014].

Digitaal Loket | Gemeente Westland. 2014. Digitaal Loket | Gemeente Westland. https://www.gemeentewestland.nl/nc/digitaal-loket/inhoud/afvalstoffenheffing/. [Accessed 02 March 2014].

Eco-metal. 2014. Metal recycling. http://www.eco-metal.eu/en/cases/metal_recycling/. [Accessed 14 April 2014].

EIA. 2013. *Frequently Asked Questions* [Online]. U.S. Energy Information Administration,. Available: http://www.eia.gov/tools/faqs/faq.cfm?id=307&t=9. [Accessed 14 April 2014].

Edenhofer, O., Madruga, R. P., & Sokona, Y. 2012. Renewable Energy Sources and Climate Change Mitigation. Cambridge: IPCC.

Elferink, E. & Vlaar, L., 2010. Compost, Carbon en Credits: Een verkennede discussienota CLM Onderzoek. [Online] Available at: http://www.clm.nl/publicaties/publicaties-2006-2011. [Accessed 2 March 2014].

ENERGY EFFICIENCY CENTRE. 2014. *Diesel Generator* [Online]. Available: http://eec-fnc-ci.org/content-learn-dieselgenerator#content-learn-energyefficiency_dieselgenerator [Accessed 14 April 2014].

Engineering Toolbox. 2014. Carbon Dioxide Emission from People. http://www. Engineeringtoolbox.com/co2-persons-d_691.html. [Accessed 24 April 2014].

FEIN. 2014. *DSke 672* [Online]. Available: http://www.fein.nl/nl_nl/boren/boormachine/dske-672-09388/# [Accessed 14 April 2014].

FORMOSO, C. T., SOIBELMAN, L., CESARE, C. D. & ISATTO, E. L. 2002. Material Waste in Building Industry: Main Causes and Prevention. *JOURNAL OF CONSTRUCTION ENGINEERING AND MANAGEMENT,* 128**,** 316-325.

Fraunhofer. 2013. Photovoltaics Report: Fraunhofer Institute.

Gemeente Westland, 2014. Afval. [Online] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/. [Accessed 25 February 2014].

Gemeente Westland, 2014. Afvalstoffenheffing. [Online] Available at: https://www.gemeentewestland.nl/nc/digitaal-loket/inhoud/afvalstoffenheffing/. [Accessed 2 March 2014].

Gemeente Westland, 2014. Bij mij in de buurt. [Online] Available at: https://www.gemeentewestland.nl/actueel/bij-mij-in-de-buurt/. [Accessed 20 April 2014].

Gemeente Westland, 2014. Elektrische apparaten. [Online] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/elektrische-apparaten/. [Accessed 20 April 2014].

Gemeente Westland, 2014. GFT. [Online] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/groente-fruit-en-tuinafval-gft/. [Accessed 2 March 2014].

Gemeente Westland, 2014. Grofvuil. [Online] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/grofvuil/. [Accessed 20 April 2014].

Gemeente Westland, 2014. Grofvuil brengen of laten ophalen. [Online] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/grofvuil/grofvuil-brengen-of-laten-ophalen/. [Accessed 20 April 2014].

Gemeente Westland, 2014. Kleding, textiel en schoenen. [Online] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/kleding-textiel-en-schoenen/. [Accessed 20 April 2014].

Gemeente Westland, 2014. Klein chemisch afval kca. [Online] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/klein-chemisch-afval-kca/. [Accessed 20 April 2014].

Gemeente Westland, 2014. Oud-papier. [Online] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/oud-papier/. [Accessed 20 April 2014].

Gemeente Westland, 2014. Plastic Heroes. [Online] Available at: http://www.plasticheroes.nl/gemeente/westland. [Accessed 19 April 2014].

Gemeente Westland, 2014. Restafval. [Online] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/restafval/. [Accessed 19 April 2014].

Gemeente Westland, 2014. Veelgestelde vragen kunstof verpakkingsafval. [Online] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/plastic-afval/veelgestelde-vragen-kunstof-verpakkingsafval/. [Accessed 20 April 2014].

Gemeente Westland, 2014. Wist u datjes gft-afval. [Online] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/groente-fruit-en-tuinafval-gft/wist-u-datjes-gft-afval/. [Accessed 2 March 2014].

Gemente Westland, 2014. Glas. [Online] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/glas/. [Accessed 20 April 2014].

GREYWATER ACTION. n.d. About greywater use [Online]. Available: http://greywateraction.org/content/about-greywater-reuse [Accessed 14 April 2014].

Groente-, Fruit- en Tuinafval (GFT) | Afval | Omgeving en Veiligheid | Wonen en Leven | Gemeente Westland. 2014. Groente-, Fruit- en Tuinafval (GFT) | Afval | Omgeving en Veiligheid | Wonen en Leven | Gemeente Westland. [ONLINE] Available at: https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/groente-fruit-en-tuinafval-gft/. [Accessed 02 March 2014].

Hildebrand, L. 2014. Better a new façade than a new building. http://www.bk.tudelft.nl/en/current/latest-news/article/detail/beter-een-nieuwe-gevel-dan-een-nieuw-gebouw/. [Accessed 07 April 2014].

Hoekstra, A. Y., Chapagain, A. K., Aldaya, M. M., Mekonnen, M. M. (2011). The water footprint assessment manual: Setting the global standard.

JAILLON, L. & POON, C. S. 2008. Sustainable construction aspects of using prefabrication in dense urban environment. *Construction Management and Economics,* 26**,** 953-966.

National Renewable Energy Laboratory. (2004). PV FAQs. Available: http://www.nrel.

gov/docs/fy04osti/35489.pdf. [Accessed 01 March 2014].

KIM. 2014. *Kennisinstituut voor Mobiliteitsbeleid (KiM)* [Online]. Available: http://www.kimnet.nl/ [Accessed 14 April 2014].

KNMI 2014. Maandelijkse stationsneerslag 2013. Available: http://www.knmi.nl/klimatologie/monv/ascii/monv_201313.txt. [Accessed 14 April 14].

KNMI. 2013. Jaaroverzicht neerslagen verdamping in Nederland. Available: http://www.knmi.nl/klimatologie/monv/pdf/monv_201313.pdf. [Accessed 02 March 14].

Kristinsson, J. 2012. Integrated Sustainable Design. Delft/Deventer. p. 162.

Lente Akkoord. 2013. Drievoudig glas en geïsoleerde kozijnen. http://www.lente-akkoord.nl/wp-content/uploads/2013/12/lente-akkoord-factsheet-drievoudig-glas.pdf. [Accessed 01 March 2014].

LETSGOGREEN.COM. 2014. Greywater Recycling Basics [Online]. Available: http://www.letsgogreen.com/greywater-recycling.html [Accessed 14 April 2014].

Milieubarometer, 2011. Milieubarometer. [Online] Available at: http://www.milieubarometer.nl/uploads/files/CO2_factoren_2010,_mei_en_juni_2011_dd_26_juni_2011_NL.pdf. [Accessed 2 March 2014].

MOBILITEITSBELEID, K. V. 2011. Mobiliteitsbalans 2011. *In:* MILIEU, M. V. I. E. (ed.).

Overheid. 2007. Besluit lozing afvalwater huishoudens. http://wetten.overheid.nl/BWBR0022910/. [Accessed 02 March 2014].

PENG, W. & PHENG, L. S. 2011. Lean and green: emerging issues in the construction industry – a case study. *EPPM Conference.* Singapore.

Plastic Heroes, 2014. Plastic Heroes. [Online] Available at: http://www.plasticheroes.nl/faq-page#t4n2134. [Accessed 20 April 2014].

Projectgroep vergisting / Biobase cluster van de Westland Agenda 2011, Biobase Westland, Gemeente Westland. http://www.gemeentewestland.nl/fileadmin/files/Typo/Wonen%20en%20leven/Duurzaamheid%20en%20milieu/Visiedocument_Biobased_Westland.pdf. [Accessed 25 February 2014].

Resource Conservation - Composting for Facilities Basics | Wastes | US EPA. 2014. Resource Conservation - Composting for Facilities Basics | Wastes | US EPA. http://www.epa.gov/composting/basic.htm. [Accessed 01 March 2014].

RIONED. 2009. Riool [Online]. Available: http://www.riool.info/home [Accessed 14 April 2014].

SenterNovem, Uitvoering Afvalbeleid 2008, Achtergronddocument Uitwerking “Gescheiden ingezameld groenafval” Ontwerpversie, Landelijk Afvalbeheerplan. http://www.lap2.nl/sn_documents/files/04%20LCA-LAP2/LCA_groenafval_achtergronddocument_ontwerpversie.pdf. [Accessed 25 February 2014].

SenterNovem, 2008. Gescheiden ingezameld. [Online] Available at: http://www.lap2.nl/sn_documents/files/04%20LCA-LAP2/LCA_groenafval_achtergronddocument_ontwerpversie.pdf. [Accessed 2 March 2014].

Tam, C. M., Tam, V. W. Y., Chan, J. K. W., Ng, W. C. Y. 2005. Use of Prefabrication to Minimize Construction Waste – A Case Study Approach. In: The International Journal of Construction Management, pp. 91-101.

Tripathi, B. D. & Shukla, B. D. 1990. Biological Treatment of Wastewater by Selected Aquatic Plants, Banaras Hindu University, India.

Van Vliet Contrans, 2011. Van Vliet Contrans. [Online] Available at: file:///C:/Users/Marie-Louise/Downloads/Duurzaamheidsverslag_2011%20(4).pdf. [Accessed 19 April 2014].

VinyLoop. 2012. VinyLoop: Smart Recycling – Low Footprint. http://www.vinyloop.com/images/doc/wp/VinyLoop_A4_ENG.pdf. [Accessed 25 April 2014].

Vlakglas Recycling. 2014. Vlakglasrecycling Nederland. http://www.vlakglasrecycling.nl/index.php?page=home-en. [Accessed 21 April 2014].

WCL. n.d. *Compact kraan* [Online]. Available: http://www.willemscompactlifting.nl/index.php/compact-kraan [Accessed 14 April 2014].

Wise. 2014. Oxxio | Hollandse Groene Stroom? Ja Graag!. http://www.groenestroomjagraag.nl/stroometiket/oxxio. [Accessed 02 March 2014].

Wise. 2014b. Essent | Hollandse Groene Stroom? Ja Graag!. http://www.groenestroomjagraag.nl/stroometiket/essent-0. [Accessed 02 March 2014].

Wise. 2014c. RWE | Hollandse Groene Stroom? Ja Graag!. http://www.groenestroomjagraag.nl/stroometiket/rwe. [Accessed 02 March 2014].

Wist u datjes gft-afval | Groente-, Fruit- en Tuinafval (GFT) | Afval | Omgeving en Veiligheid | Wonen en Leven | Gemeente Westland. 2014. Wist u datjes gft-afval | Groente-, Fruit- en Tuinafval (GFT) | Afval | Omgeving en Veiligheid | Wonen en Leven | Gemeente Westland. https://www.gemeentewestland.nl/wonen-en-leven/omgeving-en-veiligheid/afval/groente-fruit-en-tuinafval-gft/wist-u-datjes-gft-afval/. [Accessed 02 March 2014].

Zelf composteren | Milieu Centraal. 2014. Zelf composteren | Milieu Centraal. http://www.milieucentraal.nl/themas/afval-heb-je-zelf-in-de-hand/zelf-composteren. [Accessed 02 March 2014].

7 Communications Plan

7.1 Communications Project

7.1.1 Abstract

Prêt-à-Loger analyzed that the dutch building stock is growing at a very slow rate of 1% every year which lead to focusing on existing buildings, in particular the post-war row houses which have a poor energy rating. The objectives that were identified involving the communication of this project were to deliver the message that the existing building stock in the Netherlands can be made ecologically and socially sustainable. This will be achieved actively by means of dissemination through events, the press, internet, brochures, newsletters, radio and television; and passively by providing information through the team's own web page and social media. The other objectives are to work as effectively as possible as a team and to challenge the status quo that old buildings need to be demolished to make room for the new. The vision to transform existing neighbourhoods into sustainable communities while maintaining the quality and atmosphere of a home that has been built up over the course of time by its inhabitants can be summed up in the motto "Improve your house, preserve your home". The groups at which the communication will be targeted are dutch housing corporations, individual home owners, communication media and the general public. An action plan was conceived for the time period leading up to the Solar Decathlon Event in 2014 and entails events and communication strategies that have been suited for the scale of the TU Delft, the city of Delft, the Netherlands and the international stage and include events within Delft and Honselersdijk, the dissemination of information through local and national media and international websites. During the event, a public tour will be organized for visitors of the 'Home with a Skin'. The house will be presented in such a way as to convey the atmosphere of a Dutch family home rather than a sustainability pavilion. Essentially, a slice of the existing neighbourhood will be represented in Versailles as a slice of home.

7.1.2 Analysis of the Situation

In the Netherlands the building stock increases with around 60,000 houses annually since 2010. Before that, average growths would be ranging from 75,000 to 85,000 a year. Since we now have over 7 million dwellings in the Netherlands, this means that the increase of the building stock is not even 1% of the total, every year (CBS, 2013). Even less since the economic crisis of 2008. Focussing energy reducing measures on new construction is therefore not beneficial for our future. This is why we decided to do our research on existing dwellings in the Netherlands.

In order to have a clear idea of the context in which the project is operating, we need to analyse the current situation. Therefore we analysed the current state of the building stock in the Netherlands, in terms of typology, age, energy efficiency and ownership.

SenterNovem did research on these topics. They divided the existing dwellings up untill 2000 in roughly 4 categories:

1. Detached
2. Semi-detached
3. Row houses
4. Apartments

These main categories were subdivided in a total of 27 categories, defined by more specific typologies and construction periods. The statistics showed that the current building stock in the Netherlands is dominated by row houses and apartments. Row houses make up 42% of the total amount of dwellings in the Netherlands, which means we have almost 3 million row houses.

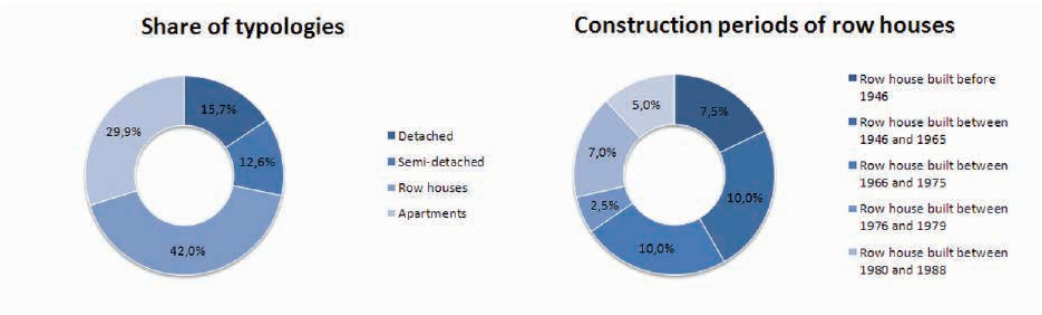


Figure 7.1 — *Housing typologies and Construction of row houses*

The problem is that a huge amount of these dwellings have low energy efficiency, since they have sprung from a post-war housing shortage which demanded fast-to-build, but unfortunately also energy-intensive housing. The dwellings from this period take up 20% of the total amount of dwellings in the Netherlands, which is more than 1.3 million dwellings. They are build from 1946 till 1975 and they all have roughly the same dimensions, which makes them ideal for large-scale renovation purposes.

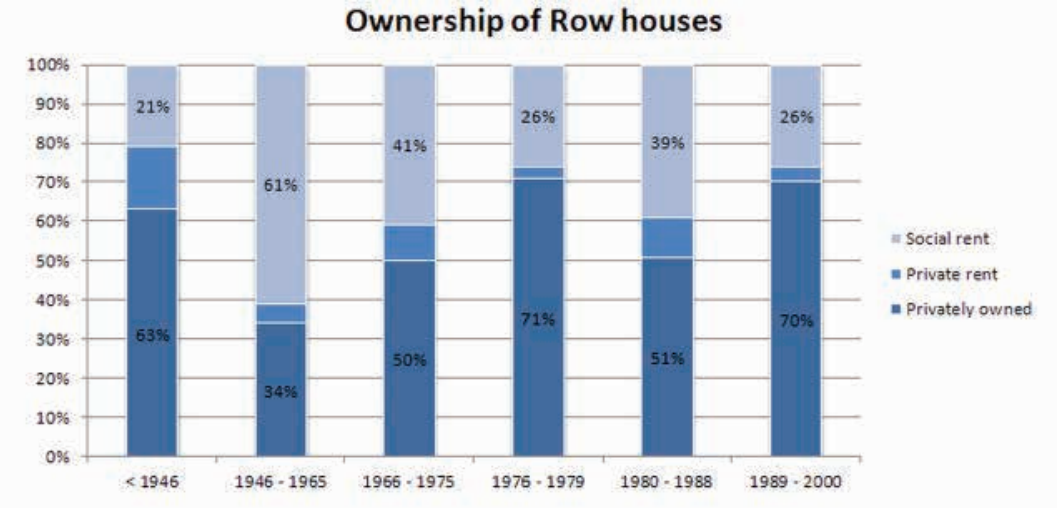
Dwellings from this period have an average energy label of E. With this rating they are among the worst performing houses in the Netherlands. All dwellings of the same construction period perform better than row houses from these periods. In comparison to row houses from other periods in the Netherlands, they also perform bad, as can be seen in the table below. The average gas usage of these dwellings is also high in comparison to the other dwellings in general. All in all, they are energy-inefficient and desperately need an upgrade.

Category	Energy label (average)	Average gas usage in m3/year
Row house built before 1946	E	1.896
Row house built between 1946 and 1965	**E**	**1.776**
Row house built between 1966 and 1975	**E**	**2.056**
Row house built between 1976 and 1979	D	1.607
Row house built between 1980 and 1988	D	1.417
Row house built between 1989 and 2000	C	1.100

Figure 7.2 — *Energy rating of houses by year of construction*

The current stock of row houses is mostly privately owned as can be seen in the diagram below. A very small amount is private rent, and a large portion is social rent, which is handled by housing corporations. What is striking is that the construction periods that we chose as focus points have the biggest parts of social rent and a relatively smaller portion of privately owned dwellings compared to the other periods.

Figure 7.3 — *Ownership of row houses by year of construction*



7.1.3 Definition of Communications Objectives

Getting our message across to the biggest public possible

With the selection of the row-house as our housing typology for this competition and beyond, we are automatically dealing with a mass market supply of over two million homes in the Netherlands. Since our message (*Improve your house. Preserve your home.*) deals with the evolution of existing communities in the Netherlands, our potential stakeholders form a huge portion of the general public. We must reach people who are: 1) already living in such homes because they are the ultimate beneficiary of our design intervention and 2) are interested in moving into such homes because they will be the most likely to have the buying-power and the motivation to retrofit an existing house before they move in and 3) housing corporations and municipalities interested in making existing communities sustainable (see 'Identification of the Target Groups' for details). The two main ways in which this objective can be reached are:

a. Seek publicity on events and press so that we increase the audience we reach

1. Actively approaching media channels for the dissemination of our message and progress of our project.

These media include websites, journals, magazines, newspapers relating to topics of architecture, real estate, engineering, sustainability, municipalities etc. Radio and Television programmes that are particularly concerned with the social aspect of our design. Events and fairs where members of our team can physically be present to promote our idea and our design in person. In the past, such events have included the Ecobouw and Solar Event exhibition. Special mention should be given to the Partners' event hosted at the TU Delft Faculty of Architecture in February to officially 'kick-off' the working relationship with our new sponsors and launch with a new, more contextualized visual iden-

tity (see Visual Identity manual) and positivity into the final stages of the competition. Actions such as the Honselersdijk event (name of the neighbourhood where our house is situated) are planned where we will have the opportunity to gain more feedback from a larger group of residents of the community.

2. Provide effective sources of information for parties interested in our cause (passive)

Within the time and budget constraints of our team of students, it is our goal to make the most use out of the available media channels. These include social media sites: Facebook, Twitter, Linkedin and our own team website. By keeping these channels up-to-date and promoting them constantly, our target groups can keep themselves informed with very little effort from their part. To stay up-to-date, Interested parties will also be able to subscribe to our monthly newsletter via our website.

	Events	Press	Websites	Newsletters	Brochures	Radio	Television
Active	Honselersdijk event, Solar event, Masters event, Zomerfestival, Engineers without borders workshop, Partners' event, RISS Rotterdam school presentation, C2C Workshops	Local Newspapers, Journals and magazines concerned with: Architecture, Urbanism, Sustainability, Interiors	Websites concerned with Architecture, Urbanism, Sustainability and Interiors, Engineering, Photovoltaics, refurbishments and restorations	Monthly newsletters sent to interested parties who want to be up-to-date with the progress of our project. Examples include all team members, faculty advisors, Advisory Committee, Partners and associates	Brochures available at events to provide basic information on our project or aspects thereof.	Broadcast an interview with a PaL team leader on a local radio station.	Televise a short story about the Dutch row-house, its sustainable intervention and the competition in Versailles.
	Social Media	Contact Info		Diversification	Uniforms & Merchandising	Audiovisual	Imagery & Brand Identity
Passive	Social media networks: Facebook, Twitter, Linked In, Youtube/Vimeo to keep people informed and up-to-date. Live tweets from events and meetings.	Provision of contact details of relevant persons on the Prêt-à-Loger website incl. telephone, address, email etc.	Prêt-à-Loger website, TU Delft website providing all relevant information for (potential) partners, press, interested parties.	Prêt-à-Loger very own football team 'Prêt-à-Goler' to compete in the university-internal football league. Documentation of successes on video and shared in social media channels.	Uniforms, clothing styles and merchandising can be effective ways to subconsciously convey our message. eg. via use of logo prints on clothing and household items that can be sold or given away at events.	A consistent production of videos documenting events and/or the progress of the team to be shared on youtube/vimeo	A consistent graphical 'language' and color scheme that follows through in all images, documents, printed articles, the website etc.

Figure 7.4 — *Pecha-Kucha - a presentation style with a strict and limited number of slides and minutes per presenter*

b. Work effectively as a team

Internal communication

Core-team meetings: Increased effectivity in the team can be achieved by knowing who is doing what and by when it needs to be done. Regular weekly Core-Team meetings (documented in minutes) give everyone involved an update on the status of each part of the team so that final decisions can be made in these meetings.

Pecha-Kucha presentations: with a team of over 50 students with different academic schedules, it becomes increasingly difficult to keep all members involved and up-to-date. Monthly 'pecha-kucha-style' presentations by each team leader are organized where all team members must attend. This is an opportunity to give and receive feedback on the work done and enables each team member to see how his/her work effects the project on a whole.

Pressure-cookers: mostly for the different design-teams and partners, these meetings are designed to be intensive workshops in which decisions can be made as all involved parties are present with the goal of achieving specific results at the end of the day. These have proven to be a very intense but also fun and effective way of working together.

To ensure a level of uniformity and clarity in our message, the marketing team which includes Internal/External communications, Partnerships, Website, Press and Events should be in charge of all external communication. This means that inquiries, should they be directed any other team members, will be diverted to members of the communications team who will be well-equipped and prepared to deal with any demands from external parties. These members will receive a certified media training by a professional in the field and will have regular contact to a university communications advisor.

c. Challenging the Status-quo

An old product, at the end of its life cycle is typically discarded and replaced with a newer model with little thought given to the fact that much of it is still functionable. Similarly, the idea that an 'old building' needs to be demolished and replaced by something new must be challenged. With the technical prospect of transforming existing neighbourhoods into sustainable communities we open a window of opportunity that is promising on a social, environmental and financial level. But for this to happen, governments, the media and consumers need a change of perspective on the current building stock. We aim to provide that new perspective. Our motto *"Improve your house. Preserve your home."* reflects this attitude.



Figure 7.5 — *The scope of the Marketing team*

7.1.4 Our Message

Who we are:

Prêt-à-Loger - Prêt-à-Loger which means “ready-to-live” is an international team of students of the TU Delft participating in the Solar Decathlon Europe 2014, promoting the enhancement of existing Dutch row houses and the preservation of Dutch homes. We see ourselves very much as a down-to-earth group of people who are out to make a difference in this world.

What we do:

Home with a Skin - Design and build an energy neutral pavilion for the Solar Decathlon 2014 in Paris that is based on an existing Dutch row-house. Special emphasis is given to the narrative of the social aspect of the community and the idea of what makes a house into a home.

What we believe:

“Improve your house. Preserve your home.” - Central to our belief is the message that we provide a toolbox that improves peoples houses, adding to them a new living quality that extends from the private gardens to the public street without disrupting the lives of the residents. Our motto clearly distinguishes between the words ‘house’ and ‘home’. A house is an anonymous set of spaces capable of supporting life. A home is one where life has ‘weathered’ itself over time into every detail giving reference to the current and often previous inhabitants.

Our Vision:

Existing neighbourhoods around the Netherlands transforming themselves into sustainable, healthy, vibrant communities at the hands of the people who inhabit them. The sharing of resources (energy, food, water) between neighbours, strengthening the communal bond and encouraging an interaction on the street level through the creation of public space.

Our Mission:

Our primary message is directed at housing corporations who have the resources to transform entire streets at a time rather than approaching individuals and families living in row houses one by one (see 7.5 Identification of the Target Groups for details). By creating a design that is modular and adaptable to various row houses, we provide options to individual (and potential) homeowners. By disseminating our idea and progress through the different media channels and organizing events in which we can spread our message we are creating a demand for such an intervention from the end users that can simultaneously be used to support our case to housing corporations.

Our message therefore needs to be adapted according to the target group. So for homeowners (the ultimate end-users) this would be: Imagine what it would be like to live in a sustainable community. And for housing corporations: Imagine how many existing homes can be sold that were previously planned for demolition.

7.1.5 Identification of Target groups

The main target group of the project is housing corporations. These are funded by the government and focus on building, maintaining and renting out living space (social housing). The work of housing corporations is regulated in the 'Besluit beheer sociale-huur-sector', which means 'Resolution management social rent-sector'. Housing corporations have six main focal points:

1. Housing quality
2. Housing rent
3. Involvement of residents in policy and management
4. Financial continuity
5. Quality of life
6. Living and care

The advantages of housing corporations is that they usually own a whole row of houses or even a neighbourhood. They own a third of all the houses in the Netherlands. They have most of their houses in the urban areas and big cities, called 'de Randstad', most of the owned houses of housing corporations are clustered together in neighbourhoods and dwelling blocks (CBS, 2011). By cooperating with them, our products can be implemented within a whole community instead of a single building. The residents in the community will have a sense of connection and belonging and they can share their experiences together. By addressing housing corporations, we are also indirectly addressing the tenants which rent their house from these corporations, which is a large group.

Our second target group are individual homeowners. This is a difficult group since every homeowner has a different mindset about renovation, sustainability and also budget. Maybe through collective groups of owners they can be a target group for this project on the long term. A leasing construction through a company could also be an option to make sure it is financially feasible for an individual homeowner to renovate his dwelling.

Another target group is the communications media. They will have interest to release information on the project and they should be provided with information suited for the medias public. Therefore, every request for information is handled differently, but the core message stays the same and is based on the teams mission and goals. The aspects that change are the images and the text accompanying them. Since communications media can be local and national newspapers, professional magazines, internet blogs etc, the amount of technical explanations and imagery can differ per type of media.

The last target group is the biggest and most versatile, it incorporates children, professionals from the building industry and the general public. They will all have interest in the project sooner or later and we will be ready to provide them with proper information. For professionals of the building industry we need to communicate on a technical and architectural level on all aspects of the design. Children will be addressed through visual stimulation with colourful and appealing artwork and architecture. Since they will mostly be a target group in the La Cité du Soleil® and after the competition, we will make sure the house is interesting and playfully designed for children as well as adults. They will be growing up in houses like these, like millions of Dutch children before them already did. We are determined to be part of that and give them a happy childhood full of playful memories. The general public can be basically any person that shows interest and is not already mentioned in the other target groups. They can be visitors of the La Cité du Soleil®, academics, teenagers/adolescents and elderly people that do not own a house themselves anymore. Every person in this group is handled individually so we are sure that he or she will get the appropriate information needed.

7.1.6 Actions Description

Previous to the competition



Figure 7.6 — *Action Plan for University, City, Country and International scale*

The following action plan highlights the main events and actions that we intend to undertake in order to achieve our objectives. These have been grouped in the following categories:

University

A monthly newsletter will be sent to all interested students, professors and partners keeping them up-to-date with the progress of the project. Uni-intern press such as journals and magazines will publish our work with contact details for those who require further information or wish to join or support the project. Our project events will be displayed in the overhead screens at the university and will be propagated by word of mouth. Professors are encouraged to share their contacts and resources for the benefit of the team. Workshops and lectures can be held on an on-demand basis depending on the theme (eg. sustainability, Cradle-to-cradle, etc). Recruitment events will be organized where new students can learn about our project and join the team or offer their support. Partners and potential sponsors will also be invited to meet or attend workshop sessions at our own Prêt-à-Loger office within the D:DREAM Hall. The team will receive their own info page on the TU Delft website, providing basic information but also links to the teams' homepage and facebook page.

City

The event in Honselersdijk is planned where feedback can be given from the residents of the community in question. The team also plans to erect the prototype for testing prior to the competition in a public space in the city as a means of promoting the project and the idea. To arrange this event the Delft municipality will be asked for their collaboration. Local newspapers, journals and magazines with a thematic interest in our project will be contacted for possible dissemination, similarly with the city radio stations which may like to interview a member of our communications team. A further interesting prospect is the execution of a public artwork under the railway bridge. This spot is a designated graffiti area and local artists will be asked to produce for us an exciting image of our project that will receive lots of public exposure. A QR-code will be implemented on the artwork to direct interested/curious smart-phone users to our website for further information.

Country

The close proximity of national venues makes the prospect of exhibiting at fairs and exhibitions very attractive. The possibility of our project appearing on national television will also be explored - seeing as Prêt-à-Loger will officially be representing not just the TU Delft but the Netherlands as a whole with the Dutch row house concept in an international competition.

International

International websites will be contacted for dissemination purposes relating to architecture, engineering, sustainability. Lectures and/or appearances will be planned in the home towns or home universities of some students where the project can be presented and discussed from another perspective. Given the international character of the team, international students leaving for home during the holidays will have the opportunity to spread the word and expose the design to people in different corners of the world and gain support.

During the competition

Public Tours

Regular public tours of the house will be provided to the public during the Solar Decathlon Europe event (see 'Public Tour Description' for details).

Printed media and merchandising

Printed media will include brochures, posters and flyers which will be on display or handed out to interested parties. Merchandising could include small, low-cost recycled or re-used items that can be given away as gifts. The design of which must fit to the overall beliefs of the team with regards to re-use and sustainability.

Audiovisuals

The teams' project video will be on display during the competition in Paris, providing supplementary information and images to support the design of the house. Headphones will be made available for guests to listen to the audio as they wish. See section *7.5.5 Video Material* for more information.

Home

In Versailles, the prototype will be represented as if it were 'sliced' directly out of an existing row of houses from the Honselersdijk - with clean sections through floors and walls visible on the outside. Architectural drawings and perspective images will be printed on the exterior representation of the 'existing' street (see Chapter 1 - Urban Design, Transportation and Affordability).

Story

In order to establish to the visitor the feeling of a Dutch home, a real narrative must be conceived, complete with characters, history, relationships etc. which can also be recognized from renderings and audiovisuals to ensure the consistent story of a real Dutch home rather than an anonymouse energy-pavilion or exhibition.

After the competition

Workshops Science Centre

To transfer the spirit of sustainable renovation onto the younger generation we decided to create workshops in the Science Centre of the TU Delft for children of the ages 12-15. We will provide them with an existing row house where they will have to design their addition to, based on requirements that we will provide. Every group of max. 4 students will have to present their redesign in front of their classmates and the winner is the team with the most sustainable solution to the given problem. In order to decide on this we will take a look at certain criteria like material choice, compactness of the solution and energy reducing/producing measures taken.

Green Village

After the competition in Versailles the prototype will be placed in the Green Village of the TU Delft. This village, situated on the old plot of the Faculty of Architecture that burned down in 2008, will host initiatives to exhibit the sustainable development in the energy and construction sector. The prototype of Prêt-à-Loger will be one of the first residents here and will have a spot in the village for the coming 2 years, possibly prolonged every 2 years after an evaluation of its performance in the village in comparison with the other concepts. For more information about the Green Village please refer to: http://www.thegreenvillage.org

7.2 Public Tour Description

Please refer to drawings PT-101 (First Floor) and PT-102 (Second Floor) in the Project Drawings for a visual guide of the following tour description. In PT-001 the accessibility of the plot as a whole is shown.

The purpose of the public tour is to convey a feeling of homeliness. Visitors of Home with a Skin must leave the house in Versailles with the impression that they are leaving somebody's home. So the guided tour becomes like the welcoming of friends at a housewarming.

7.2.1 Waiting line and Tour

Guides will be available at the beginning of the waiting line who will welcome the people entering the plot (1). If it happens to be that there are too many people waiting, new visitors can be either showed around the site (short tour) by the guides and will be entertained with stories about the history of the house and the urban context. The visitors can also choose to come back at a later time when they please and they could subscribe to the digital brochure.

Visitors that will be entering the house will have to follow the waiting line into the house. The waiting line is placed on the ramp (2) that is lead along the section of the house. In the waiting line a lot of information is shown: information panels and drawings, in the form of framed paintings on the wall, along the ramp will introduce the visitors to the relevance of our project on a bigger urban/ country scale. The further the visitors will be in the line to more the information will zoom in to the concept of one house, introducing them with the life of a typical Dutch family. At one point the ramp will cross the blue-

print of the row houses that we will show on the on the plot (refer to project drawing AR-002). The section of the row house and the footprint of the row house will show the visitor more of the Dutch housing context. By the time the visitors are at the end of the waiting line the background information needed to understand our intervention in this format will be clear. We will use parasols on both sides of the house and waiting line to provide solar shading.

At the front entrance of the house (3) the amount of visitors inside the house will be controlled by a guide/decathlete. The guests are welcomed in groups of 5-7 people by the guide and led through the house [(4) (5) (6) (7) (8)]. There will be maximum 2 groups inside the house. The two decathletes who are hosts for the group provide more information when required and regulate the flow of visitors. If a group has exited the house the guide/decathlete will make sure another group will be allowed inside the house.
After the visitors have left the existing house, they will walk through the glasshouse (9) which is the actual intervention. The purpose of the glasshouse must be clear at one glance. Limited information is placed inside the greenhouse in order to continue the visitor flow. At this point a decathlete will ask the group of visitors to continue into the garden (10), in order to explain the working of the glasshouse structure (open in summer and closed in winter) and tell more about the glasshouse and garden design for those who are interested. Other visitors can walk around and enjoy the garden. Note: there will be no live demonstrations of mobile elements in the glasshouse as the space is very limited and we want to guarantee the flow of visitors. We will demonstrate this by clear graphics on the information panels and in the brochure.
The exit route will be formed by a second ramp (11) placed at the other side of the house. Here the information panels and drawings will show the effect of our intervention with the existing building stock on the bigger urban scale; zooming out again from one family home to a whole neighborhood. At the end of the ramp the guest will be fully informed by our design intervention and the effects of this. If visitors will have any more questions after visiting the house, around the plot extra decathletes from the team will be walking around for answering any question. The guests are able to subscribe here to our digital brochures about our project (15).

The first floor is only accessible by the jury. This floor contains a bathroom (12), a model master bedroom (13), and the model room (14). In the model room an urban model of our site will be shown to show the house and skin on a bigger urban scale.

The total time of the tour from the entrance of the house until the exit from the winter garden will take approximately 10-15 minutes and the guide will be made available in French, English, Dutch, German, Greek, Spanish, Italian, Hungarian, Chinese, Korean, Romanian, Indonesian, Bulgarian and Arabic - depending on the decathlete that is available at that moment.

7.2.2 Specific Tour Description - Adults

The tour begins in the hallway (4) where a member of the team will introduce themselves and invites the visitor groups inside the house. The guests notice the shoes in the showrack and the jackets and umbrellas hanging from the coat-hanger. Then the guests will be guided along the cabinet and restroom (5) to the living room (6). In the living room there are newspapers on the coffee table and photographs of family and friends on the wall. The guests may take a seat on the spacious couch if they wish while the tour-guide entertains with stories of growing up and living in a Dutch neighborhood. Children may take the opportunity to go play in the garden while the tour continues through to the

kitchen (7). The tour guide gives information on the energy-efficient appliances and the monitoring system of the house while some guests may choose to explore the spatial qualities of the dining room (8) which overlooks the garden to the South.

Since the tour cannot be continued up the stairs a visual tour is made available on a screen where the tour continues up the stairs into the second floor. Here the children's bedroom will be shown, the master bedroom and the bathroom with water-saving appliances.

After the visitors have experienced the house they will enter the winter garden (9). Here they will get an impression of a dynamic green space which can function as an interior and exterior. Furniture is placed and limited but concise information about the intervention, the winter garden, will be shown on panels inside the glasshouse.

When having experienced the homeliness of a Dutch family in relation to our intervention of the added skin, the tour continues into the garden (10). Here more guides will be made available to explain the functioning of the skin to a larger group and give more information when there is the need to; the guest will have the opportunity to learn more about the skin or continue their path to the exit of the plot, along the ramp (11).

There will not be a distinction between the different target groups in the amount of information shown. A combination of text and clear and interesting graphics will be shown to allow visitors to take in the information they want, at the speed they prefer. The tour guides will anticipate on the interests of the specific target groups.

7.2.4 Specific Tour Description - Children

The children that will be visiting our house should also meet with the homeliness of our design; having the feeling they are visiting a friend's house where they can play around the house. During the tour that their parents will follow the children will pass several (small) objects with keycards or taglines showing them funny facts about the house. Goal is to educate children in a playful matter and on a smaller scale what energy use in a household means. They will find these facts on the coffee mug left on the table, sticky notes on the fridge, on the cereal box that is left in the kitchen etc… If all the facts are collected the children will be awarded with a gadget at the end of the tour, in the garden.

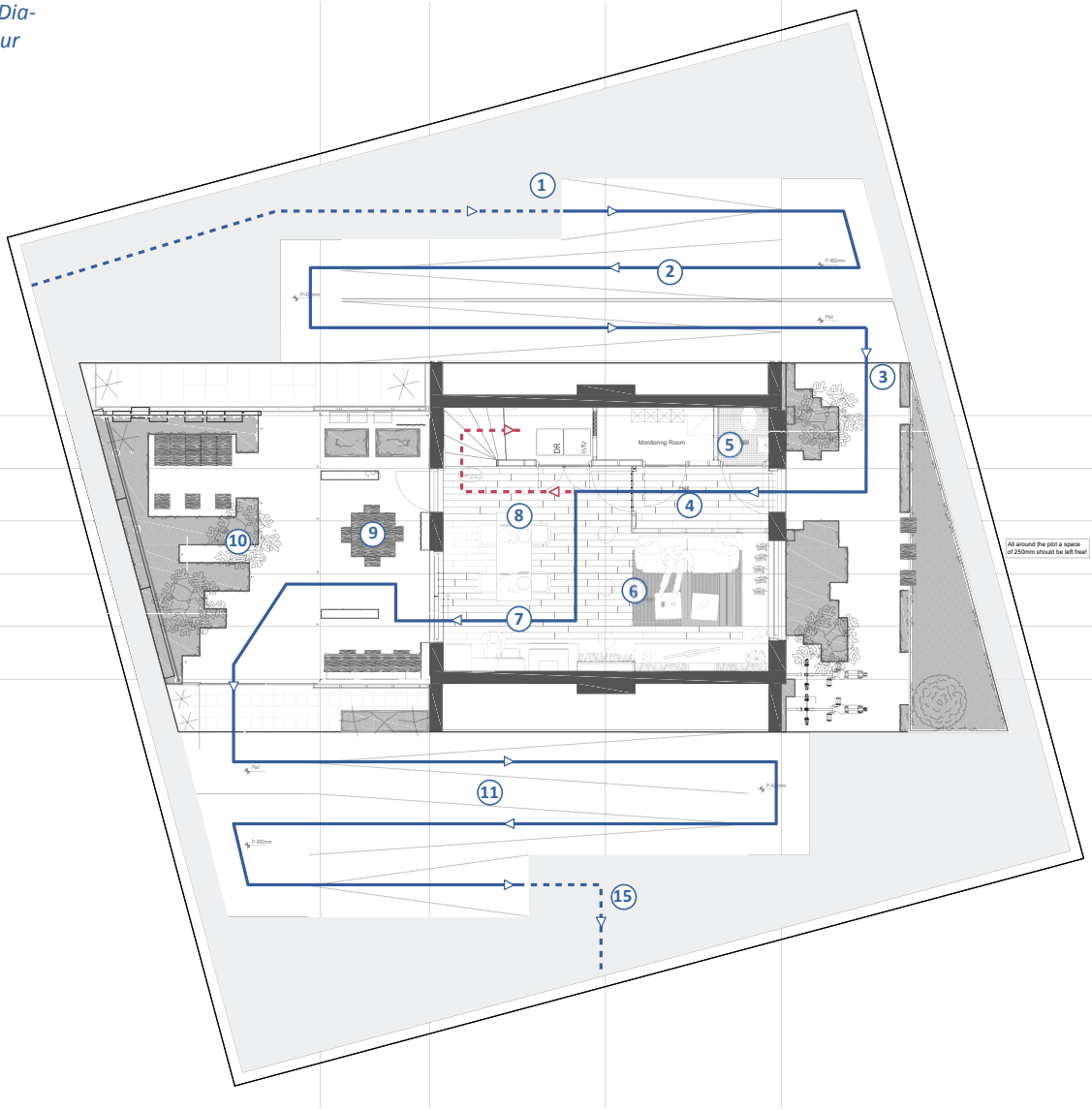
7.2.3 Public Tour Brochures

For the two target groups 'adults' and 'children' brochures with more information about the project will be made available in French and English. The brochures will be available digitally. Making sure we harm the nature the least.

The brochure for the adults will show the 'interested guests' the design intervention, what will change in their houses and the effect of the project on their lives and the world. The technical and energy saving informations will be shown in clear diagrams and info graphics as this is interesting for 'professionals' and possibly for 'interested guests' as well;

The children will get a booklet with the funny facts, puzzles and drawings that explain the house, and learn them more about energy use and the effects on their lives and the world.

Figure 7.7 — *Diagram of Public Tour*



7.3 Team Visual Identity Manual

7.3.1 Team personality

Prêt-à-Loger believe the idea of sustainable living is an universal belief for everyone. Prêt-à-Loger's character shares aspects of culture, harmonization, sustainability, and responsibility.

7.3.2 Team Logo

Special importance was given to the dutch street. The two colours used in the logo are blue and white - directly derived from the Dutch street-signage from the 1960s - the period in which (most) row-houses in the Netherlands were built. The same can be said about the font style used in the logo. The original logo used comes in two variations: blue-on-white and white-on-blue. For image backdrops such as that used in the audiovisuals the white logo can be placed.
With the colors used, typeface, border and house-icon with inhabitants, the logo addresses (respectively) the street, the skin, the row-house and the home in combination with our team-name *Prêt-à-Loger* and product *Home with a Skin* in an attempt to further contextualize our brand.

7.3.3 Street Sign

Prêt-à-Loger
Home with a Skin

C82, M56, Y0, K18
C0, M0, Y0, K0





Figure 7.8 — *Street-sign inspired Logo - printed as an actual street-sign*

7.3.4 Blue-on-white



7.3.5 White-on-blue



Figure 7.9 — *Our Original Logo in its 2 variations - blue-on-white and white-on-blue (depending on the background)*

7.3.6 Icon

For the use in social media or where the space doesn't permit the rectangular proportions of the logo, the logo itself has been reduced to the 'Home icon' without any names.





Figure 7.10 — *The icon in its 2 variations developed for use in places where horizontal space is limited. ie. as icon on Social media sites (Facebook, Twitter etc.)*

7.3.7 Delft Blue

The colour-palette developed addresses the significance of the color ‘blue’ in Delft and harmonizes perfectly with the logo. ‘Delft Blue’ was known all over the world as state-of-the-art porcelain and pottery. Famous for its blue decorations, this form of Delftware would compete against the chinese porcelain (‘china’) which grew in popularity in the 16th century. Delft’s close proximity to Europe’s largest port - Rotterdam helped establish this tradition as a symbol of the city - a symbol adopted by many Delft-based firms, institutions and societies including the municipality (Gemeente Delft). When roaming the city of Delft, and even the university, this color-scheme can be recognized everywhere.



1



2



3

Figure 7.11 — *Various examples of where the ‘Delft Blue’ theme can be seen around the city, the university and represented in various local logos and typographies.*



4



5



6

Figure 7.12 — *1- Graffiti on walls*

Figure 7.13 — *2- Delft porcelain street lamp*

Figure 7.14 — *3- Delft blue porcelain*

Figure 7.15 — *4 - Graffiti near train station*

Figure 7.16 — *5- ‘Kiss’ icon used on porcelain items*



7



8

Figure 7.17 — *6- DUT Racing car in ‘Delft Blue’ style*

Figure 7.18 — *7- ‘Blue Heart’ of Delft*

Figure 7.19 — *8- Visualisation of new Delft train station in ‘Delft Blue’ style*

Delft

9

Gemeente Delft

10

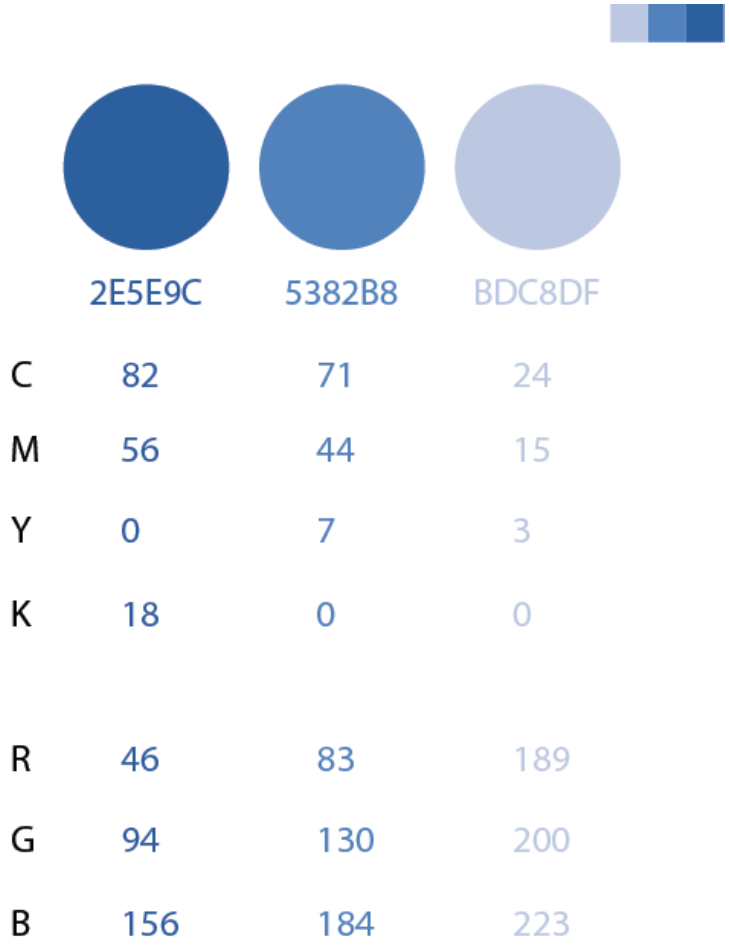
Figure 7.20 — *9- Delft logo*

Figure 7.21 — *10- Delft municipality logo*

7.3.8 Color palette

Combining the Delft Blue theme with the color used for our logo (derived from the street-sign in the 1960s), we chose three shades of blue to be used consistently in all of our communication. These can be seen below:

Figure 7.22 — *3 shades of Blue - Delft blue inspired color scheme based on the 1960s street-sign blue*



7.3.9 Motto

As mentioned in points 7.4.2 and 7.4.3, we deliberately distinguish between the terms 'house' and 'home'. Displayed as a motto in combination with our logo, the motto takes on the typeface used in the Logo in an attempt to seamlessly integrate the product (*Home with a Skin*) with our motto (*Improve your house. Preserve your home.*).

Figure 7.23 — *Motto in the same typographic style as 'Home with a Skin'*





7.3.10 Logo in combination with SDE Organization logo

Full Colour



Figure 7.24 — *Prêt-à-Loger logo in combination with SDE organization logo*

White



Greyscale



7.3.11 Logo in combination with supporting institutions

Full Colour



White



Greyscale



Figure 7.25 — *Prêt-à-Loger logo in combination with supporting institutions*

7.3.13 Typography

The typography consists of two typefaces. The first is used for Logos and slogans (Anwb) and is the same as that used for street-signage. The second (Calibri) is used for all text and was chosen on the basis of its compatibility with the logo and readability with long texts. Color of text: Blue.

Logo typeface (including combination with motto): Anwb

abcdefghijklmnopqursuvwxyz
ABCDEFGHIJKLMNOPQURSUVWXYZ
12345678901234567890

Figure 7.26 — *Typographic style reduced to 2 fonts: Anwb - as that used in Dutch street signs and Calibri*

All text: Calibri

abcdefghijklmnopqursuvwxyz
ABCDEFGHIJKLMNOPQURSUVWXYZ
1234567890!@£$%^&*()Ê-À

7.3.14 Partners and sponsoring institutions

Main Sponsors



Energie Sprong

PLATFORM31

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties







7.3.15 Gold Sponsors - Helios

putman ONDERHOUDSDIENSTEN BV INSTALLATIES BV KOELTECHNIEK

solar COMPLEET

DMEGC

Technische Unie

7.3.16 Silver Sponsors - Ra

sto

VAN DORP installaties

SELECTWINDOWS

RECYSTEL Het stelkozijn met meerwaarde

SELECT WINDOWS VOOR BETER WONEN WWW.SELECTWINDOWS.NL

GREEN DPA VILLAGE

AN INITIATIVE OF TU DELFT UNIVERSITY OF TECHNOLOGY

TU Delft Delft University of Technology Delft Energy Initiative

TU Delft Delft University of Technology Delft Environment Initiative

Robisol NOBUTEC GREENHOUSE PROJECTS

NLGreenlabel

bruynzeel KEUKENS

BOSCH Technologie voor het leven

SOLARLUX glass in motion

7.3.17 Bronze Sponsors - Inti

PP PRINTER PRO.nl PRO'S IN PRINT- EN DRUKWERK

Techcomlight

Deerns

SOLARevent

ECO BOUW 2013

komPLOT

Serge Ferrari

PVSYST SOFTWARE

raab karcher

solaredge

DERBIGUM MAKING BUILDINGS SMART

INTERSAFE Groeneveld

Interface

jongeneel NATUURLIJK GOED.

SPARTA

Sunstock Holland

For further information on sponsors - please see sub-section 7.4 Sponsorship Manual

7.3.18 Iconography

In line with the colour-scheme and logo-style, a set of icons was developed to convey the diversity of the dutch landscape and street community. And so this takes the form of street-sign inspired icons like cars, busses, bicycles etc arranged in a section through what we believe represents a typical Dutch landscape. These can be found in our printed articles and our website.



Figure 7.27 — *Icons developed to depict an urban Dutch streetscape*

7.3.19 Renderings

Our renderings will focus on the family and the social life of the home and street respectively. The goal is not to convey an image of a stunning architectural prototype but rather a more subtle story of how a specific family lives their lives in their homes. Attention will be paid to the last detail from the books they read, the style of furniture and even the characters in the image should have a recognizeable quality to establish the emotional bond with the family and to be able to identify with them. A variation of the logo as a 'base-line' allows the image to be 'branded' if required - suitable for presentations and audiovisuals.



Figure 7.28 — *Renderings can be 'branded' with our logo if needed*

Business Cards

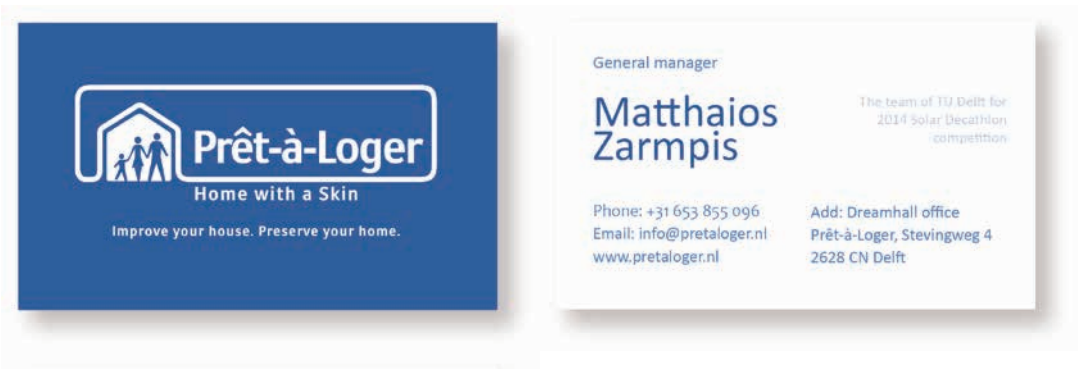
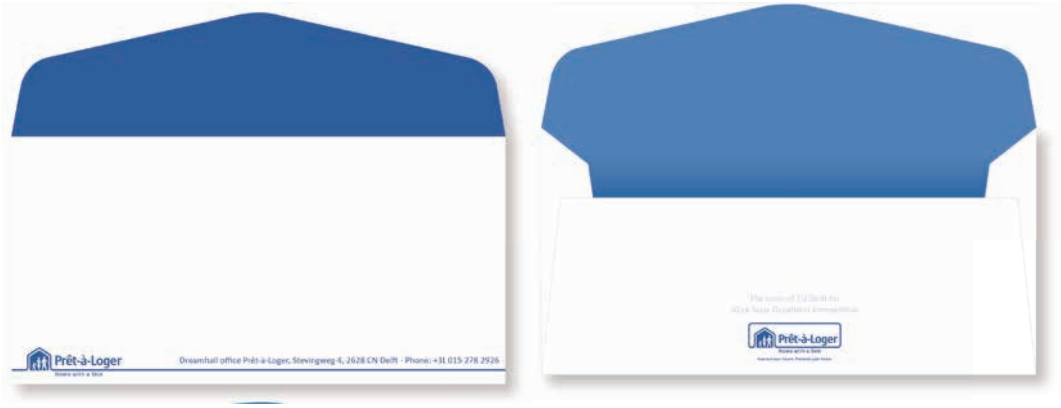
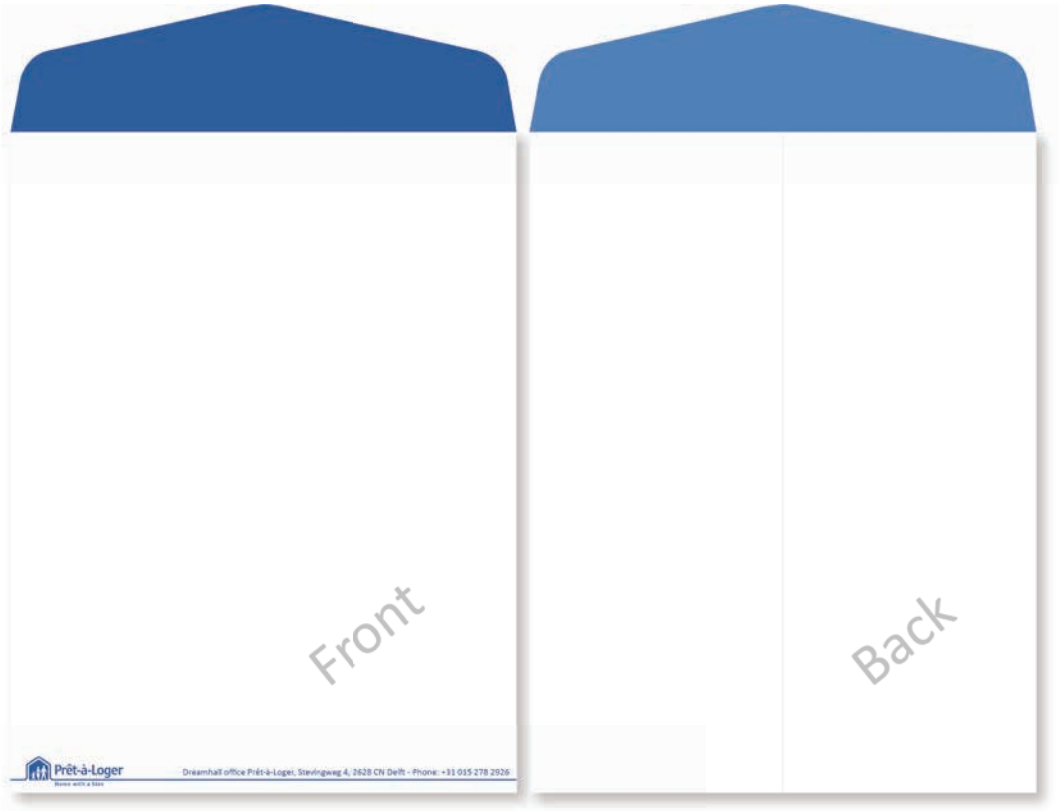


Figure 7.29 — *Prêt-à-Loger stationary developed as dictated through this Visual Identity Manual*

Envelopes - regular



Envelopes - A4



Letters - A4



Folder - A4



Where our concept is to a great extent about the non-anonymity of existing houses i.e. the specific lives of their inhabitants, so must this be addressed to an extent in our uniform design without compromising or confusing the brand image. So the solution is to 'simply' customize each participants shirt by adapting the words used in the logo printed across the chest. The shirt will display each participants' name and role in the team - in the same, uniformity of our logo!

Casual clothing

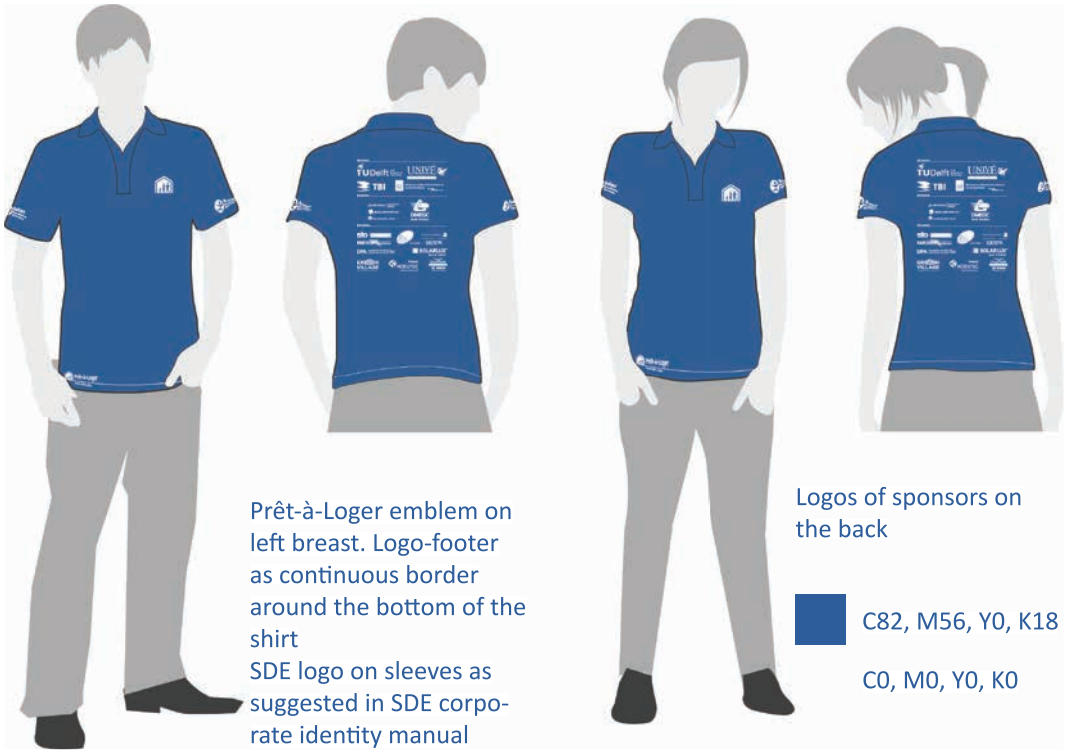
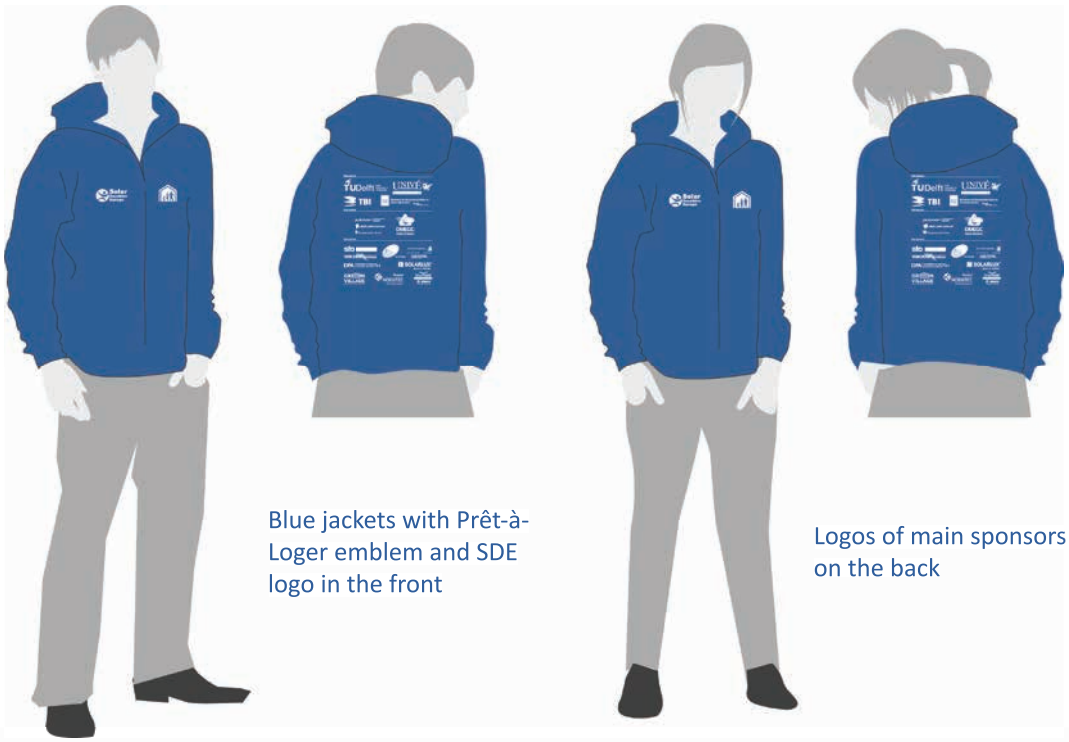


Figure 7.30 — *T-shirts developed to keep a 'personal' touch while maintaining uniformity of our logo*

Jackets



7.4 Tracking Table of the Communication actions

All project dissemination from has been recorded in a spreadsheet format (displayed below) with information including the author, title, and date of publication.

Table 7.1 — *Spreadsheet of all dissemination to date.*

Publisher	Media Type	*Title*	Date	Document Type	Language
TU Delft	Website	*Solar Decathlon Team 'Prêt-à-Loger' 2014 awarded the status*	2013.02.21	Article	English
ClickNL	Website	*Pret-a-Loger awarded dream team status*	2013.03.06	Article	English
TU Delft	Website	*Studenten, ideeën en geld gezocht voor duurzame transforma*	2013.03.12	Article	Dutch
Prêt-à-Loger	Website	Press Release #1	2013.04.01	Press Release	English
Imagine the blog	Website	*SOLAR DECATHLON TEAM TU DELFT*	2013.04.15	Video Link	English
Prêt-à-Loger	Website	Press Release #2	2013.07.01	Press Release	English
Aedes	Website	*TU-studenten ontwerpen toolbox duurzame woning*	2013.08.07	Article	Dutch
IVVD	Website	*TU-studenten ontwerpen toolbox duurzame woning*	2013.08.13	Article	Dutch
APK Vastgoed.nl	Website	*TU-STUDENTEN ONTWERPEN TOOLBOX DUURZAME WO*	2013.08.15	Article	Dutch
National Renovatie Platform	Website	*PARTNERS GEVRAAGD VOOR SOLAR DECATHLON*	2013.08.27	Article	Dutch
TU Delft	Website	*Pret-a-Loger Team - Solar Decathlon 2014*	2013.09.01	Article + Video Link	English
Energievergelijken.eu	Website	*Nederlandse bouwwereld steunt inzending TU Delft voor Sola*	2013.09.12	Article	Dutch
Volkskrant	Newspaper	*In onderzoek week 37*	2013.09.14	Article	Dutch
Bright	Website	*Het huis van de toekomst is een rijtjeshuis*	2013.09.20	Article + Video Link	Dutch
Cobouw	Website	*TU Delft doet mee aan zonnewedstrijd*	2013.09.20	Article	Dutch
Board Engineering	Website	*TU DELFT INZENDING VOOR SOLAR DECATHLON 2014 K*	2013.10.01	Article	Dutch
de Architect	Journal	*Visionair: Pret-a-porter: Rijtjeshuizen voor de toekomst*	2013.10.01	Article	Dutch
BK City News	Newsletter	*Nederlandse bouwwereld steunt Solar Decathlon 2014*	2013.10.03	Article	Dutch
Freelists	Website	*Persbericht TU Delft: Nederlandse bouwwereld steunt inzendi*	2013.10.07	Article	Dutch
ROC	Website	*Nederlandse bouwwereld steunt inzending TU Delft voor Sola*	2013.10.07	Article	Dutch
TU Delft	Website	*Dutch construction industry supports TU Delft's submission fo*	2013.10.07	Article	English
Architectenweb	Website	*TU Delft finalist Solar Decathlon 2014*	2013.10.08	Article	Dutch
Bouwwereld	Website	*Bouwend Nederland enthousiast over Prêt-à-Loger*	2013.10.08	Article + Video Link	Dutch
Engineeringnet	Website	*TU Delft inzending voor Solar Decathlon 2014 krijgt steun van*	2013.10.08	Article	Dutch
duurzaamgebouwd	Website	*Nederlandse inzending strijdt mee in Solar Decathlon 2014*	2013.10.09	Article	Dutch
Energienieuws	Website	*NEDERLANDSE BOUWWERELD STEUNT INZENDING TU I*	2013.10.09	Article	Dutch
Lijst Beta	Website	*Veel steun voor inzending TU Delft voor de Solar Decathlon 2*	2013.10.10	Article	Dutch
nujij	Website	*Nederlandse bouwwereld steunt inzending TU Delft voor Sola*	2013.10.15	Article	Dutch
Telegraaf	Newspaper	*Transformatie rijtjeshuis*	2013.10.19	Article	Dutch
Bnieuws	Journal	*Pret-a-Loger, Paris 2014*	2013.10.28	Article	English
La Librairie	Journal	*Transition Energetique ON AVANCE! - Panorama des 20 proj*	2013.11.01	Article	French
Prêt-à-Loger	Website	*Press-release #3*	2013.11.01	Press Release	English
Cobouw	Website	*Broeikas om een woning*	2013.11.04	Article	Dutch
Energiegids	Website	*Broeikas om een woning*	2013.11.04	Article	Dutch
Wij Zuid Holland	Website	*Studenten Delft: rijtjeshuizen in kas worden energieneutraal*	2013.11.04	Article + Video Link	English
Dutch Ambassy, Paris	Website	*NEDERLANDS TEAM TU DELFT BIJ SOLAR DECATHLON 2*	2013.11.08	Article	Dutch
Nova Techniek	Website	*Rijtjeshuizen zijn woningen van de toekomst*	2013.11.08	Article	Dutch
Jan Willem de Groot	Website	*Solar Decathlon 2014*	2013.11.11	Article	Dutch
Jan Willem de Groot	Website	*Solar Decathlon 2014*	2013.11.11	Article	Dutch
TU Delft	Website	*Prêt-à-Loger maakt indruk in Parijs*	2013.11.11	Article	Dutch
duurzaamgebouwd	Website	*Plan maakt niet-duurzaam rijtjeshuis energieneutraal*	2013.11.12	Article + Video Link	Dutch
gebiedsontwikkeling	Website	*Prêt-à-Loger maakt indruk in Parijs*	2013.11.14	Article	Dutch
Archinieuws	Website	*TU Delft finalist Solar Decathlon 2014*	2013.11.15	Article	Dutch
aE journal	Magazine	*Solar Decathlon 2014*	2013.11.20	Article	English
Delta (Author: Marco Villares)	Website	*Students compete at Solar Decathlon Europe*	2013.11.20	Article	English
Stroomversnelling	Website	*Inspirerend filmpje over renovatie*	2013.12.05	Video Link	Dutch
Dutch Green Building Council	Website	*TU Delft wil met verduurzamen bestaande woningen Solar De*	2013.12.06	Article	Dutch
FACE - International Facade (	Website	*House with a Skin*	2014.01.15	Article + Video Link	English
Domotica Platform Nederland	Website	*Nederlandse inzending voor Solar Decathlon gaat door*	2014.01.21	Article	Dutch
Dutch Ambassy, Paris	Website	*FANTASTIQUE!*	2014.01.21	Article	Dutch
Vaktechnisch	Website	*Nederlandse inzending voor Solar Decathlon gaat door*	2014.01.21	Article	Dutch
Duurzaamgebouwd	Website	*Nederlandse inzending voor Solar Decathlon gaat door*	2014.01.22	Article	Dutch
Omroep West	Website	*TU Delft doet mee aan wedstrijd voor duurzame bouw*	2014.01.22	Article	Dutch
Green-Deals.nl	Website	*Nederlandse inzending voor Solar Decathlon gaat door*	2014.01.22	Article	Dutch
Bouw Almanak	Website	*TUDelft doet mee aan Solar Decathlon*	2014.01.23	Article	Dutch
Solar Magazine	Website	*Nederlandse inzending voor Solar Decathlon gaat door*	2014.01.24	Article	Dutch
gebiedsontwikkeling	Website	*Solar Decathlon-team TU Delft neemt deel aan de 'Olympic G*	2014.01.28	Article + Video Link	Dutch
Archinect	Website	*Saving face: Prêt-à-Loger designs solar-powered skin to press*	2014.02.04	Article + Video Link	English
Architectenweb	Website	*TU Delft definitief naar Solar Decathlon*	2014.02.04	Article	Dutch
Architectuur.org	Website	*Studenten TU Delft maken energieneutraal rijtjeshuis*	2014.02.04	Article	Dutch
Energie +	Website	*Delfts renovatieconcept naar Solar Decathlon*	2014.02.04	Article	Dutch
Energieniewus	Website	*STUDENTEN TU DELFT MAKEN HOLLANDS RIJTJESHUIS*	2014.02.04	Article	Dutch
ensoc	Website	*Studenten maken rijtjeswoning energieneutraal*	2014.02.04	Article	Dutch
Frismakers	Website	*Het huis van de toekomst is een rijtjeshuis*	2014.02.04	Article + Video Link	Dutch
Nederlandse Ambassade Par	Website	*STUDENTEN TU DELFT MAKEN HOLLANDS RIJTJESHUIS*	2014.02.04	Article	Dutch
Renda	Website	*Delfts renovatieconcept naar Solar Decathlon*	2014.02.04	Article	Dutch
ROC	Website	*Studenten TU Delft maken Hollands rijtjeshuis tot energie neu*	2014.02.04	Article	Dutch
Stadebouw & Architectuur	Website	*Studenten TU Delft maken Hollands Rijtjeshuis tot energieneu*	2014.02.04	Article	Dutch
TU Delft	Website	*Studenten TU Delft maken Hollands rijtjeshuis tot energieneut*	2014.02.04	Article	Dutch
TU Delft	Website	*Studenten TU Delft maken Hollands rijtjeshuis tot energieneut*	2014.02.04	Press Release	Dutch
Vastgoedwereld	Website	*TU Delft definitief naar Solar Decathlon*	2014.02.04	Article	Dutch
BNR Radio	Website	*Interview with Josien Kruizinga and Dennis IJsselstijn*	2014.02.05	Radio Interview	Dutch

Publisher	Media Type	Title	Date	Document Type	Language
Cobouw	Website	Studenten TU Delft nemen deel aan Solar Decathlon	2014.02.05	Article + Video Link	Dutch
Energie Vastgoed	Website	Rijtjeshuis energieneutraal met slimme schil	2014.02.05	Article	Dutch
Gemeente Delft	Website	Rijtjeshuis energieneutraal	2014.02.05	Article + Video Link	Dutch
Mundialis	Website	Studenten maken rijtjeshuis energieneutraal	2014.02.05	Article	Dutch
rtlnieuws	Website	Delfts energieneutraal rijtjeshuis in beeld	2014.02.05	Article	Dutch
rtlnieuws	Website	Delfts energieneutraal rijtjeshuis in Solar-wedstrijd	2014.02.05	Article	Dutch
Science Guide	Website	Groen rijtjeshuis in Versailles	2014.02.05	Article	Dutch
Duurzaam Bedrijfsleven	Website	Studenten TU Delft maken energieneutraal rijtjeshuis	2014.02.05	Article	Dutch
Cobouw	Website	Rijtjeswoning krijgt zonneschil	2014.02.06	Article	Dutch
de Architect	Website	Delftse uitdaging - Solar Decathlon 2014	2014.02.06	Article	Dutch
Duurzam Bedrijfsleven	Website	Studenten TU Delft maken Hollands Rijtjeshuis tot energieneu	2014.02.06	Article	Dutch
Engineeringnet.nl	Website	Studenten TU Delft verbouwen rijhuis tot energieneutrale won	2014.02.06	Article + Video Link	Dutch
Nationale Onderwijsgids	Website	TECHNIEKSTUDENTEN DELFT NAAR VERSAILLES	2014.02.06	Article	Dutch
Zonopkomst	Website	Studenten TU Delft maken Hollands rijtjeshuis tot energieneut	2014.02.06	Article	Dutch
rtlnieuws	Website	Delfts energieneutraal rijtjeshuis in Solar-wedstrijd	2014.02.07	Article	Dutch
rtlnieuws	Website	In deze tijd kun je huis en tuin niet los zien'	2014.02.07	Article	Dutch
TBI Woonlab	Website	Energieneutraal renovatieconcept Prêt-à-Loger tijdens Solar D	2014.02.07	Article + Video Link	Dutch
Telegraaf	Newspaper	Klaar om te wonen	2014.02.12	Article	Dutch
NL Greenlabel	Website	Uitgelicht	2014.02.14	Article	Dutch
Recystel	Website	Studenten TU Delft maken Hollands rijtjeshuis tot energie neu	2014.02.14	Article	Dutch
Selectwindows	Website	Blog #1	2014.02.14	Blog	Dutch
Technisch Weekblad	Website	Nieuwe huid maakt doorzonwoning energieneutraal	2014.02.14	Article	Dutch
era contour	Website	Energieneutraal renoveren tijdens de Solar Decathlon	2014.02.16	Article	Dutch
TBI	Website	Energieneutraal renoveren tijdens de Solar Decathlon	2014.02.16	Article	Dutch
De Leidschenveensche Coura	Website	Studenten TU Delft maken Hollands rijtjeshuis tot energieneut	2014.02.18	Article	Dutch
Delft Studentenstad	Website	Techniekstudenten Delft naar Versailles	2014.02.18	Article	Dutch
DMEGC	Website	DMEGC Solar Magnetics Ltd. is sponsoring TU Delft students	2014.02.19	Article + Video Link	English
The Green Village	Website	TU Delft students turn Dutch terraced house into energy-neutr	2014.02.19	Article	English
Kennislink	Website	Duurzame huis voor rijtjeshuis	2014.02.20	Article	Dutch
Besparen met de zon	Website	Studenten TU Delft nemen deel aan Solar Decathlon	2014.02.21	Article	Dutch
Board Engineering	Website	TU DELFT INZENDING VOOR SOLAR DECATHLON 2014 K	2014.02.21	Article	Dutch
Energie Vergelijken	Website	Studenten TU Delft maken Hollands rijtjeshuis tot energie neu	2014.02.21	Article	Dutch
Isolatie team	Website	Studenten Delft willen woning energieneutraal maken	2014.02.21	Article	Dutch
Zonne-Energie Gids	Website	Laatste ontwikkelingen zonne-energie in Nederland	2014.02.23	Article	Dutch
Exterior Coatings	Website	STUDENTEN TU DELFT NEMEN DEEL AAN SOLAR DECA	2014.02.25	Article	Dutch
Groothuis Wonen	Website	Groothuis Wonen bouwt woning Solar Decathlon 2014!	2014.02.25	Article + Video Link	Dutch
Archinect	Website	Saving face: Prêt-à-Loger designs solar-powered skin to pres	2014.02.26	Article + Video Link	English
The Needs	Website	Saving face: Prêt-à-Loger designs solar-powered skin to pres	2014.02.26	Link Article	English
Architizer	Website	An Adaptable Solar Skin Hopes to Help Dutch Row Homes Be	2014.02.27	Blog	English
VHG	Website	TU Delft transformeert rijtjeshuis tot energieneutrale woning	2014.02.27	Article	Dutch
My-Architecture.com	Website	Saving face: Prêt-à-Loger designs solar-powered skin to pres	2014.02.27	Link Article	English
Co.exist	Website	These Solar Skins Preserve Architectural History--But Add A	2014.03.03	Article + Video Link	English
Gizmag	Website	Solar-panel skin could make Dutch homes energy neutral	2014.03.05	Article	English
Inhabitat	Website	Dutch Students Design Revolutionary Solar Power 'Skins' for	2014.03.05	Article	English
infohightech	Website	UNE « PEAU DE PANNEAUX SOLAIRES » POURRAIT REN	2014.03.06	Article	French
Renewable Energy Magazine	Website	TU Delft students develop 'solar power skin' for Dutch terrace	2014.03.06	Article	English
Technology4Change	Website	Dutch students strive to make the existing more sustainable w	2014.03.06	Article	English
Econews	Website	Φωτοβολταϊκό-μονωτικό "δέρμα" κάνει ενεργειακά ουδέτερα τ	2014.03.07	Article	Greek
Green Building Elements	Website	Energy Neutral Architecture That Inspires	2014.03.07	Article	English
LiveModern	Website	TU Delft students convert Dutch terraced house into energy n	2014.03.07	Article	English
Polytexnikanea	Website	Φωτοβολταϊκό-μονωτικό "δέρμα" κάνει ενεργειακά ουδέτερα τ	2014.03.07	Article	Greek
Rinnovabili	Website	Un pannello solare "a pelle" per la ristrutturazione degli edifici	2014.03.07	Article	Italian
Energy Harvesting Journal	Website	Solar panel skin to make homes energy neutral	2014.03.07	Article	English
Duurzaam Bedrijfsleven	Website	Green Village: een podium voor nieuwe ideeën	2014.03.08	Article	Dutch
Masters in Educatie	Website	TU Delft neemt deel aan Solar Decathlon	2014.03.08	Article	Dutch
Arquitectura Prefab	Website	Instalación solar para antiguas casas holandesas	2014.03.10	Article	Spanish
Dutch Innovation	Website	Prêt-à-Loger - Giving Traditional Dutch Row Houses a New S	2014.03.10	Article	English
Arquitetando Ideias	Website	Obsolescencia x reutilizacao de casas	2014.03.11	Article	Portuguese
ekovesti	Website	СОЛАРНА ОБВИВКА ЗА КУЌИ	2014.03.12	Article	Russian
Holland	Website	Dutch students design solar panel covers for historic buildings	2014.03.13	Link Article	English
Design News	Website	Solar-Panel 'Skin' May Be Future of Sustainable Home	2014.03.14	Article	English
Ansys Blog	Website	Solar-Panel 'Skin' May Be Future of Sustainable Home	2014.03.15	Article	English
Energie Next	Website	Green Village: een podium voor nieuwe ideeën	2014.03.20	Article	Dutch
Polis, TU Delft	Magazine	Evolve, Improve & Renew	2014.03.21	Article	English
Wiwo Green	Website	statt-daemmung-vorhang-aus-glas-spart-energie-bei-historisc	2014.03.25	Article	German
Leidsch Dagblad	Website	Van oude warmteslurper naar energiebron	2014.03.28	Article	Dutch
Planet Custodian	Website	Prêt-à-Loger: Solar skin turns existing building into green pow	2014.03.28	Article	English
Solar Decathlon 2014	Website	Solar Decathlon 2014 Project Profiles	2014.03.28	Press Release	English
Enllave	Website	Prêt-à-Loger una casa de 60 años autosuficiente energéticam	2014.04.03	Article	Spanish
Dag van de Bouw	Website	Nieuwbouw Prêt-à-Loger, Harbrinkhoek, terrein Groothuis Wo	2014.04.24	Article	Dutch
Industriepark Kleefse Waard	Website	Studenten TU Delft maken energieneutraal rijtjeshuis	2014.04.24	Article	Dutch

This list is constantly updated with new entries and it is now too long for it to be bractically displayed here anymore. For the updated file, please visit the respective google drive document. [https://docs.google.com/spreadsheet/ccc?key=0AkXlq1-I0YjFdFNwZi1NNjIxUVAxR2JUTnZPWER1U0E&usp=sharing]

7.5 Dissemination tools

7.5.1 Renderings

The images that follow are the latest renders and diagrams that have been disseminated in the recent past. They depict impressions of a Dutch home (with a skin) and community and also an visualisation of the home in Versailles.



Figure 7.31 — *Image of our 'Home with a Skin' in Versailles*



Figure 7.32 — *An impression of the scenario of the interior space provided by the Skin used during winter*



Figure 7.33 — *A summer-impression with the Skin opened completely to let the outside in.*

7.5.2 Website

The aim for the website **www.pretaloger.nl** was to create a clear page for permanent information on the project, competition, and team. This page also had to conform to the visual identity of the team. It shares much of it's look with the project manual. The front page serves as an overall view, displaying:

the house and it's components
latest news and blog entries
connections to social media and newsletter



Figure 7.34 — *Our 'Home'-page with links to the relevant pages, newsletter, 'live' pages, our main sponsors and social media pages.*

Our project is first defined in the "our story", telling the concept and basis for the design. This leads on to the project pages which go into more details about the prototype we will bring to Versailles. The "competition" explains the wider aims of the Solar Decathlon. Press is a resource centre for media to find press releases and media to help spread our message. Further information on the Team, Partners and Contact are given in the respective pages.

The core of the website is our blog, which is updated with the latest developments in the project and stands as a record of each step of the process. The user can view this as a whole block or focus in on our blog posts, pictures, videos and press articles.

Other notable feature on the website are the live time-lapse feed for construction, by using the timecam. The website also hosts links to our newsletter subscription and 'Prêt-à-Loger Live' which was used during construction of our prototype prior to the competition and will be used during the competition in Versailles.
The interactive toolbox to allow real house owners to see what options work for them.

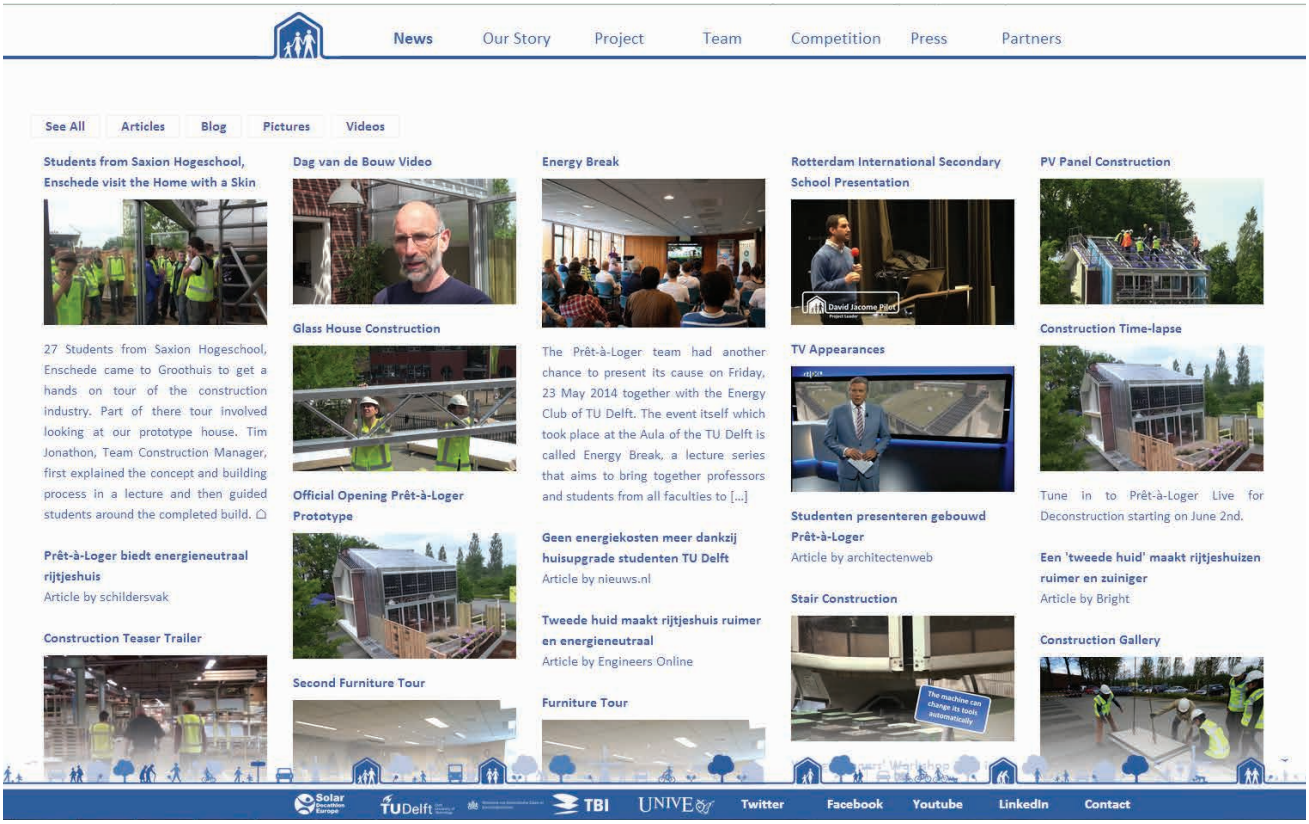


Figure 7.35 — *The heart of our website - the 'News' page with regularly updated blog posts featuring an array of photos, videos and articles*

Achievement so far:
Since taking it's current design, we have been tracking the website traffic and location. Timcam was used to help in the boosting of website traffic to a maximum of 548 views per day from a total (so far) of 56 different countries worldwide.

Newsletters
The fortnightly Newsletter helps to keep out followers informed, especially those who are not on social media. In each edition are around 6 stories that link through to videos, photos and blogs on our website. Mailchimp was used to achieve an open rate link through to our website by subscribers. See section *7.5.4 Newsletters* for more information.

Facebook
Facebook is our primary social media outlet and, like the newsletter, links through to content on our website. It is by far the largest link through for website traffic. Facebook is used to host our picture galleries, as images are the most effective media form on the site. We aim for at least 5 posts a week, with a targeted post on Monday morning and Friday afternoon.

Achievement so far:
We have seen steady growth of followers and increasing engagement, which is a good sign that we are posting interesting items.

Twitter + Instagram
Twitter is used as a live feed of activities, usually at our events, providing an in the moment view on proceedings. Similarly Instagram is for pictures and videos. In Versailles we plan to use this as our prime media outlet. See section *7.5.3 Social Media* for more information.

Videos

Video material is a core part of our communication strategy. Whether it's events, construction or deliverable video we find that the combination of sound and moving pictures really helps to breathe life into our project. See section *7.5.5 Video Material* for more information.

Links

Incoming | Domains | Recent | Unique | Outgoing

facebook.com/	544	+555%
bright.nl/tweede-huid-voor-je-h...	254	0%
tudelft.nl/nl/actueel/laatste-n...	196	0%
tudelft.nl/en/current/student-p...	110	+999%
aannemervak.nl/bouwpraktijk/bes...	95	0%
bk.tudelft.nl/en/current/latest...	71	0%
dagvandebouw.nl/waar/overijssel...	70	+999%
engineersonline.nl/nieuws/id235...	66	0%
bk.tudelft.nl/en/current/latest...	62	0%
bk.tudelft.nl/nl/actueel/laatst...	46	+999%

Searches

Searches | Keywords | Recent | Unique | Rankings

[secure search]	688	+842%
pret a loger	30	+200%
pretaloger	9	+80%
www.pretaloger.nl/	3	+50%
Prêt-à-Loger	3	0%
rtl 4 pret a loger	3	0%
pretaloger.nl/	3	0%
pretaloger live	3	0%
pret-á-loger	2	0%
pret a loger tu delft	1	0%

Locale

Countries | Cities | Languages | Org | Hostnames

The Netherlands	3,948	+753%
Germany	75	+999%
The United Kingdom	61	+999%
Belgium	57	+999%
France	47	+571%
The United States	45	+999%
Australia	41	0%
Taiwan	32	+999%
Greece	32	+300%
Italy	25	+999%

Content

Pages | Entrance | Exit | Downloads | Events | Media

pretaloger.nl/ Prêt-à-Loger | Improve your...	3,935	+894%
pretaloger.nl/live/ Live | Prêt-à-Loger	1,840	+459%
pretaloger.nl/news/ News | Prêt-à-Loger	1,325	+999%
pretaloger.nl/team/ Team | Prêt-à-Loger	1,093	+999%
pretaloger.nl/our-story/ Our Story | Prêt-à-Loger	909	+999%
pretaloger.nl/project/ Project | Prêt-à-Loger	906	+999%
pretaloger.nl/press/	642	+999%
pretaloger.nl/competition/ Competition | Prêt-à-Loger	639	+999%
pretaloger.nl/project/archite... Architecture | Prêt-à-Loger	611	+999%
pretaloger.nl/climate/ Climate | Prêt-à-Loger	545	+999%
pretaloger.nl/partners/ Partners | Prêt-à-Loger	526	+892%
pretaloger.nl/project/garden/ Garden | Prêt-à-Loger	492	+999%
pretaloger.nl/interiors/ Interiors | Prêt-à-Loger	487	+999%

Traffic sources

Links	1,640	+999%
Direct	1,502	+513%
Searches	757	+705%
Social media	579	+403%
Email	85	0%
Syndication	18	0%
Media searches	8	0%

Figure 7.36 — *Statistics allow us to constantly monitor the traffic on our website, its sources, what content was viewed etc. These allow us to make informed decisions on the information we decide to disseminate, through which medium etc for the most effective reach and engagement*

7.5.3 Social Media

Prêt-à-Loger has been actively using social media as a means to further spread the message we believe in. In order to change from a society that is inheritably unsustainable into a society that is able to sustain itself for generations and generations to come, we should improve our houses, but preserve our homes.

Facebook

Facebook is our primary social media outlet. With pictures, movies and articles we use it in a diverse way. We have noticed that our Facebook posts are by far the largest link through to our website, which makes it an ideal way of generating traffic to our website and helping people to understand more facets of the project. We try to post a maximum of 2-3 posts a day, although usually once per day or less. This frequency is considered ideal and helps us to maintain a steady stream of information, without being too overwhelming. Using Facebook to reach your fans proves to be hard, since you are battling against pages that pay for their ranks on peoples newsfeeds through advertisements. Since we have no budget on social media, we try to reach our audience in more clever ways like tagging team members in pictures and sharing posts of the official page. This spreads our posts far and wide over the medium, creating engagement along the way. Using the build-in app system of Facebook pages allows us to directly link through to our videos on YouTube, Twitter page and subscription to our Newsletter.



Figure 7.37 — *Our facebook page www.facebook.com/pretaloger has experienced increased growth throughout the previous months with the greater involvement of social media actions.*

Google +

We use the Prêt-à-Loger Google + account to host all our high-quality pictures. We link through to this digital album to press and partners interested in high quality pictures of our work. This way they can choose the pictures themselves from a diverse offer. We do not use Google + for other purposes.

Twitter

Twitter is used as a live feed of activities, usually at our events, providing an in the moment view on proceedings. Our Twitter account has also been proven useful for interacting with people that our interested in our idea, since Tweets tend to spread far and wide and you never know who will read it. The 'instant' concept of Twitter will be further enhanced by using Instagram in Versailles.

LinkedIn

We have used LinkedIn as a way of communicating with our professional partners. By creating a Prêt-à-Loger group where they can share their experiences and articles about our project we compiled relevant information in a virtual group for professionals in the industry. Besides this it also created a way for the team members involved in the project to state their function and job descriptions in their personal profiles, therefore enabling them to elaborate on their resume.

Instagram

In Versailles we plan to use Instagram as our prime media outlet. We have made an account to host our pictures and videos and will use this medium to provide an instant insight into the team's activities throughout the whole Solar Decathlon.



Figure 7.38 — *Our social media channels include Facebook, Google+, Twitter, Instagram and LinkedIn.*

7.5.4 Newsletters

Our Newsletter is primarily produced to maintain contact with people that are not actively following us through our website or social media. With around 6 topics per newsletter, sent out every 2 weeks, we maintain a steady flow of information linking trough to our Facebook page and website.

Newsletter #5_May (2/2) Regular · Newsletter **Sent** on Fri, May 23, 2014 08:17 am	344 Subscribers	52.2% Opens	18.5% Clicks
Newsletter #5_May (1/2) Regular · Newsletter **Sent** on Mon, May 12, 2014 09:00 am	335 Subscribers	52.7% Opens	16.0% Clicks
Newsletter #4_April (2/2) Regular · Newsletter **Sent** on Fri, Apr 25, 2014 12:24 pm	286 Subscribers	48.8% Opens	12.7% Clicks
Newsletter #3_April (1/2) Regular · Newsletter **Sent** on Fri, Apr 11, 2014 08:30 am	294 Subscribers	54.1% Opens	5.0% Clicks

Figure 7.39 — *Steady growth of subscribers and clicks on our newsletter give a good indication to what type of content is popular and what can be left out in future*

As you can see in the statistics above, our Newsletter has seen steady growth, and an increase in Open Rate and Click Rate throughout the process. We discovered how to use this medium to our advantage by keeping the texts in the newsletter small and linking through to our other media more often. This has helped us gaining traffic to mostly our website and Facebook page!

Newsletter May

"We achieved the seemingly impossible. We constructed the house."

Welcome to May's newsletter! The words above are of Josien Kruizinga and they capture the overwhelming feeling within the team. We have passed a major milestone in the project and the momentum towards Versailles keeps on growing. Read on to find out what we've been up to. As always, please feel free to follow us on Facebook and Twitter and spread the word!



Official Opening

After a 1,5 year of hard work, 3 months of intensive development, and 5 weeks of construction; our prototype is a reality. To celebrate we organised an official opening. We made an after-movie for everyone that missed it!



Dag van de Bouw

On the 24th of May our prototype in Harbrinkhoek will open it's doors to the public for the very first time. Come and visit us! You can sign up here and find more information about the venue here.

Figure 7.40 — *A screen-shot of our newsletter in May sent just after the official opening of our prototype. Short newsbites provide the most essential information with links to further information and movies on our website.*

7.5.5 Video Material

We really value the communicative value of videos. A picture is a thousand words, and a video is a lot of pictures. The aim is to produce regular videos leading up to and including the competition. These fall into the following categories:

Deliverable Videos - Of course a necessity, but a great platform for focusing on the concept of the project. From the Introduction (01) to Audiovisual #2 (02+03) we made sure to deliver our core message of improving existing homes.

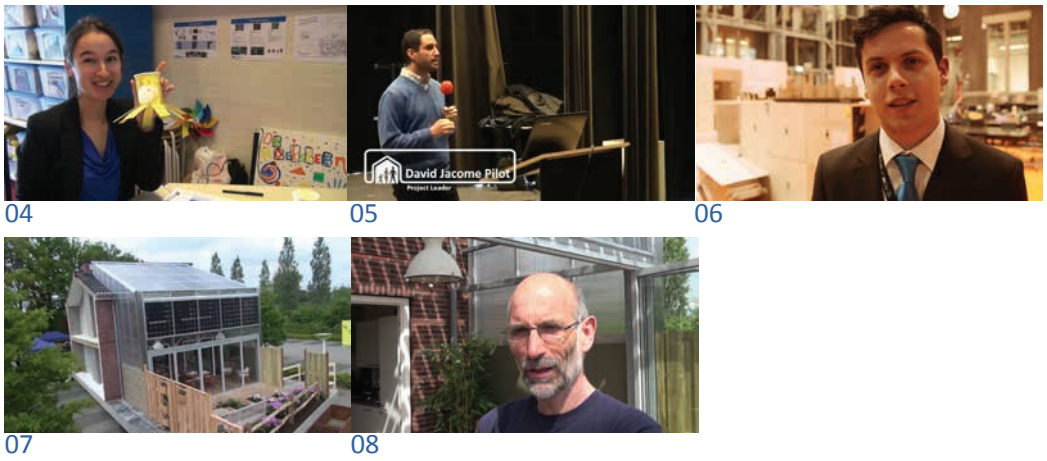
Figure 7.41 — *Screenshots from our Deliverable videos: 01 - Introduction video, 02 - Concept video, 03 - Project video*



01 02 03

Event Videos - These are highlights of some of our numberous events such as Honselersdijk (04), Rotterdam International Secondary School (RISS) presentation (05), our Prêt-à-Loger kick-off event (06), the grand opening of the house (07) and the Dutch Dag-van-de-Bouw (Building day) (08). These show the highlights of these events and include opinions of the public.

Figure 7.42 — *Screenshots from our event videos: 04 - Honselersdijk, 05 - RISS, 06 - Kick-off event, 07 - Grand opening, 08 - Dutch 'Building day'*



04 05 06

07 08

Short videos - These include mostly construction videos that help to inform how each part of the house is built. They are short videos (between 1-2 minutes each) and give insight to the building of our prototype and most importantly the fact that viewers see the students actively engaged in construction. These videos include a construction teaser (09), a construction time-lapse (10), the construction of the stairs (11), glass house (12), PV panels (13), floor panels (14) and wall panels (15). But we also produced a short clip of Prêt-à-Goler (16) where we draw attention to football as a team-building exercise and a vehicle to gain additional awareness of our project.

Figure 7.43 — *Screenshots from our short videos: 09 - construction teaser, 10 - time lapse, 11 - stairs, 12 - glass house, 13 - PVs, 14 - Floor panels, 15 - Wall panels, 16 - Prêt-à-Goler*



09 10 11


12

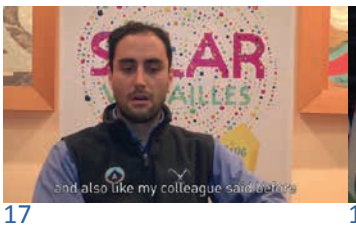

13


14


15


16

Solar Decathlon appearances - To keep and reinforce the link to the solar decathlon competition we of course included our appearances during the 2nd Versailles workshop (17+18) and the online speed peer review (19).



17



18


19

Figure 7.44 — *Screenshots from our Solar Decathlon appearances: 17 - Interviews, 18 - Versailles workshop, 19 - Online Speed peer review*

Televised appearances - We are of course exceptionally proud to have had several appearances on national TV. With this we have achieved one of our goals to disseminate nationwide and this has really helped to spread our message. So far Prêt-à-Loger has appeared on the news with 'RTL Nieuws' (20), 'RTV Oost' (21) and 'Hart van Nederland' (22) and has also featured on the popular television show 'Ons Huis verdient het' (23) (Dutch: Our house deserves it) which focuses on renewing existing houses. Please visit our facebook page **www.facebook.com/pretaloger** to find the links to these videos.


20


21


22


23

Figure 7.45 — *Screenshots from our TV appearances: 20 - RTL Nieuws, 21 - RTV Oost, 22 - Hart van Nederland, 23 - Ons Huis Verdient Het*

Viral video - This can't be manufactured but we are trying. Look out for 'All the single glazing (Put a Skin on it)! This will be released shortly before the competition in Versailles to boost the interest in our team and what we're doing in Versailles.

Versailles Videos - In Versailles, because events will be taking place so quickly, we will focus on using Instagram to post 15 second videos as soon as possible.
To view all these videos, please visit our website at **www.pretaloger.nl**

7.5.6 Events

We believe that Prêt-à-loger is building a very important project for the future of sustainability in the Netherlands. At the same time, we also understand that good projects will not mean anything if people don't know about it. Hence it is our task to make sure that people are aware about the benefits of our project through events.
Every events means different unique opportunities for us to showcase our project and receive feedback on what we do. Several events such as the Sustainable Westland (Duurzaam Westland), Dag van de Bouw and Zomer Festival 2014 are meant to inform the general public about the possibilities of improving their house and preserving their homes. In addition to that we have hosted our own events to talk to home owners, local residents and any person interested, to learn from their comments and advice. Events like our Kick-off meeting in February and the Grand Opening at 15th of May are important to maintain the support provided from relevant companies in the Netherlands as the sponsors of our project but also to show them that their energy and resources are invested in capable hands. While the Energy Break presentation that we've done with the collaboration with Energy Club of TU Delft has also been important share the ideas of our project to the professors and student of the university. Feedback given from people that we met at these events was incredibly valuable for us to improve ourselves and move forward with our project.



01 02 03

04 05 06

07 08 09

Figure 7.46 — *Photographs from some of our events we've organised in the past including Sustainable Westland (01+02), Energy club presentation (03+06), Honselersdijk event (04+05), RISS school workshop (07+08) and the grand opening of our house in Harbrinkhoek (09)*

Finally, we also hope that we can contribute to the education of children about the importance of sustainability and going green to the general public with our events. Even though we have our eyes aimed at the Solar Decathlon competition this summer with our project, we put the utmost importance to deliver our key message of sustainability to the general public. With more awareness about sustainability generated through our project, we hope that we can stimulate more 'green' initiatives in the future.
For more information on events see the following section *7.6 Events timetable.*

7.6 Events timetable

The following table shows the events that have been organised by the team in the past and those that are still in planning. They have been sorted by the categories: Privat, Public and Official.

Table 7.2 — *Events agenda up until Deliverable #7*

What [EN]	Where	When	Type
Deliverable #1	Dreamhall - TU Delft	1st April 2013	Official
Team BBQ + CL-Final	Rotterdam	25th May 2013	Private
Design Workshop with Professors	Faculty of Architecture - TU Delft	27th May 2013	Private
Methabolic Lab Workshop	Faculty of IDE - TU Delft	28th May 2013	Private
Miro Zeman's Thin Film PV Lab	Faculty of EEMCS - TU Delft	31st May 2013	Private
Zomerfestival TU Delft	Unit Sport & Culture TU Delft	31st May 2013	Public
Pret-a-Loger Introduction Presentation (1/2)	Dreamhall - TU Delft	4th June 2013	Private
Energy Club Meeting	Faculty of TPM - TU Delft	5th June 2013	Public
Design Workshop with Professors	Faculty of Architecture - TU Delft	13th June 2013	Private
Rotterdam Unlimited	Rotterdam	15th June 2013	Private
Deliverable #2	Dreamhall - TU Delft	1st July 2013	Official
Interactive presentation with sponsors	Faculty of Architecture - TU Delft	26th August 2013	Private
Multicultural Event	Aula - TU Delft	29th August 2013	Public
Ecobouw	Jaarbeurs Utrecht	17 - 19th September 2013	Public
Energy Event (Energy Club)	Aula - TU Delft	19th September 2013	Public
Solar Event	Brabanthallen Den Bosch	24-26th September 2013	Public
C2C Lab presentation	Faculty of Architecture - TU Delft	23rd October 2013	Private
Dreamteam of the year Event	Dreamhall - TU Delft	23rd October 2013	Private
Deliverable #3	Dreamhall - TU Delft	1st November 2013	Official
Solar Decathlon Workshop #2 Paris	Versailles	6-8th November 2013	Official
Pret-a-Loger Introduction Presentation (2/2)	Faculty of Architecture - TU Delft	9th September 2013	Private
Passiegroep - workshop with Mark Spee	Dreamhall - TU Delft	12th November 2013	Private
Safety Instructions Dreamhall (1/2)	Faculty of CEG - TU Delft	16th September 2013	Private
Partnermeeting	Faculty of Architecture - TU Delft	19th November 2013	Private
Master Event	Aula - TU Delft	21st November 2013	Public
Safety Instructions Dreamhall (2/2)	Faculty of CEG - TU Delft	25th November 2013	Private
Duurzaam Gebouwd Corporatie Seminar	Eindhoven	3rd December 2013	Public
Cleantech Business Day	Eindhoven	11th December 2013	Public
Market research presentation	Ministry of Internal Affairs - The Hague	9th January 2014	Private
Presentation on Zeldenrust Steelant-College	Zeldenrust Steelant-College - Terneuzen	13th Januari 2014	Private
Masterclass for House of Representatives	Faculty of Architecture - TU Delft	13th Januari 2014	Public
Pecha Kucha #1	Faculty of Architecture - TU Delft	17th January 2014	Private
Pressure Cooker #1	Faculty of Architecture - TU Delft	31st January 2014	Public
Official Kick-Off Presentation	Faculty of Architecture - TU Delft	6th February 2014	Public
Planning workshop with partners	Faculty of Architecture - TU Delft	6th February 2014	Private
Garden Design Workshop	Faculty of Architecture - TU Delft	6th February 2014	Private
Metabolic Lab meeting	New Energy Docks - Amsterdam	7th February 2014	Private
Pressure Cooker #2	Library - TU Delft	11th February 2014	Public
RISS Presentation High School	RISS - Rotterdam	13th February 2014	Private
Mediatraining (1/2)	Library - TU Delft	17th February 2014	Private
Pressure Cooker #3	Library - TU Delft	18th February 2014	Public
Visiting Prototype Stroomversnelling	Bosboomstraat - Heerhugowaard	19th February 2014	Private
Pressure Cooker #4	Library - TU Delft	21st February 2014	Public
Deliverable #4	Dreamhall - TU Delft	3rd March 2014	Official
PechaKucha #2	Faculty of Architecture - TU Delft	6th March 2014	Private
Webcare training	Library - TU Delft	6th March 2014	Private
Green drinks at the Green Village	Green Village Townhouse - Delft	7th March 2014	Private
Team Event	Delft	7th March 2014	Private
Media training (2/2)	Library - TU Delft	11th March 2014	Private
All Energy Day	Fokkerterminal - The Hague	14th March 2014	Private
FIFA Tournament	Rotterdam	14th March 2014	Private
Honselersdijk event – meeting the locals	Honselersdijk	22th March 2014	Public
PechaKucha #3	Faculty of Architecture - TU Delft	3th April 2104	Private
SummerSpring Sustainable Westland	s Gravenzande	12th April 2014	Public
Engineers Without Borders symposium	Kivi Niria HQ - The Hague	19th April 2014	Public
Interior drinks	Architecture???	24th April 2014	Private
Deliverable #5	Dreamhall - TU Delft	30th April 2014	Official
PechaKucha #4	Faculty of Architecture - TU Delft	1st May 2014	Private
Completion testhouse	Harbrinkhoek	15th May 2014	Public
Energy club lunch lecture	TU Delft	22th May 2014	Public
Summer Festival 2014	Delft	23-24-25 May 2014	Public
Day of building	Harberinkhoek	24th May 2014	Public
PechaKucha #5	Faculty of Architecture - TU Delft	28th May 2014	Private
Deliverable #6	Dreamhall - TU Delft	2nd June 2014	Official
Alumni Event TU Delft	Aula - TU Delft	6th June 2014	Public
Competition weeks	Versailles	16th June - 18th July 2014	Official
Building weeks Solar Decathlon 2014	Versailles	16th June - 25th June 2014	Public
Announcing the Winner of Solar Decathlon 2014	Versailles	12th July 2014	Public
Assembling house on Green Village	Delft	September 2014	Public
Deliverable #7	Dreamhall - TU Delft	3rd November 2014	Official

7.7 Sponsorship Manual

“WE ARE NOT DESIGNING THE HOUSE OF THE FUTURE...”

--- David Jacome Polit, Team Captain of Prêt-à-Loger

ADVISORY COMMITEE

Ir. M.A.E. (Marc) Calon, president Aedes (Association for housing associations)
A. (Annemarie) van Doorn, manager Dutch Green Building Council
Dr.ir. P. (Peter) Fraanje, director Dutch Association of Suppliers for Building
A. (Annemarie) Jorritsma-Lebbink, chairman Association of Dutch Municipalities
Prof.ir. K. (Karin) Laglas, Dean Faculty of Architecture, TU Delft
Prof.ir. K.C.A.M. (Karel) Luyben, Rector Magnificus TU Delft
Mr.drs. M. (Marjan) Minnesma MBA, director of the Urgenda foundation
Drs. E.H.T.M. (Ed) Nijpels, president NL Ingenieurs
Ir. W.H. (Willem Hein) Schenk, president BNA, Union of Dutch Architects
T. (Titia) Siertsema MBA, Chair of UNETO-VNI (branch society of building services companies)
Ir. S. (Stefan) van Uffelen, World Business Council for Sustainable Development
Drs. M.J.M. (Maxime) Verhagen, president Bouwend Nederland

1. Why become a Sponsor?

POSITIVE IMAGE

- It is time to make a stand!
- Politicians, principals, consumers and employees demand action
- Demonstrate your ambition of sustainability
- Being green is economically favourable
- Show that you are outstanding in your area
- Show that you are stimulating sustainable knowledge
- Being a pioneer in a new market

PUBLICITY - EXPOSURE

- Your brand/name in the 'The Green Village' expo for at least 2 years
- Mentioned on Prêt-à-Loger website
- Mentioned in Prêt-à-Loger (and so TU Delft) audiovisuals
- Mentioned on Prêt-à-Loger T-shirts
- Mentioned on the sponsor-board at the Solar Decathlon fair
- Brochures distributed among participants
- Mentioned on sponsor board in the Solar Decathlon campus in Versailles (300.000 visitors expected)

PUBLICITY - REPRESENTATION

- Your name and promotion on a stand in "La Cité du Soleile"
- Your name and promotion on the World Construction Forum 2014, Paris
- Your name and promotion during events on our stand
- Your name and promotion during our workshops
- Banners with your name during the build in Paris
- Lectures to SD-members and TU Delft
- Possibility for presentations at the welcome reception

KNOWLEDGE IS POWER

- Acquiring knowledge of sustainable building!
- Sustainable workshops at your company organized by our students
- Working with the most enlightened students from the TU Delft
- Find an upcoming first-class engineer for your company!

STAY 'UP TO DATE'

- Latest updates in sustainability by the community
- Desired information on demand
- Receive our newsletter



2. Merits to Sponsors

MAIN SPONSOR / PARTNER

With regards to the main sponsorship, the financial support and conditions are negotiable. The least merits we can offer are:

- Lodge at the SD fair (only for main sponsor)
- Logo with hyperlink on sponsor-page of the Prêt-à-Loger website
- Logo in Prêt-à-Loger Audiovisuals
- Logo on the sponsor-board at the fair
- Logo in the Prêt-à-Loger brochure
- Logo on the T-shirts back
- Logo and credits on mailed matter
- Prêt-à-Loger inauguration-cocktail invitation
- Lecture to SD team members and TU Delft
- Additional merits



HELIOS PACKAGE (GOLD SPONSOR)

Sponsoring of specific targets

- Logo with hyperlink on sponsor-page of the Prêt-à-Loger website
- Logo in Prêt-à-Loger Audiovisuals
- Logo on the sponsor-board at the fair
- Logo in the Prêt-à-Loger brochure
- Logo on the T-shirts back
- Logo and credits on mailed matter
- Prêt-à-Loger inauguration-cocktail invitation
- Lecture to SD team members and TU Delft





RA PACKAGE (SILVER SPONSOR)

Sponsoring of specific targets

- Logo with hyperlink on sponsor-page of the Prêt-à-Loger website
- Logo in Prêt-à-Loger Audiovisuals
- Logo on the sponsor-board at the fair
- Logo in the Prêt-à-Loger brochure
- Logo on the T-shirts back
- Prêt-à-Loger inauguration-cocktail invitation
- Lecture to SD team members and TU Delft





INTI PACKAGE (BRONZE SPONSOR)

Sponsoring of specific targets

- Logo with hyperlink on sponsor-page of the Prêt-à-Loger website
- Logo in Prêt-à-Loger Audiovisuals
- Logo on the sponsor-board at the fair
- Logo in the Prêt-à-Loger brochure
- Prêt-à-Loger inauguration-cocktail invitation



3. What is our capacity?

TU DELFT WORLD WIDE

- World wide respected and valued
- Over 17.000 students whereof 16% international students
- Annually about 3,500 new students
- 2,500 researchers
- Annually about 700 publications
- In the University top 100, Faculty of Architecture number 6 of the world
- Strong connections with international businesses

TEAM MEMBERS

- International team with a Dutch theme
- Multidisciplinary team
- Lead by professors in Architecture, Building Technology and Real Estate & Housing
- Committee of recommendation with leading engineers and politicians
- More information about team members and advise www.pretaloger.nl/team

WEBSITE WWW.PRETALOGER.NL

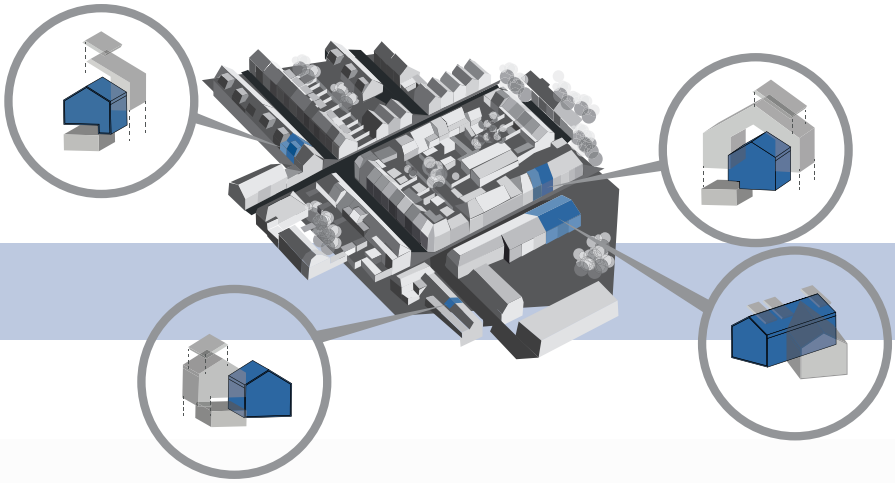
- Last updates about the Prêt-à-Loger project
- Team information
- The latest developments in sustainability
- Actual site views a day can be seen on www.pretaloger.nl

FACEBOOK PRÊT-À-LOGER

- Prêt-à-Loger fanbase
- Up to date activities and progress
- Latest YouTube-posts and news items
- Number of “likes” via www.facebook.com/pretaloger

TWITTER @PRETALOGER

- Interesting links and information
- Answering questions #pretaloger
- Number of followers via twitter.com/pretaloger



4. Package Overview

SOLAR DECATHLON	Main / PARTNER	HELIOS	RA	INTI
	Main	Gold sponsor	Silver sponsor	Bronze sponsor
General financial support or inkind*	€50,000	€50,000 - €25,000	€25,000 - €10,000	€10,000 - €5,000
MERITS TO PARTNER				
Additional	3			
Logo and credits on mailed matter	3	3		
Logo on the T-shirts back *	3	3	3	
Lecture to SD team members and TU Delft	3	3	3	3
Logo with hyperlink on sponsor-page of the PàL website*	3	3	3	3
Logo in PàL's Audiovisuals*	3	3	3	3
Logo on the sponsor-board at the fair*	3	3	3	3
Logo in the PàL brochure*	3	3	3	3
Prêt-à-Loger inauguration-cocktail invitation	3	3	3	3

*All these possible combinations are subject to the latest SDE 2014 regulations.

5.Conditions

RULES REGARDING FINANCIAL SUPPORT AND INKIND

1. Material support is covered by financial support. The financial support will include in kind. Inkind will be validated by concurrent prices and hourly overviews.

RULES REGARDING LOGO'S

2. The size of the logo's will be according to the sponsored amount. The size on the available area will be the same percentage of the sponsored amount with a maximum percentage of 10%.

The Design

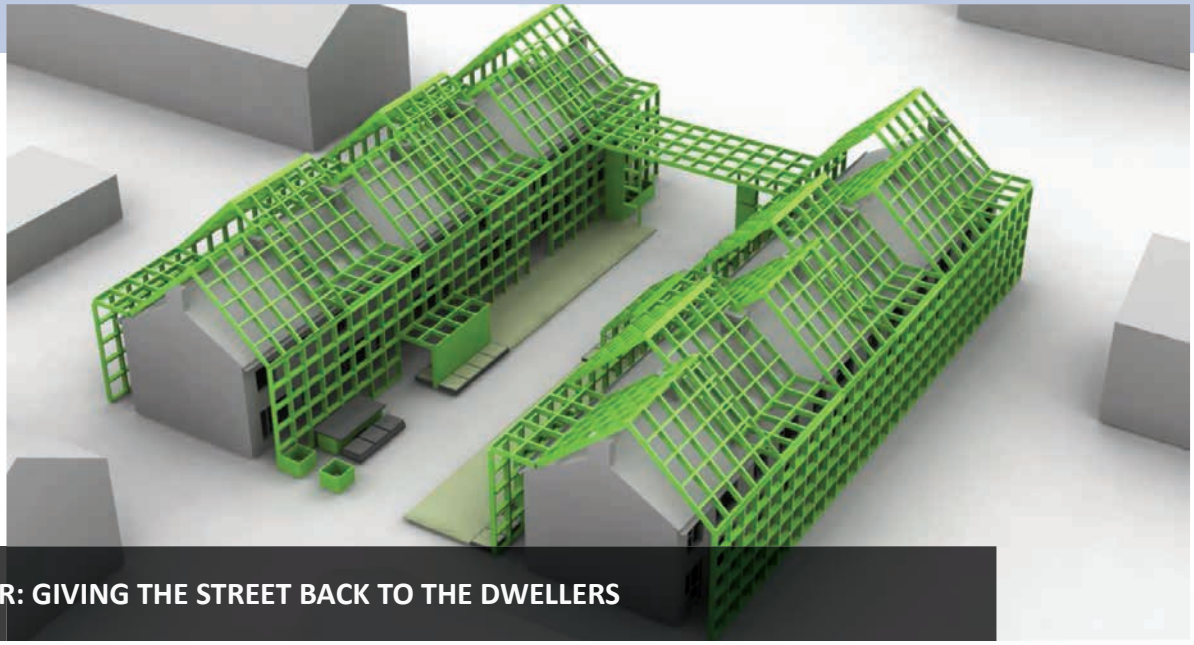
THE CONCEPT

A significant amount of housing in the Netherlands has fallen into disuse or does not meet the physical and social demands of current times. This, along with the depressing fact that our resources will be exhausted in the nearer future is a spearhead of our project. The main objective of our project is to not to make a house that can be showcased as a prototype but to change the current housing stock into completely functional , CO2 -neutral and sustainable houses.

Because our design is based on one of the most common scenarios in Netherlands, our proposal, with some modifications, could easily be replicated and applied in large parts of northern Europe. Our goal goes beyond designing or renovating a house. We want to inspire others to change their home into an energy-efficient and energy-producing place to live where the space, the light and the material are being used in the most optimal way. For such a transformation (from an energy-consuming house to an energy-efficient house) appropriate solutions for individual cases are necessary. To achieve these ambitious goals there will be a number of resources and products designed to assist the parties involved in the preservation process. By a variety of affordable, innovative, flexible and technical solutions to this question, the design will be usable to both individual home owners as well as collective parties, housing associations and municipalities.



Figure 7.47 — *"The flexible facade system makes it that the skin can be modified to fit the users needs. These different configurations ar-en't only making it possible to perform a technical upgrade, but also create an architectural increase in value."*



A 'NEW SKIN'

The inspiration for this idea, giving an existing home a 'new skin', is derived from the principle to maintain, as much as possible, the existing building stock. Examples of elements to maintain are the structural building elements and appliances that can still go along for many years. On top of it, also the lives of the residents that call the house 'their home' will be able to live there for many years to come. Finding a balance between achieving conservation and implementing improvement is essential in the concept of the skin: a skin that packs the existing building, as it were. This skin is thus a common link between the street and the individual rooms in the house.

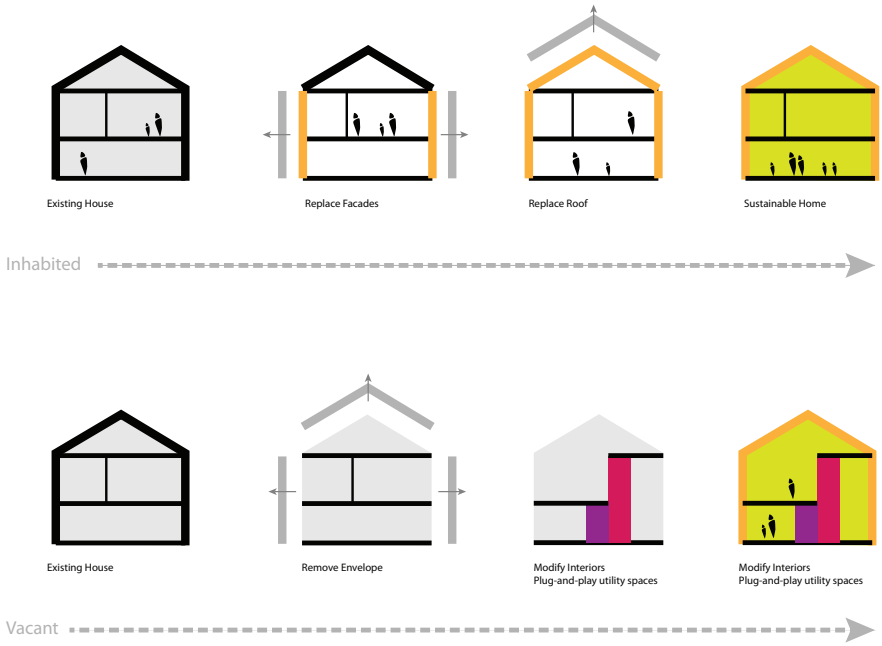


Figure 7.48 — *"Besides the flexibility when it comes to the appliances of the skin, there also is flexibility in applying the skin to empty or occupied housing."*

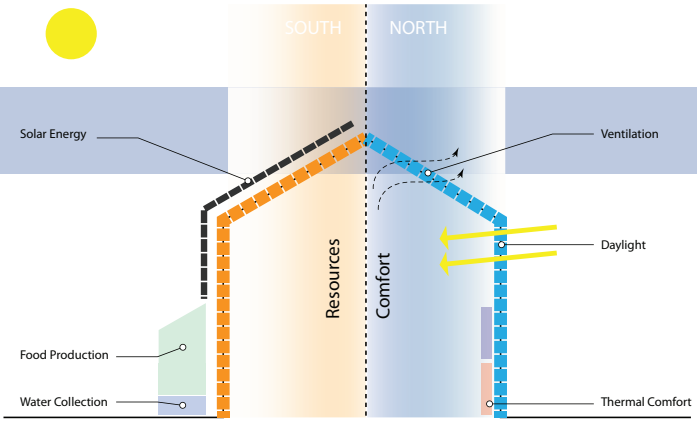


Figure 7.49 — *"The skin's function in the aspect of sustainable climate techniques to enhance the performances of the house."*

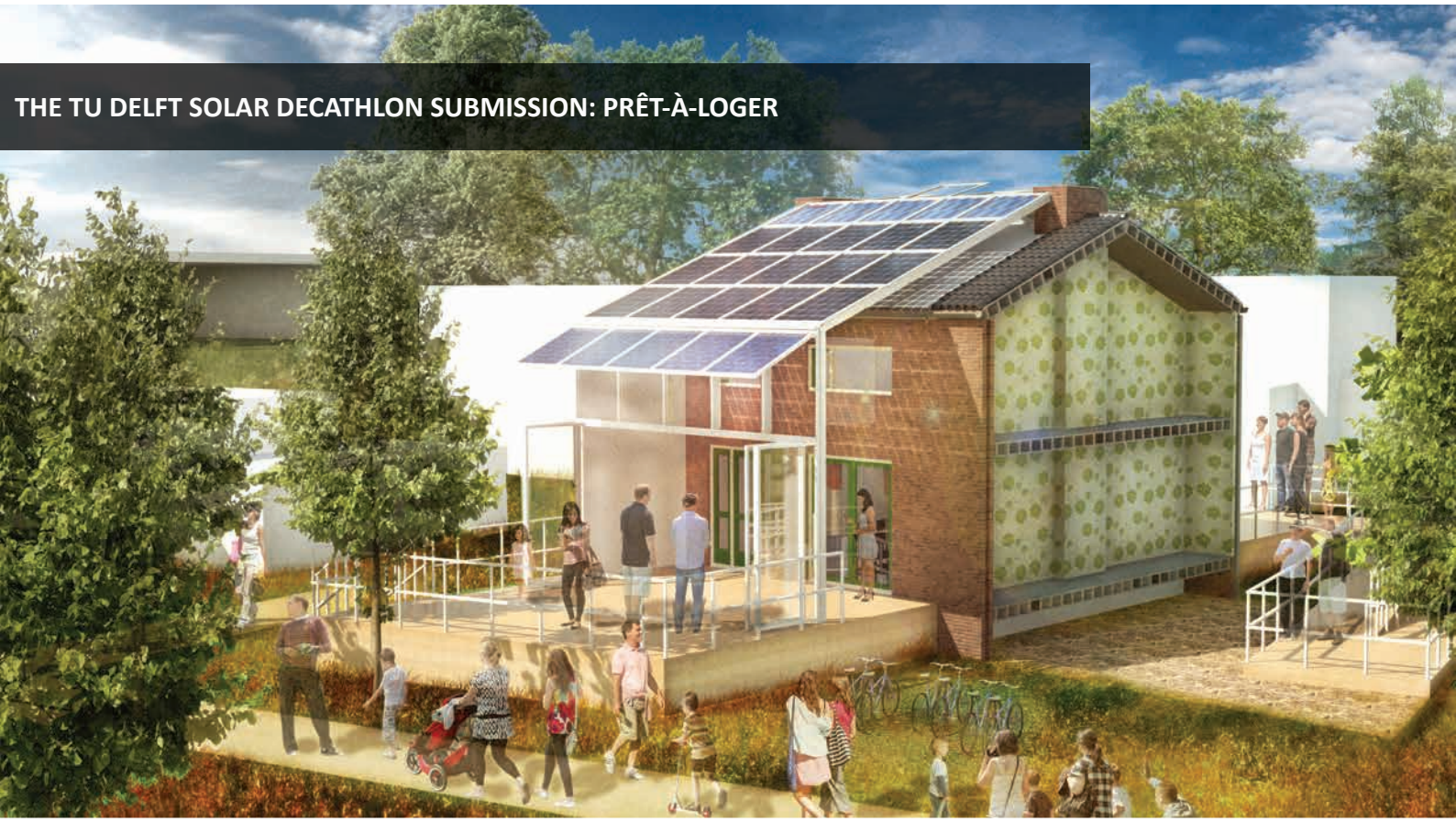
HOW DOES IT WORK?

The most important functions of the skin are reducing, reusing and producing energy, food and water - the essential elements of making a livable house. The plug-and-play system, that will be connected to the existing facilities, will make the newly built skin immediately ready to use after instalment. All the required spaces to support the newly added skin-functions, such as machinery, are given a place in the skin itself. This makes it possible to reduce the fundamental influence that the skin has on the existing house to a minimum. The materials used to clad the facade are selected on grounds of affordability, possibilities for reuse and aesthetic aspects.

THE LARGER CONTEXT

When it comes to defining the scale of the urban design we've chosen to design two rows of houses. These two rows form the basis for the production of energy, water, food and warmth. The two rows of houses are combined by the skin that, next to connecting the houses on a social scale, also creates a food producing community. The design of the street exists out of a variety of open and enclosed areas to facilitate the growth, storage, selling and consuming of food. On the spots where the skin meets the houses a buffer zone will arise. This buffer zone will form a transition area between public and private and will change its appearance during the seasons, more open or more closed. The further you will walk into the private backyard, the higher privacy is ensured.

In general the skin can be seen as an extension of the house; being closed in winter times (winter garden) and being the point of activities and openness during summers. By this, the traditional fixated dwelling is transformed into an open, 21st century, state of the art 'Smart House' by only adding a second skin.



THE TU DELFT SOLAR DECATHLON SUBMISSION: PRÊT-À-LOGER

Solar Decathlon Competition

HISTORY

The Solar Decathlon competition finds its origin in the United States where it has been organised since 2002 by the U.S. Department of Energy. The competition aims on designing and building a solar based house that's energy independent. The competition is meant for all universities and institutes for higher education from all over the world. The competition is held every two years in the United States and since 2010 the competition has also made its entrance in Europe every other year.

GOAL

The Solar Decathlon goal is to transfer knowledge, research and experiments on the field of sustainable energy and solar energy. Also, the competition tries to reach a broad audience in creating awareness about being responsible for the environment when it comes to materials, products and techniques that can be used in housing the worlds future.
Finally, the underlaying thought of the competition is bringing universities together with the commercial world. The competition is about bringing together students, professors, researchers, building professionals, businessmen and industrial actors who are bent on developing research, innovation and understanding of renewable energy in the building sector and inventing and testing new processes and materials that can be used in the houses of tomorrow.

COMPETITION

Teams around the world can apply for the Solar Decathlon. Only 20 teams can be part of the Solar Decathlon Competition. Teams have 18 months to design and build a house for the "La Cité du Soleile". In 2010 and 2012 this "La Cité du Soleile" was in Madrid, Spain, this edition will be held in the gardens of Versailles, France. The Solar Decathlon is worldwide the only competition where teams can design and build a fully functioning self-sufficient house only powered by solar energy. These concepts need to be applicable in real life.

TU DELFT

The team of the TU Delft is one of the 20 selected teams to take part in the competition of the Solar Decathlon in Versailles 2014.

FIGURES

- 220,000 vistors visited the Solar Decathlon 2012 in Madrid, whereof:
- 2,000 students
- 6.000 professionals
- Facebook reached 124,000 persons
- Twitter reached 120,000 persons
- 150,000 persons visited the Solar Decathlon-website
- Around 300,000 visitors will visit the Solar Decatholan Village in Versailles 2014.
- There will be a increasing amount of visitors following digital media



VISUALISATION OF THE SOLAR DECATHLON TERRAIN IN THE VERSAILLES GARDENS







The Green Village

WHAT HAPPENS AFTER THE SOLAR DECATHLON COMPETITION?

Initially we, as team members and partners, are working towards the competition in June 2014. As a project in which sustainable use of materials and energy stands central, we must think about the entire lifecycle of our Prêt-à-Loger. Therefore the Delft University of Technology Solar Decathlon team works together with the 'Green Village' initiative. A place where the design will be exposed for the next 10 years. The house will stand in the middle of mobile energy neutral housing, a generator car park and a convention center integrated into a wind turbine, the Harp.

'THE GREEN VILLAGE'

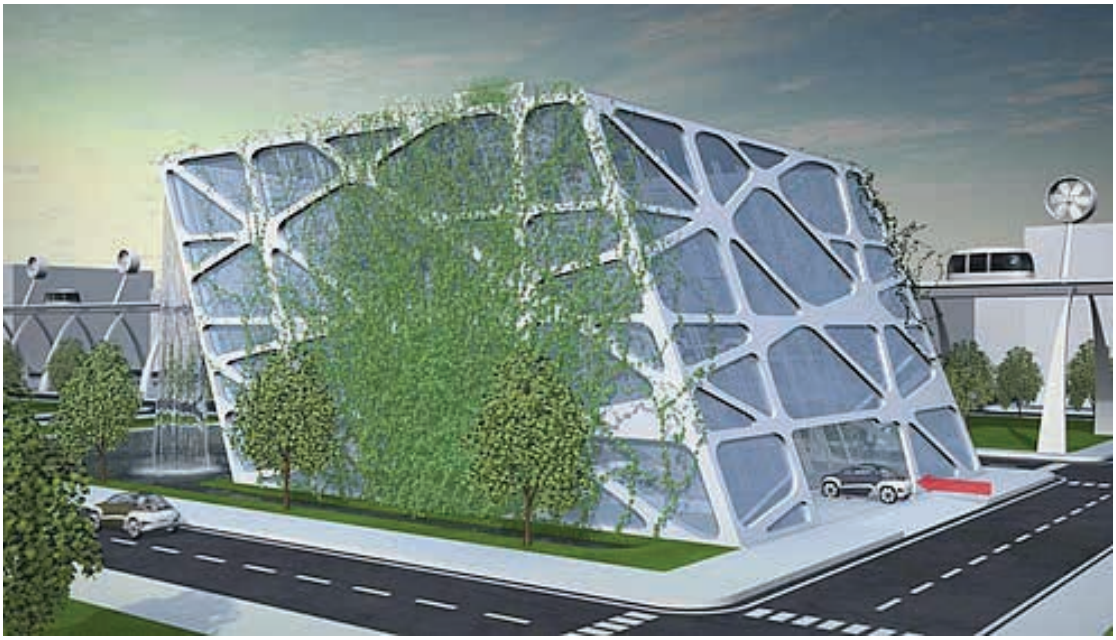
The Green Village concept is invented by Prof. Ad van Wijk of TU Delft and is an initiative to exhibit the sustainable development in the energy and construction sector. Specifically, this means the creation of a small 'green village' at the TU Delft campus. This village is the first Dutch village where innovative ideas from the university can be directly implemented. The TU Delft Solar Decathlon team gets a place in the village for the coming years to exhibit their homes. For more information please refer to: http://www.thegreenvillage.org

WHAT DOES THIS MEAN FOR YOU?

Your investment in our project will not only validate the way to and during the competition, but also in the years after the competition in 2014. Your investments in techniques and / or your name will remain attached to the house and your logo will remain visible in the house. On 'The Green Village', many national and international guests will follow a customized tour through the village and our sustainable renovation, Prêt-à-Loger. It will also function as a home stay, space for a cafe, information center or kiosk.

"Creating a sustainable, lively and entrepreneurial environment where we discover, learn and show how to solve society's urgent challenges"
- prof.dr. Ad van Wijk







Dreamteams

TU Delft, more specifically it's student-community, has a long tradition of successful participation in student competitions. Many of these victories contribute greatly to the positive image of the university. At the moment there are 12 Dreamteams within the TU-Delft including Prêt-à-Loger.



NUNA NUON SOLAR TEAM

The NUNA project is one of the most prestigious solar projects of the TU Delft. Started in 1999, they have been leading the World Solar Challenge. Winning 5 of the 7 challenges during the past 14 years. The latest NUNA 7 is the first succesfull four-wheel solar race car of the team winning the 2013 World Solar Challenge past October in Australia.



DUT RACING TEAM

Founded in 2000 by two students of the TU Delft, the team started their first racing adventure in the summer of 2001. In October 2013 they managed to get a record in the Guiness World Book of Records with the fastest acceleration, 2,15 seconds to reach 100 km/h.



FORZE HYDROGEN RACING

A battery car stores the electric energy in a battery while a hydrogen vehicle stores energy in hydrogen. This hydrogen is converted in a fuel cell system to electric energy. In 2006, the team started with the Forze I, nowadays they're working on Forze VI. The car accelerates within 4 seconds to 100 km/h. The hydrogen system in the race cars is developed by Forze.



HUMAN POWER TEAM

The team was founded in September 2010, and in September 2011 it obtained a European and student record with a speed of 129 km/h, and in September 2013 that new world record was placed at 133.78 km/h. This happened at the yearly World Human Powered Speed Challenge event in Battle Mountain, Nevada, United States of America. At this moment, the fourth team of students is preparing for the new world record attempt with a new high-tech recumbent: the VeloX4.



DELTA LLOYD SOLAR BOAT

2006, on this first edition of the Frisian Solar Challenge the Solar Boat Team of the TU Delft achieved a first place. Since 2010 the team came up with a completely new and innovative design: a solar boat with hydrofoils. "Actually, we do not sail, the technique is more like flying".



DARE

Delft Aerospace Rocket Engineering (DARE) is a student rocketry organization. DARE has flown over 100 rockets since its founding in 2001. Winning multiple times and breaking numberous records.



NOVABIKE

NovaBike wants to reshape the image of bio-ethanol by proving its potential for high performance. The main goal is to show that bio-ethanol offers equal or greater performance compared to conventional fossil fuels. Since the start in 2009 they have gained positions and taken podium places in races.



ECO-RUNNER

The team has two main goals for the Eco-Runner 4. The first goal is to win the Shell Eco-marathon in the hydrogenation prototype class. The second, very ambitious goal is to establish the most energy-efficient vehicle in the world. In 2008 eco-runner rode on 1 litre 2,282 kilometers. Nowadays they're trying to reach 1 litre to 5,000km!



SERIOUS GAMING TEAM

On a daily basis there is about two hundred kilometers of traffic jam in the Netherlands. Drivers claim they can't do anything about it. However, the opposite is true. Driver behavior is of great influence on the flow of traffic. So far there has been mainly focus on infrastructure and policy technical solutions, which did not cause the desired effect. It is time to move towards the drivers. The Serious Gaming Team develops a new game, CatasTraffic to change the focus to the drivers.



THE OCEAN CLEANUP

Approximately 1/3 of global oceanwaters suffer from plastic pollution. Total amount of plastics is about 7,250,000,000 kg. With the Ocean Cleanup Array, an anchored network of floating booms and processing platforms will span the radius of such a gyre. The debris then enters the platforms, where it will be filtered out of the water, and stored in containers until collected for recycling on land.



WASUB

There are two main human powered submarine races that take place biannually: the ISR (International Submarine Races) and the EISR (European International Submarine Races). This year the Wasub 3 team achieved a second fastest speed in the ISR. This year it will be up to the Wasub 4 team to go for a submarine prize at the EISR.



PRÊT-À-LOGER

The new prestige team of the TU Delft participates in the Solar Decathlon competition under the name Prêt-à-Loger. The challenge to design and build a self-sufficient house that is powered only by solar energy.

Events

The below-mentioned events have been visited or will be vistited by the Prêt-à-Loger-team, with the goal to common share the vision and expose our project. We extend our network, which means visibility for sponsors.

February 6th, 2014: Official Kick-Off
Time: 17:00, Location: TU Delft Faculty of architecture

March 22nd, 2014: Honselersdijk event
Time: 13:00, Location: Honselersdijk

May 15th, 2014: Official opening Prototype
Time: 14:00, Location: Groothuis wonen, Harbrinkhoek

May 24th, 2014: Dag van de Bouw
Time: full day, Location: Groothuis wonen, Harbrinkhoek

June 6th, 2014: Alumni Event TU Delft
Time: 12:00 - 18:00, Location: Aula TU Delft, Delft

June, 2014: Big Wave-off event
Time: unknown, Location Groothuis wonen, Harbrinkhoek

June 27th, 2014: Official "press-day" in Versailles
Time: unknown, Location: Versailles, France

June 28th- July 14th, 2014: SOLAR DECATHLON COMPETITION
Time: unknown, Location: Versailles, France

July 12th, 2014: Competition results and announcement of WINNER
Time: unknown, Location: Versailles, France

September, 2014: Official opening in Delft / Green Village
Time: unknown, Location: Green Village, Delft



THE PRÊT-À-LOGER TEAM



PROMOTING PRÊT-À-LOGER AT THE ECOBOUW FAIR





“...WE ARE DESIGNING, SO THAT OUR HOMES WILL MAKE IT THERE.”

--- David Jacome Polit, Team Captain of Prêt-à-Loger

Energie Sprong

PLATFORM31

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties

TU Delft Delft University of Technology

TBI

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DINNER PARTY MENU

1.1 Introduction

The essence of the design of the “Home with a Skin” has been creating a product that is capable of providing sustainable homes for millions of Dutch inhabitants. In the process of doing so, the aim is to also increase the inhabitants’ awareness of sustainability. The Prêt-à-Loger renovation addresses various aspects, such as climate needs, space, aesthetics and affordability, of people living in Dutch row houses. When taking on the role of a chef, our challenge was to provide those qualities, which we believe to be important in our design. We want our dinner to reflect what our design is all about. At the same time, we also aimed at showing that the Netherlands is not only about Tulips and mills, but that we have always considered the importance of international relations and consequently want to be good hosts.

In order to make our dinner coherent with our ambitions and make it mass applicable, we decided to limit the use of extraordinary ingredients and cooking methods. This would also drive up the cost beyond acceptable levels. Another important aspect, which has been integrated in our design is that our design creates a better home – and does so in a sustainable way. In order to reflect this approach in our menu, we strived to develop it in a way that it would have little environmental impact. As a result, we chose vegan dishes. However, we feel that, just as with our home, we should not promote it is as being sustainable or vegetarian/vegan. What we want to achieve is a menu that fulfills every need with zero compromise, while being thoughtful of our environment.

1.2 The Prêt-à-Loger Menu

1.2.1 A Dutch welcoming (Some vegan/some vegetarian)



Whenever you are welcomed into a Dutch home, you are sure to encounter some snacks on the table. These typically consist of toasts or pieces of bread with some sort of ‘tapenade’ or cheese or meat on it. Therefore, for our menu, we will make roasted bread with several toppings:

A tapenade of mint, peas, beans and parmesan cheese
A tapenade of grilled vegetables and fresh herbs
A tapenade of mushrooms and nuts

All of these can be easily prepared with a blender and then spread on the bread.

Energy

A few minutes of blending (700 W, 3 minutes) amounting to 35 Wh, are required.

1.2.2 One change at a time (vegan)

Tomato soup is probably the most eaten soup in the Netherlands. Locally produced, widely available and tasty. People are used to tomato soup like they are used to their homes. The design of our house leaves the old house intact, but changes its exterior. For the tomato soup, we will make a variation that will still be very recognizable, but it will be prepared cold and not cooked. This reduces the energy needed for the dish and shows that it can still result in a tasty dish!



Ingredients

Amount	Ingredient
2.5 kilo	tomatoes
3	toes of garlic
0.5 litre	tomato juice
1.5	cucumber
1	red paprika
handful	basil
0.7 dl	aceto balsamico

Will be served with some olive oil, tabasco and bread.

Preparation

All ingredients will be put in the blender until a smooth texture is achieved.

Costs

Total cost of this dish is based on the actual quantities used in the dish and prices from the largest Dutch supermarket www.ah.nl/appie:

Euro	Ingredient
4.95	tomatoes (500 g 0.99)
0.20	garlic (2 pieces 0.69)
0.50	tomato juice (1 box 0.97)
0.80	cucumber (per piece 0.55)
0.79	paprika (per piece 0.79)
0.70	basil (per packaging 1.39)
0.20	aceto balsamico (1.89 per bottle)
0.75	bread (0.75 per loaf)
0.50	olive oil (2.89 per bottle)
0.30	tabasco (2.29 per bottle)
9.69	TOTAL

This amounts to 1.21 Euro per serving.

Energy

A few minutes of blending (700 W, 3 minutes) 35 Wh.

1.2.3 Asparagus Toolbox (vegan)

Our main dish will show part of what our Toolbox concept is about. It will demonstrate how a similar product can have several shapes to which everyone can have a different liking. The asparagus is typically a more festive food, seen during spring and perfect for a dinner party. Although the asparagus season is almost over at the end of June, we decided to stretch it a little to show one of the advantages of our renovation. This advantage is that during this season, you could already eat outdoors in our glasshouse, making the dish even more attractive. A traditional Dutch preparation of asparagus would entail butter sauce, ham and egg and the asparagus themselves. For this dish, we decided to bring out the taste of the asparagus by making three variations of a lemon sauce to accompany the asparagus.



Ingredients

Amount	Ingredient
2.5 kg	asparagus
50 g	salt
40 g	sugar
1 kg	potatoes
500 gr	spinach
1	salted lemon
	olive oil
100 ml	soy milk
250 ml	oil
4 ts	mustard
2 sp	vinegar
8	lemons
4 g	lecithin powder

The asparagus are placed over the spinach and served with 3 sauces spread over the plate. Some potatoes and some garnish are added.

Preparation

The ends of the asparagus are cut and the rest is peeled. This residue is boiled in 5 liters of water, together with the sugar and salt. This liquid is then sieved and used to boil the asparagus in it for about five minutes. The spinach is prepared shortly in a wok. The potatoes are boiled in water. The lemon oil is made with lemons that have been salted and rested in a pot with salt. The skin is cut and mixed with olive oil.

The lemon veganaise is made with the soy milk, oil, mustard, vinegar, lemon juice and scrapings. The lemon foam is made of lemon juice, water and lecithin powder.

Altogether, the dish is prepared with a blender and several pans.

Costs

Euro	Ingredient
18.95	asparagus (3.79 per 500 gr)
0.70	salt (1.51 per packaging)
0.07	sugar (1.15 per kg)
1.69	potatoes (1.69 per kg)
1.50	spinach (1.50 per 450gr)
3.38	lemons (1.69 per 5)
1.50	olive oil (2.89 per bottle)
0.11	soymilk (1.09 per L)
0.20	mustard (0.93 per pot)
0.05	vinegar (0.59 per L)
0.25	lecithin (11.50 per 200gr)
28.40	TOTAL

This amounts to 3.55 Euro per serving.

A few minutes of blending (700 W, 3 minutes) 35 Wh
Potatoes, stove (1800 W, 20 minutes) 600 Wh
Spinach, stove (1800 W, 4 minutes) 120 Wh
Asparagus, stove (1800 W, 20 minutes) 600 Wh

1.2.4 A house & a home (vegan)

Our desert will show a nice combination of both a traditional dish and a new dish. On the one hand, we will make a traditional rhubarb compote with muesli crumble that shall remind the guest of a typical Dutch grandmothers' recipe. On the other hand, we will have a modern strawberry granite. The rhubarb compote shows the traditional homely feel of the Netherlands and the strawberry granite will represent the new excitement that modern developments bring into a house.



Ingredients

Amount	Ingredient
500 gram	strawberries
50 gram	powdered sugar
1	lemon
1 sp	aceto balsamico
1.5 kg	rhubarb
500 gr	sugar
0.25 L	white wine
50 gr	maizena
50 gr	margarine
75 gr	flour
50 gr	bastard sugar
50 gr	nuts (left out in case of allergy)
50 gr	oats (left out in case of allergy)



Preparation

The Granite: the strawberries and the powdered sugar are mixed and blended with the juice of the lemon and aceto balsamico. Afterwards, the mixture is put in the freezer on a plate and scooped every now and then. The rhubarb compote: The rhubarb is peeled and the leftovers are put in the wine and sugar, the red color is then extracted from the leftovers. The juice is sieved and used to boil the rhubarb. Maizena is added for proper texture. The crumble: The margarine, flower, sugar are mixed, when there is no allergy the nuts and oats as well. This is put on top of the compote and baked in the oven for about 15 minutes.

Costs

Euro	Ingredient
2.99	strawberries (2.99 500 gr)
0.16	powdered sugar (0.83 per 250gr)
0.35	lemon (1.69 per 5)
0.20	aceto balsamico (1.89 per bottle)
4.98	rhubarb (2.49 per 700 gr)
0.60	sugar (0.91 per 750gr)
0.99	white wine (2.99 per 750ml)
0.13	maizena (0.53 per 200gr)
0.17	margarine (0.85 per 250gr)
0.03	flower (0.39 per kg)
0.10	bastard sugar (0.87 per 600gr)
0.70	nuts (2.69 per 175gr)
0.10	oats (1.09 per 750gr)
11.50	TOTAL

This amounts to 1.43 Euro per serving.

A few minutes of blending (700 W, 3 minutes) 35 Wh
Rhubarb, stove (1800 W, 15 minutes) 450 Wh
Crumble, oven/grill (2500 W, 15 minutes) 625 Wh

1.2.5 After dinner: Selection of Dutch cheese

After dinner there will be coffee and some chocolates, or some cheese with drinks based on the desires of the guests.



1.2.6 Beverages

Besides a selection of wines to accompany the dishes, we will serve water, orange and apple juice.

1.3 Facts and Figures

1.3.1 Cost evaluation

The 3 courses cost 1.21 Euro, 3.55 Euro and 1.43 Euro per person, respectively. This amounts to a three course dinner for only 6.19 Euro. This would be a very acceptable amount for a Dutch family having friends or family over for a dinner party. Of course, the drinks need to be considered as well. However, the menu is likely to stay within the range of 10 Euro. The ingredients that are left over can either be stored for a longer time or used in other standard dishes.

1.3.2 Energy consumption

When summing up the energy consumption, it amounts to about 2.5 kWh of energy. For a three course menu, this is slightly below average. The estimation of 2.5 kWh is somewhat on the high side, because of the assumption that everything will always be on full power. In our menu, there are a few aspects that address saving energy. First of all, we do not heat the soup, which would be about 0.9 kWh (30 min 1800W). Secondly we cook asparagus, which will only be boiled for about 2 minutes before turning off the

heat. There are some minutes needed to preheat the water, but this will be done in a water cooker, which is much more efficient than heating water on the stove. Finally, it has to be stressed once more that because of the absence of meat and other animal products, the energy consumption and the environmental impact that was reduced as a result from that is significant.

1.3.3 Nutrition

A healthy diet consists of a diverse range of foods. With the hectic lifestyle that most of us follow, it is not always easy to cover all the essential vitamins, proteins and macro and micro nutrients that our body needs. The proposed plant based menu provides for all these nutritional needs.

1.3.4 Local content

Every ingredient we use, we want it to be widely available in the Netherlands for our menu to be considered local. At the same time, the recipes should also be considered local, meaning that they have a typical Dutch origin. In Dutch, we have the saying: “Wat de boer niet kent vreet hij niet”, which translates into: “What the farmer doesn’t know, he doesn’t eat.” We wanted to create a dinner that the farmer (and everyone else) eats! To make extra use of the glasshouse and the garden, we will grow many herbs and some vegetables in these areas. However, due to the many factors that we cannot influence during the competition, especially regarding health and safety, we will not use them for the actual dinner parties.

CONTEST WEEK TASKS' PLANNING

The following calendar is based on the provided calendar of the SD organisation. A draft of the overall schedule has been made according to the period of competition and public elements. The assembly and disassembly period are left out of this calendar.
The detailed calendar per daily measurement and contest element is left out, and will be further elaborated on in a later stage, stating what needs to be done and by which team member.

The tasks are divided in three categories:

1. Events that need to be arranged by the team
2. Daily contests and measurements
3. Events organized by the Solar Decathlon organization

Events that need to be arranged by the team itself, a responsible team member is appointed.

DAY		TIME		TASK	RULE	# people needed	# people allowed in hous
Thursday	26-jun						
					Day leaders	Matt, David	
Events		09:00	16:00	Final inspections	11.6		
		16:00	22:00	Team private visits			19
					Day leaders	Tim J.	
Assembly		08:00	16:00	Minor changes house			
Friday	27-jun						
					Day leaders	Esti, Nick	
Events		17:00	19:00	Official opening ceremony			
		17:00	22:00	Media	12.4		
		11:00	13:00	PaL Partner visits			
		13:30	15:30	Friends and family visits			
					Day leaders	Stelios , Matt	
Assembly		21:00	23:00	System functioning	10	2	6
		21:00	23:00	Lighting	12.6	1	
Saturday	28-jun						
					Day leaders	Rianne, Josien	
Events		10:00	14:00	Public tour	12.4	9	19
		14:00	18:00	Public tour	12.4	9	19
		18:00	22:00	Public tour	12.4	9	19
					Day leaders	Vasilis , Matt	
Assembly		09:00	17:00	System functioning		2	6
		21:00	23:00	Lighting	12.6	1	
Sunday	29-jun						
					Day leaders	Esti, Jules	
Events		10:00	14:00	Public tour	12.4	9	19
		14:00	18:00	Public tour	12.4	9	19
		18:00	22:00	Public tour	12.4	9	19
					Day leaders	Stelios , Vasilis	
Measurements		09:00	17:00	System functioning		2	6
		21:00	23:00	Lighting	12.6	1	
Monday	30-jun						
					Day leaders	Nick, Dennis	
Events		11:30	14:30	Public tour	12.4	9	19
		17:30	19:30	Public tour	12.4	9	19
		16:00	19:30	Speed peer review **Osama**, Nick, Laurence, David	21	4	6
					Day leaders	Stelios , Vasilis	
Measurements		08:00	16:00	Check MEAS/ TASK	¡/19.5/20.5	2	
		16:00	23:00	Check MEAS/TASK	¡/19.5/20.5	2	
		21:00	23:00	Lighting	12.6	1	
Tuesday	1-jul						
					Day leaders	Rianne, Marina	
Events		11:30	14:30	Public tour	12.4	9	19
		17:30	19:30	Public tour	12.4	9	19
		12:00	18:00	Communications jury visits **Osama**, Nick, Laurence, David	21	4	6
		21:00	23:00	Dinner Bob, Jasper S	20.5		19
					Day leaders	Stelios , Vasilis	
Measurements		08:00	16:00	Check MEAS/ TASK	¡/19.5/20.5	2	
		16:00	23:00	Check MEAS/TASK	¡/19.5/20.5	2	
		21:00	23:00	Lighting	12.6	1	
Wednesday	2-jul						
					Day leaders	Nick, Sevan	
Events		11:30	14:30	Public tour	12.4	9	19
		17:30	19:30	Public tour	12.4	9	19
		12:00	18:00	Communications jury visits **Osama**, Nick, Laurence	21	4	6
		12:00	18:00	UDTA jury visits **Todor**, Bob, Daniel, David	22	4	6
					Day leaders	Stelios , Vasilis	
Measurements		08:00	16:00	Check MEAS/ TASK	¡/19.5/20.5	2	
		16:00	23:00	Check MEAS/TASK	¡/19.5/20.5	2	
		21:00	23:00	Lighting	12,6	1	

Thursday	3-jul						
					Day leaders	Esti, Futura	
Events		11:30	14:30	Public tour	12.4	9	19
		17:30	19:30	Public tour	12.4	9	19
		19:00	20:30	Communications Jury Conference & debate	21	4	6
				Osama, Nick, Laurence, David			
		19:00	20:30	Communications contest award	21	all	
		12:00	18:00	Arcitecture Jury visits	15	3	6
				Josien, Dennis, David			
		12:00	18:00	UDTA jury visits	22	4	6
				Todor, Bob, Daniel, David			
		21:00	23:00	Dinner	20.5	2	19
				Bob, Jasper S			
					Day leaders	Stelios , Vasilis	
Measurements		08:00	16:00	Check MEAS/ TASK	/19.5/20.5	2	
		16:00	23:00	Check MEAS/TASK	/19.5/20.5	2	
		21:00	23:00	Lighting	12.6	1	
Friday	4-jul						
					Day leaders	Esti, Rianne	
Events		11:30	14:30	Public tour	12.4	9	19
		17:30	19:30	Public tour	12.4	9	19
		08:00	18:00	Country day			
		19:00	20:30	UDTA Conference & Debate		4	6
				Todor, Bob, Daniel, David			
		19:00	20:30	UDTA Contest Award	22	all	
		12:00	18:00	Architecture Jury Visits	15	3	6
				Josien, Dennis, David			
				UDTA contest	22	4	6
				Todor, Bob, Daniel, David			
					Day leaders	Stelios , Vasilis	
Measurements		08:00	16:00	Check MEAS/ TASK	/19.5/20.5	2	
		16:00	23:00	Check MEAS/TASK	/19.5/20.5	2	
		21:00	23:00	Lighting	12.6	1	
Saturday	5-jul						
					Day leaders	Nick, Stravoula	
Events		10:00	12:00	Public tour	12.4	9	19
		12:00	16:00	Public tour	12.4	9	19
		16:00	22:00	Public tour	12.4	9	19
		19:00	20:30	Architecture Jury Conference & Debate		3	6
				Josien, Dennis, David			
		19:00	20:30	Architecture Contest Award	15	all	
					Day leaders	Stelios , Vasilis	
Measurements		08:00	16:00	Check MEAS/ TASK	/19.5/20.5	2	
		16:00	23:00	Check MEAS/TASK	/19.5/20.5	2	
		21:00	22:30	Lighting	12.6	1	
Sunday	6-jul						
					Day leaders	Rianne, Tim R	
Events		10:00	12:00	Public tour	12.4	9	19
		12:00	16:00	Public tour	12.4	9	19
		16:00	22:00	Public tour	12.4	9	19
					Day leaders	Stelios , Vasilis	
Measurements		08:00	16:00	Check MEAS/ TASK	/19.5/20.5	2	
		16:00	23:00	Check MEAS/TASK	/19.5/20.5	2	
		21:00	22:30	Lighting	12.6	1	
Monday	7-jul						
					Day leaders	Esti, Oswaldo	
Events		11:30	14:30	Public tour	12.4	9	19
		17:30	19:30	Public tour	12.4	9	19
		09:00	18:00	Engineering & construction jury visits	16	4	6
				George, Stelios, Vasilis, David			
					Day leaders	Stelios , Vasilis	
Measurements		08:00	14:00	Water delivery	8.2		
		08:00	16:00	Check MEAS/ TASK	/19.5/20.5	2	
		16:00	22:30	Check MEAS/TASK	/19.5/20.5	2	
		21:00	22:30	Lighting	12.6	1	
Tuesday	8-jul						
					Day leaders	Rianne, Nicki	
Events		11:30	14:30	Public tour	12.4	9	19
		17:30	19:30	Public tour	12.4	9	19
		09:00	18:00	Engineering & construction jury visits	16	6	6
				George, Stelios, Vasilis, Gabriele, Tim, David			
		09:00	18:00	Energy efficiency jury visits		5	6
				George, Hardik, Sergiu, Stefan, David			
					Day leaders	Stelios , Vasilis	
Measurements		08:00	16:00	Check MEAS/ TASK	/19.5/20.5	2	
		16:00	23:00	Check MEAS/TASK	/19.5/20.5	2	
		21:00	23:00	Lighting	12.6	1	

Wednesday	9-jul							
					Day leaders		Esti, Jan	
Events		11:30	14:30	Public tour	12.4		9	19
		17:30	19:30	Public tour	12.4		9	19
		19:00	20:30	Engineering & Construction Jury Conference & Debate			6	6
				George, Stelios, Vasilis, Gabriele, Tim, David				
		19:00	20:30	Engineering & Construction Contest Award	16	all		
		12:00	18:00	Urban Design, Transportation & Affordability Jury Visits	22		4	6
				Todor, Bob, Daniel, David				
		12:00	18:00	Sustainability Jury Visits	24		4	6
				Carolin, Josien, Oswaldo, David				
				Engineering & construction contest				
					Day leaders		Stelios , Vasilis	
Measurements		08:00	16:00	Check MEAS/ TASK	/19.5/20.5		2	
		16:00	23:00	Check MEAS/TASK	/19.5/20.5		2	
		21:00	23:00	Lighting	12.6		1	
Thursday	10-jul							
					Day leaders		Nick, Anil	
Events		11:30	14:00	Public tour	12.4		9	19
		17:30	19:00	Public tour	12.4		9	19
		19:00	20:30	Energy Efficiency Jury Conference & Debate			5	6
				George, Hardik, Sergiu, Stefan, David				
		19:00	20:30	Energy Efficiency Contest Award	17	all		
		09:00	18:00	Sustainability Jury Visits	24		4	6
				Carolin, Josien, Oswaldo, David				
		21:00	23:00	Dinner	20.5			19
				Bob, Jasper S				
					Day leaders		Stelios , Vasilis	
Measurements		08:00	16:00	Check MEAS/ TASK	/19.5/20.5		2	
		16:00	23:00	Check MEAS/TASK	/19.5/20.5		2	
		21:00	23:00	Lighting	12.6		1	
Friday	11-jul							
					Day leaders		Esti, Derek	
Events		11:30	14:00	Public tour	12.4		9	19
		17:30	19:00	Public tour	12.4		9	19
		19:00	20:30	Sustainability Jury Conference & Debate			4	6
				Carolin, Josien, Oswaldo, David				
		19:00	20:30	Sustainability Contest Award	24	all		
				Sustainability contest	24			
					Day leaders		Stelios , Vasilis	
Measurements		08:00	16:00	Check MEAS/ TASK	/19.5/20.5		2	
		16:00	23:00	Check MEAS/TASK	/19.5/20.5		2	
		21:00	23:00	Lighting	12.6		1	
Saturday	12-jul							
					Day leaders		Rianne, Jasper O	
Events		10:00	12:00	Public tour	12.4		9	19
		12:00	16:00	Public tour	12.4		9	19
		16:00	22:00	Public tour	12.4		9	19
		20:00	22:00	Public's Favourite Award	14.6	all		
		20:00	22:00	Electrical Energy Balance, Confort Conditions and House Functioning contest award		all		
		20:00	22:00	Innovation Contest Award	23	all		
		20:00	22:00	Final Competition Award	23	all		
		20:00	22:00	Closing Ceremony		all		
				Innovation contest	23			
					Day leaders		Stelios , Vasilis	
Measurements		21:00	23:00	Lighting	12.6		1	
Sunday	13-jul							
					Day leaders		Nick, Jasper S	
Events		10:00	12:00	Public tour	12.4		9	19
		12:00	16:00	Public tour	12.4		9	19
		16:00	22:00	Public tour	12.4		9	19
		21:00	21:30	Fireworks chateau de Versailles				
					Day leaders		Stelios , Vasilis	
Measurements		21:00	23:00	Lighting	12.6		1	
Monday	14-jul							
					Day leaders		Rianne, Esti	
Events		08:00	12:00	Public tour	12.4		9	19
		12:00	16:00	Public tour	12.4		9	19
		16:00	22:00	Public tour	12.4		9	19
					Day leaders		Stelios , Vasilis	
Measurements		21:00	23:00	Lighting	12.6		1	6

COST ESTIMATE AND PROJECT FINANCIAL SUMMARY

1 ELEMENTS COST

Solar Decathlon Europe 2014 EN FRANCE		SDE 2014 COMPETITION EN FRANCE			
		Team's Abbreviations	DEL		
		School's Name	Delft University of Technology		
		Team's Name	Prêt-à-Loger		
Nº	Name	Description	Budget		% Total
			ex VAT	VAT	on ex VAT
A. DEVELOPMENT PHASE_COST ESTIMATE					
A.1	Personnel				
A.1.1	professors and researchers	Estimated Hours * Hourly Rate	€ 65.000,00		11%
		Personnel	65.000,00 €	0,00 €	11%
A.2	Communication				
A.2.1	model		€ 2.000,00	€ 420,00	0%
A.2.2	communication		€ 10.000,00	€ 2.100,00	2%
A.2.3	reproduction		€ 500,00	€ 105,00	0%
	…				0%
		Communication	12.500,00 €	2.625,00 €	2%
A.3	First Workshop				
A.3.1	travel	Team Members * Unit Cost	€ 240,00	€ 50,40	0%
A.3.2	lodging	Team Members * Unit Cost	€ 240,00	€ 50,40	0%
A.3.3	expenses allowance	Team Members * Unit Cost	€ 60,00	€ 12,60	0%
A.3.4	miscellaneous expenses	Team Members * Unit Cost	€ 40,00	€ 8,40	0%
	…				0%
		First Workshop	580,00 €	121,80 €	0%
A.4	Second Workshop				
A.4.1	travel	Team Members * Unit Cost	€ 2.400,00	€ 504,00	0%
A.4.2	lodging	Team Members * Unit Cost	€ 2.400,00	€ 504,00	0%
A.4.3	expenses allowance	Team Members * Unit Cost	€ 600,00	€ 126,00	0%
A.4.4	miscellaneous expenses	Team Members * Unit Cost	€ 400,00	€ 84,00	0%
	…				0%
		Second Workshop	5.800,00 €	1.218,00 €	1%
A.5	Administrative and miscellaneous				
A.5.1	General meetings and inputs		€ 2.000,00	€ 420,00	0%
	…				0%
		Administrative and miscellaneous	2.000,00 €	420,00 €	0%

		Sub-Total_Development Phase Cost Estimate	**85.880,00 €**	**4.384,80 €**	14%
B. HOUSE CONSTRUCTION_COST ESTIMATE					
B.1	**Direct Materials**				
B.1.1	foundations		€ 10.000,00	€ 2.100,00	2%
B.1.2	structure: floors, walls and inner façade		€ 15.000,00	€ 3.150,00	2%
B.1.3	floor finishing (carpet)		€ 4.000,00	€ 840,00	1%
B.1.4	inner wall finishing (wallpaper)		€ 5.000,00	€ 1.050,00	1%
B.1.5	outer façade, incl. insulation & finishing		€ 15.000,00	€ 3.150,00	2%
B.1.6	window frames and HR+++ glass		€ 15.000,00	€ 3.150,00	2%
B.1.7	structural roof elements		€ 10.000,00	€ 2.100,00	2%
B.1.8	roof finishing (tiles, gutters)		€ 5.000,00	€ 1.050,00	1%
B.1.9	side wall insulation		€ 5.000,00	€ 1.050,00	1%
B.1.10	greenhouse structure		€ 20.000,00	€ 4.200,00	3%
B.1.11	PV panels		€ 30.000,00	€ 6.300,00	5%
B.1.12	solar collector, heat pump and boiler		€ 15.000,00	€ 3.150,00	2%
B.1.13	phase change materials		€ 10.000,00	€ 2.100,00	2%
B.1.14	domotics system		€ 5.000,00	€ 1.050,00	1%
B.1.15	heat recovery ventilation system + hp		€ 10.000,00	€ 2.100,00	2%
B.1.16	traditional radiator system		€ 5.000,00	€ 1.050,00	1%
B.1.17	cables, piping, ducts, grids etc.		€ 5.000,00	€ 1.050,00	1%
B.1.18	lighting		€ 5.000,00	€ 1.050,00	1%
B.1.19	Solatubes*		€ 5.000,00	€ 1.050,00	1%
B.1.20	solar shading*		€ 5.000,00	€ 1.050,00	1%
B.1.21	kitchen furnishing incl. equipment		€ 10.000,00	€ 2.100,00	2%
B.1.22	bathroom and toilet furnishing		€ 10.000,00	€ 2.100,00	2%
B.1.23	all other furniture		€ 5.000,00	€ 1.050,00	1%
B.1.24	garden		€ 7.500,00	€ 1.575,00	1%
B.1.25	rain water system		€ 7.500,00	€ 1.575,00	1%
B.1.26	unforeseen		€ 10.000,00	€ 2.100,00	2%
	…				
		Total Direct Materials	**249.000,00 €**	**52.290,00 €**	41%
B.2	**Material Overhead**				
		% Estimated Rate * Total Direct Materials		0	0%
	…				0%
		Total Material Overhead	**0,00 €**	**0,00 €**	0%
B.3	**Direct Labor**				
B.3.1	labourers (2 x 35 euro/h, 3 p, 3x)	Estimated Hours * Hourly Rate	€ 30.000,00		5%
B.3.2	project management (80 euro/h)	Estimated Hours * Hourly Rate	€ 15.000,00		2%
B.3.3	professors and researchers	Estimated Hours * Hourly Rate	€ 15.000,00		2%
B.3.4	administratives		€ 8.000,00		1%
	…				
		Total Direct Labor	**68.000,00 €**	**0,00 €**	11%
B.4	**Lower - Tier Subcontractors**				
B.4.1	plumbing (50 euro/h)		€ 5.000,00	€ 1.050,00	1%
B.4.2	electricity (50 euro/h)		€ 5.000,00	€ 1.050,00	1%
B.4.3	construction of greenhouse		€ 5.000,00	€ 1.050,00	1%
B.4.4	unforeseen		€ 10.000,00	€ 2.100,00	2%

	…				0%
		Total Lower - Tier Subcontractors	**25.000,00 €**	**5.250,00 €**	4%
B.5	**Consultants**				
B.5.1	climate consultant		€ 5.000,00	€ 1.050,00	1%
B.5.2	building physics consultant		€ 10.000,00	€ 2.100,00	2%
B.5.3	greenhouse consultant*		€ 5.000,00	€ 1.050,00	1%
	…				0%
		Total Consultants	**20.000,00 €**	**4.200,00 €**	3%
B.6	**Other Direct Costs**				
B.6.1	security		€ 10.000,00	€ 2.100,00	2%
B.6.2	indirect expenses		€ 10.000,00	€ 2.100,00	2%
	…				0%
		Other Direct Costs	**20.000,00 €**	**4.200,00 €**	3%
		Sub-Total_House Construction Cost Estimate	**382.000,00 €**	**65.940,00 €**	63%
C. HOUSE DISASSEMBLY IN ORIGIN AND TRANSPORTATION					
C.1	**Disassembly in origin**				
C.1.1	disassembly in Harberinhoek		€ 2.000,00		0%

C.2.1	transport		€ 4.800,00	€ 1.008,00	1%
	…				
		House Transportation	**4.800,00 €**	**1.008,00 €**	1%
		Sub-Total_House Disassembly in Origin Cost Estimate	**6.800,00 €**	**1.008,00 €**	1%
D. FINAL PHASE IN LE CITE DU SOLEIL:COST ESTIMATE					
D.1	**Travels & Costs for Final Phase in Paris**				
D.1.1	travel		€ 25.000,00	€ 5.250,00	4%
D.1.2	lodging		€ 30.000,00	€ 6.300,00	5%
D.2	**Assembly and Disassembly Processes**				
D.2.1	cranes and construction quipment		€ 20.000,00	€ 4.200,00	3%
D.2.2	assembly in Versailles		€ 2.000,00	€ 420,00	0%
D.2.3	disassembly in Versailles		€ 2.500,00	€ 525,00	0%
	…				
		Total Assembly, Transport, Disassembly Processes	**24.500,00 €**	**5.145,00 €**	4%
D.3	**Insurance Policies**				
D.3.1	liability insurance		€ 2.000,00	€ 420,00	0%
D.3.2	transport insurance		€ 6.000,00	€ 1.260,00	1%
D.3.3	accident insurance		€ 8.000,00	€ 1.680,00	1%
D.3.4	property and moveables insurance		€ 4.000,00	€ 840,00	1%
D.3.5	travel insurance		€ 2.000,00	€ 420,00	0%
D.3.6	medical insurance		€ 8.000,00	€ 1.680,00	1%
	…				0%
		Total Insurance Policies	**30.000,00 €**	**6.300,00 €**	5%
		Sub-Total_Final Phase in La Cité du Soleil® Cost Estimate	**121.500,00 €**	**25.515,00 €**	20%
E. POST EVENT COST ESTIMATE					
E.1	**House Permanent Assembly**				
E.1.1	cranes and construction quipment		€ 5.000,00	€ 1.050,00	1%
E.1.2	assembly in Delft		€ 500,00	€ 105,00	0%
E.1.3	transport		€ 4.800,00	€ 1.008,00	1%

	...				0%
		Sob-Total House permanent Assembly	10.300,00 €	2.163,00 €	2%
E.2	As built				
	...				
		As Built	0,00 €	0,00 €	0%
		Sub-Total_Post Event Cost Estimate	10.300,00 €	2.163,00 €	2%
		Total Price / Cost Estimated	606.480,00 €	99.010,80 €	100 % Total
Please CHECK (X) your status >>>		If you benefit VAT Recovering		-99.010,80 €	
	X	If you don't	99.010,80 €		
		Total Price / Cost Estimated included VAT	705.490,80 €	606.480,00 €	

Solar Decathlon Europe 2014 EN FRANCE

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

SDE 2014 COMPETITION	
Team's Abbreviations	DEL
School's Name	Delft University of Technology
Team's Name	Prêt-à-Loger

Company Name	Collaboration Details	Amount of support	% Total
Institutional Support			
TU Delft	Financial and professors hours Asistance	€ 112.200,00	
CSTB SOLAR	Finacial and Inkind Asistance	€ 100.000,00	
Unive (to be signed): Insurance and cash sponsoring	Finacial and Inkind Asistance	€ 86.300,00	
Ministry of Internal Affairs, energy renovation programme: cash sponsoring	Financial Asistance	€ 75.000,00	
Climate KIC - SusLabNWE	Financial Asistance	€ 40.000,00	
Delft Energy Initiative: cash sponsoring	Financial Asistance	€ 20.000,00	
		433.500,00 €	66%
Industrial Partners & Sponsors			
TBI Groep: laborers, project manager, transport, house materials and construction	Inkind Asistance	€ 51.000,00	
DMEGC: PVs	Inkind Asistance	€ 30.000,00	
Sto Isoned: inkind sponsoring of products and hours	Inkind Asistance	€ 20.000,00	
Select Windows/Recystel: window frames and HR+++ glass	Inkind Asistance	€ 15.000,00	
Van Dorp Installaties: PCMs and domotics	Inkind Asistance	€ 15.000,00	
Putman: ventilation and radiation system	Inkind Asistance	€ 15.000,00	
Solar Compleet: solar collector, heat pump and boiler	Inkind Asistance	€ 15.000,00	
Denvl: garden and rain water system	Financial Asistance	€ 15.000,00	
Nobutech: green house consultant and construction	Inkind Asistance	€ 10.000,00	
Technische Unie: Bathroom furnishing	Inkind Asistance	€ 10.000,00	
DPA: building physics consultant	Inkind Asistance	€ 10.000,00	
Serge Ferrari: solar shading	Inkind Asistance	€ 5.000,00	
Techcom Light: solar tubes	Inkind Asistance	€ 5.000,00	
Deerns: climate consultant	Inkind Asistance	€ 5.000,00	
Printer Pro		€ 500,00	
		221.000,00 €	33%
Other Income Details			
EcoBouw		€ 5.000,00	
Solar Event		€ 2.000,00	
		7.000,00 €	1%
		661.500,00 €	**100 % Total**

SITE OPERATIONS PLAN (SOP)

1 General data

Aim

The solar decathlon Europe contest requires a complete site op ations plan. This plans aim is to make the assembly and disassembly of the Pret-a-Loger design in Versailles as sufficient and safe as possible. The assembly and disassembly are described step-by-step in this guide. This guide will then serve to time, material and manpower management as well as for safety management.

Deciding factors

The Prêt-à-Loger Home will be assembled during the last phase of the SDE competition in Paris, France. The site on which all the teams will place all their houses is called Solar Village. It is located west of the centre of Paris in the park of Versailles, one of the most well-known touristic places in Europe.
The site operation plan serves as the principal guide for the scheduling and logistics needed for a successful project. We include an outline of the reasoning process for a better understanding of our choices.
The assembly time in Paris is limited to ten days, including all the functional tests. The deciding factor for the organisational tasks of the transport of the structure is the length of this period.
The definition of the transport units tries to comply with the phases of assembly by creating loads that are deployable on site relatively easily. We put great effort to minimise the waiting times for each transport units to have all the necessary modules and materials on time at the erection site.
For the Prêt-à-Loger team one of the most important tasks is to ensure the arrival of the loads to the building site in the predefined times and order. This is a major concern for us, as the transport distance is relatively long.
We decided to transport the house in 55 elements, 47 of them are prefabricated panels. This is a reasonable compromise of transport and assembly concerns. Following the disassembly of the prototype in Holland the modules are loaded onto several trucks and transported to Paris on road. The transport units include 7 trucks. The movement and scheduling of the arrival times of these units are detailed below in the transport section.
According to the plans of the SDE Prêt-à-Loger Solar Decathlon team the assembly takes six days and the testing of the equipment takes a further three. During the assembly and disassembly we plan our operations to be inside the designated operational area of the plot.
The planning of the site operations and logistics are carried out with an accent on safety and security issues. The site operation report and drawings are closely related with the Health and Safety section.

Design data

The construction is a 2-floor house made by timber structure.
The area of the house is 85.74 m^2 (ground floor) and height of 7 m.
For construction would be used prefabricated panels made from timber. The insulation for the outside walls will be inside the panel.

The construction would also have an envelope skin system made of glass.
The time duration for the construction is 10 days.
The disassembly would take 5 days.

Type	Material
Foundation	Prefab concrete with poured in steel beams
Ground floor	Prefab wooden panels with insulation
First floor	Prefab wooden panels
Wall	Prefab wooden panels with insulation, brick outer layer
Roof	Prefab wooden panels with insulation, roof tiling
Glasshouse main structure	Steel beams
Glasshouse sub structure	Aluminium profiles
Glasshouse cover	Glass with integrated PV-panels

1.1 Site Operations Coordinators

The assembly and disassembly will be done by two teams. Each team will work for maximum 8 hours per day. So on the construction site is estimated the two teams to work maximum for 16 hours. The schedules would be made so it would be used maximum daylight during the construction.

Team #1 coordinator:
Name: Petar Rumenov Zhivkov
Telephone: (+31) 6 1637 7994
Email: zhivkovpetar@gmail.com
Address: Roelofsstraat 32, 2596 VN, The Hague, The Netherlands
Study: Construction management and Engineering, TU Delft
Certificates: Msc Structural Engineering and First aid

Team #2 coordinator:
Name: Rudger Andries de Jong
Telephone: (+31) 6 5334 4898
Email: rudgerdejong@hotmail.com
Address: Oudraadtweg 15, 2612SL, Delft, The Netherlands
Study: Construction management and Engineering, TU Delft
Certificates: First aid

Pret a loger shall work in two shifts of 8 hours, of which 7 working hours and 1 hour br

2 Outside Solar Village logistic

Project Phases

Our project is divided in four major phases

Phase 1: Project design in TU Delft, the Netherlands
The team will design the construction project. The office of the team is situated in the Dream Hall of TU Delft where teams different fields and specializations design and build their models for various competitions around the world.

Phase 2: Prototype fabrication and prefabrication in Harbrinkhoek, the Netherlands.
We will build the prototype with a scale of 1:1 in the warehouse of our main sponsor. The prototype will be made of prefabricated panels. The panels will be built and assembled in Harbrinkhoek, before the competition in Paris. The prototype will be tested in real Dutch conditions and at the end some improvements can be made if there is a need.

Phase 3: Solar Decathlon competition in Paris.
Transport, assembly and disassembly in Paris.
Our Dutch house representation will be exhibited during two weeks in Paris, with the nineteen others projects in the Cité du Soleil. The prototype will be assembled within 10 days and disassembled within 5.

Phase 4: Final location in Delft.
Transport, assembly in Delft. The prototype will be relocated in Delft's sustainable village called the Green Village. It will stay there for at least 2 years. Our prototype will have the opportunity to be the first that will be exhibited there. The idea of the Green Village is to expose sustainable buildings where university workers, students and visitors can see some good practices for one green future.

2.1 Trucks Routing

The route passes through three countries. It begins from Harbrinkhoek, Netherlands. Then, it passes through Belgium. Finally, the route terminates in Paris, where is situated the Solar Village. We have taken the size and weight of the heaviest truck in consideration when choosing the route. We have also taken the available gas stations in considerations to provide fuel. The length is approximately 615 km.

Starting point	Finishing point
Name: Groothuis B.V. Address: Ootmarsumseweg 12 Zip code:7615 PL City: Harbrinkhoek	Name: La Cite Du Soleil Address: Route de Saint-Cyr Zip code: 78000 City: Versailles

Total journey: 615 km

Route description

Total Time: 09:26 Total Distance: 614.45 km		
1.	Head toward Klosseweg on N349. Go for 3.5 km.	Time: 00:08 Distance: 3.51 km
2.	Turn left onto Van Rechteren Limpurgsingel (N349). Go for 3 km.	Time: 00:04 Distance: 2.761 km
3.	Turn right onto Nijreessingel (N349) toward A1/A35/N36/N349 (West)/Industrieterrein Overige/Ring. Go for 2 km.	Time: 00:03 Distance: 2.194 km
4.	Turn left onto Henriëtte Roland Holstlaan (N35) toward A1/A35/N349 (West)/Industrieterrein Zuid/Nijrees/Bornerbroek. Go for 1 km.	Time: 00:01 Distance: 1.029 km
5.	Continue toward A1/A35/N36/N349 (West)/Xl-Park. Go for 600 m.	Time: 00:01 Distance: 0.553 km
6.	Continue on Aanloop toward Xl-Park. Go for 250 m.	Time: 00:01 Distance: 0.27 km
7.	Turn left and take ramp onto A35 toward A35 (Oost)/A1/Hengelo/Enschede/Deventer/Amsterdam. Go for 3 km.	Time: 00:03 Distance: 3.01 km
8.	Take the A1/E30/Deventer/Amsterdam exit onto A1. Go for 48 km.	Time: 00:41 Distance: 48.16 km
9.	Take the A50/Zwolle/Arnhem exit onto A50 toward Arnhem/Eindhoven. Go for 69 km.	Time: 01:00 Distance: 68.516 km
10.	Take the A59/N329/Oss/Heesch/'s-Hertogenbosch exit onto A59. Go for 18 km.	Time: 00:17 Distance: 17.873 km
11.	Continue on A2. Go for 4 km.	Time: 00:04 Distance: 4.021 km
12.	Keep right onto A65 toward Ring-West/Tilburg/Vught-Centrum. Go for 3 km.	Time: 00:03 Distance: 2.815 km
13.	Continue on Helvoirtseweg (N65). Go for 13 km.	Time: 00:14 Distance: 12.69 km
14.	Continue on A65 toward Eindhoven. Go for 6 km.	Time: 00:05 Distance: 6.087 km
15.	Continue on A58. Go for 27 km.	Time: 00:23 Distance: 26.749 km
16.	Continue on A16. Go for 4.5 km.	Time: 00:04 Distance: 4.514 km
17.	Continue on A1. Go for 44 km.	Time: 00:40 Distance: 44.404 km
18.	Take the Antwerpen-Zuid exit onto A12 toward Boom/Brussel. Go for 33 km.	Time: 00:31 Distance: 32.908 km
19.	Take the R0/E19/E40/E411/Haven-Noord/Industriezone Anderlecht/Strombeek-Bever/Expo/Wemmel/Ring/Industriezone Verbrande Burg exit. Go for 2 km.	Time: 00:02 Distance: 2.118 km
20.	Continue on R0. Go for 31 km.	Time: 00:27 Distance: 31.037 km
21.	Continue on A7. Go for 10 km.	Time: 00:09 Distance: 10.34 km

22.	Take the E19/Paris/Mons exit to stay on A7. Go for 50 km.	Time: 00:43 Distance: 50.316 km
23.	Continue on A2. (partial toll road) Go for 77 km.	Time: 01:07 Distance: 77.468 km
24.	Continue on A1. (partial toll road) Go for 136 km.	Time: 01:59 Distance: 136.389 km
25.	Take the Rouen/Pte de Clignancourt/Périphérique Ouest exit onto Boulevard Périphérique. Go for 11 km.	Time: 00:12 Distance: 10.525 km
26.	Take ramp onto A13 toward Rouen/St Quentin en Ynes/ Versailles. Go for 7.5 km.	Time: 00:10 Distance: 7.703 km
27.	Take exit Échangeur de Versailles Nord (5) toward Versailles-Centre/Versaiiles-Château/Vaucresson/La Celle-St Cloud. Go for 400 m.	Time: 00:01 Distance: 0.392 km
28.	Turn left onto Boulevard de Jardy (D182). Go for 2.5 km.	Time: 00:05 Distance: 2.604 km
29.	Continue on Avenue des États-Unis (D185). Go for 1.8 km.	Time: 00:05 Distance: 1.763 km
30.	Turn left onto Avenue Rockfeller (D186). Go for 150 m.	Time: 00:01 Distance: 0.168 km
31.	Continue on Avenue Rockfeller. Go for 150 m.	Time: 00:00 Distance: 0.137 km
32.	Turn right onto Avenue Nepveu Sud. Go for 200 m.	Time: 00:01 Distance: 0.206 km
33.	Continue on Rue Pierre de Nolhac. Go for 150 m.	Time: 00:00 Distance: 0.133 km
34.	Bear left onto Rue de l'Indépendance Américaine. Go for 300 m.	Time: 00:01 Distance: 0.317 km
35.	Turn right onto Route de Saint-Cyr (D10). Go for 0.8 km.	Time: 00:01 Distance: 0.767 km
36.	Arrive at Route de Saint-Cyr (D10). The trip takes 614 km and 9:26 h.	Total Time: 09:26 Total Distance: 614.45 km



Figure 4.1 — *Route trougt the Neterhlands*

Figure 4.2 — *Route trought Belgium*

Figure 4.3 — *Route trough France*

2.2 Trucks specifications and shipments

With planning of the truckload always the prior criterium was to optimalize the assembly in Versailles. We want to avoid that we have to unload objects temporary to reach objects that are needed for the assembly. Desides from some small garden elements all the objects go directly from the truck onto the house.

To realize this we will use eight trucks to transport the complete house to Versailles. Six of these trailers will be flatliners and carry the foundation and the panels of the 'existing house'. The other two trailers will be closed tautliners from 13 meter, they will carry the sensitive element of the glasshouse, the garden element and the complete interior.

We want flexibility in the assembly planning so if we work ahead that we dont have holdups due to trucks that still need to arrive. In the first three days we take the loads of our first six truck. As a result of this the single parkinglot on the Allée des Matelots is insuficient to garanty this flexibilty. Therefore we arranged an additional two trailer parking lots at the secured parking lot of a logistics company in Trappes, around 10 minuts from la Cité du Solei.

Truck nr. 3 and nr. 4 will leave the Netherlands on the 13th of June heading for Trappes. The drivers will be back in Holland before Sunday, when it's not allowed for truck drivers to pass the French highways.
Truck nr. 1 and nr.2 will depart from the Netherlands directly to the competition terrain and arrive at the beginning of the first day. The remaining will travel from the Netherlands to trappes from there to the Allée des Matelots and then to enter La cité du soleil. During the competition we will keep two trucks in Paris to commute the trailers from the secured parking lot to our construction site.

When the trucks enter the la Cité du Solei they will follow the designated route to the operation area of our plot while escorted by two team member in front and behind the truck. The first seven trucks with constructive element will be unloaded with the 35 Ton crane and the closed taut liner will be unloaded with telehandler and by hand.

	type	Elements	weight elements	Weight trailer + truck
Truck 1	Lowered trailer			13 Tn
		Foundation plates	22 Tn	
		Container	2 Tn	

	type	Elements	weight elements	Weight trailer + truck
Truck 2	Flatbed trailer			13 Tn
		Water tanks	0.5 Tn	
		Floor panels	8 Tn	
		Fences	0.5 Tn	

	type	Elements	weight elements	Weight trailer + truck
Truck 3	Lowered trailer			13 Tn
		wall panels	7 tn	
		Interior wall panel	1 tn	

	type	Elements	weight elements	Weight trailer + truck
Truck 4	Lowered trailer			13 Tn
		wall panels	7 tn	
		Floor panel	1.5 Tn	

	type	Elements	weight elements	Weight trailer + truck
Truck 5	Lowered trailer			13 Tn
		Wall panels	2.5 Tn	
		Roof panels	7.5 Tn	
		Chimneys	1 Tn	

	type	Elements	weight elements	Weight trailer + truck
Truck 6	Closed Tautliner			13 Tn
		Steel structure	2.5 Tn	
		Glas + PV panels	1 Tn	
		Roof tiling	0.5 Tn	
		Greenroof	0.25 Tn	

	type	Elements	weight elements	Weight trailer + truck
Truck 7	Lowered trailer			13 Tn
		Ramps	4 Tn	

	type	Elements	Weight elements	Weight trailer + truck
Truck 8	Closed Tautliner			13 Tn
		Garden elements	2.5 Tn	
		Furniture	7.5 Tn	
		Kitchen	1 Tn	

Table 4.1 —
Truckloading tables

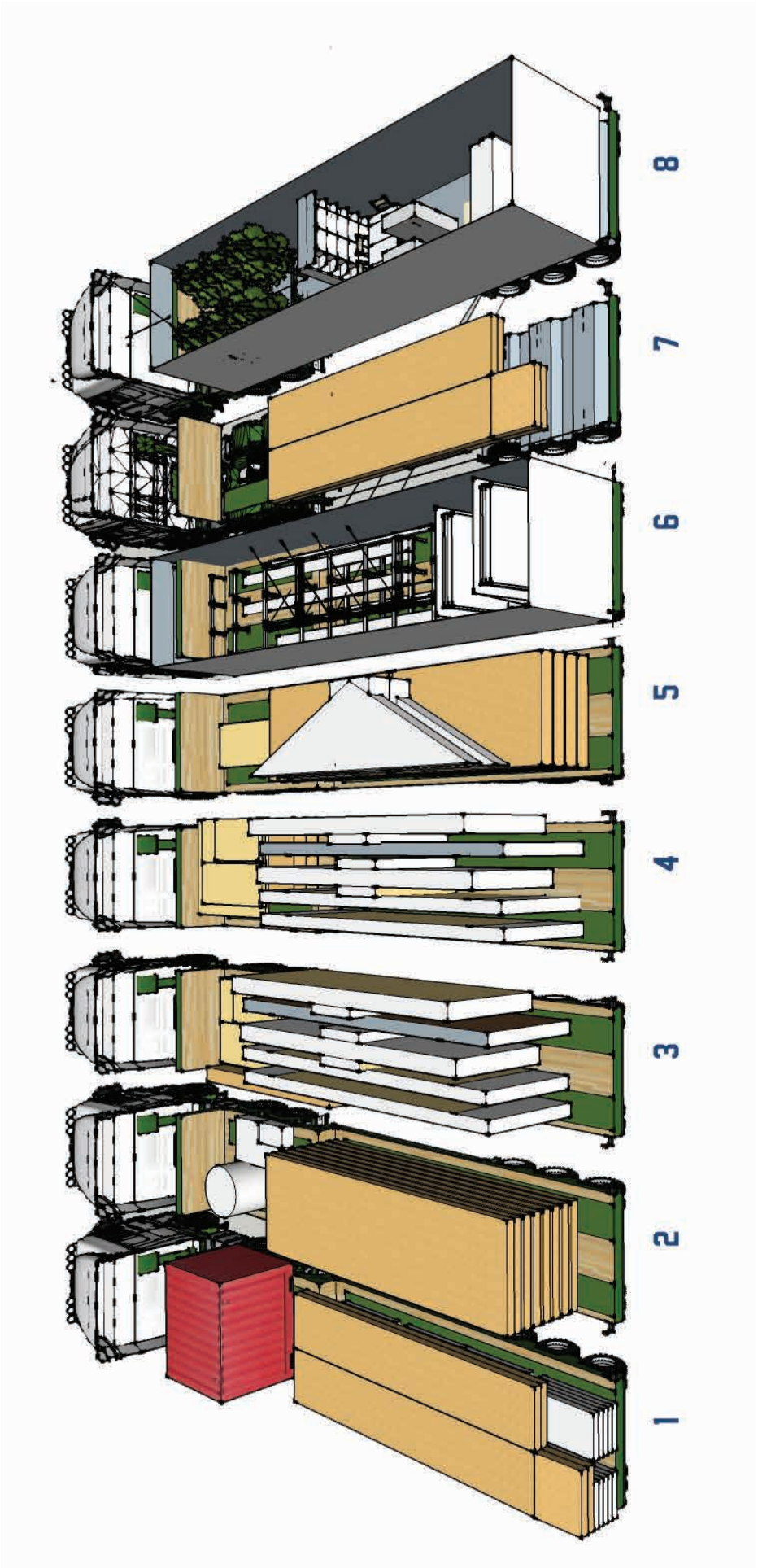
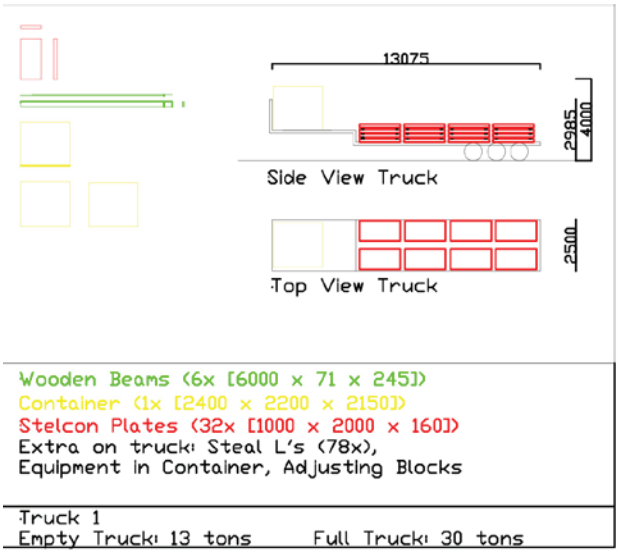
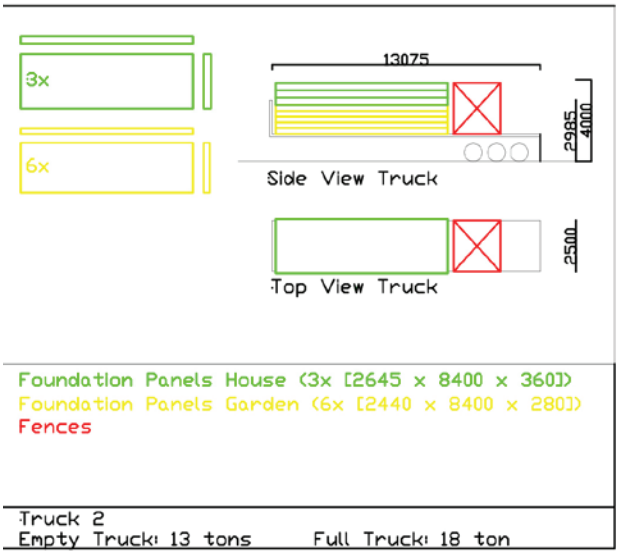


Table 4.2 —
Visualization of truck-loads



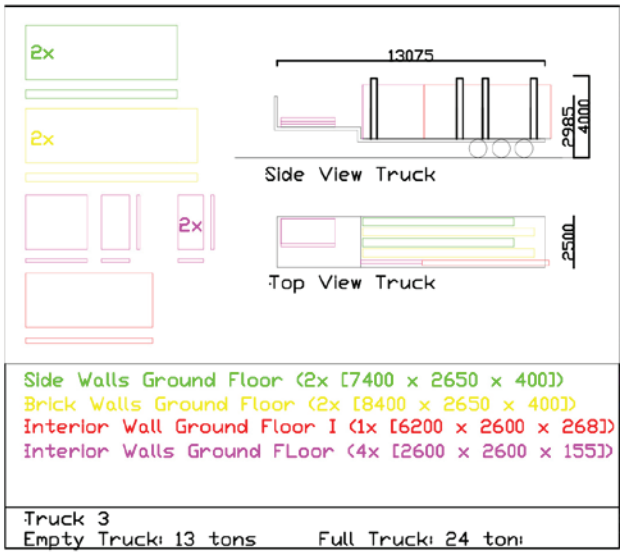
Wooden Beams (6x [6000 x 71 x 245])
Container (1x [2400 x 2200 x 2150])
Stelcon Plates (32x [1000 x 2000 x 160])
Extra on truck: Steal L's (78x),
Equipment in Container, Adjusting Blocks

Truck 1
Empty Truck: 13 tons Full Truck: 30 tons



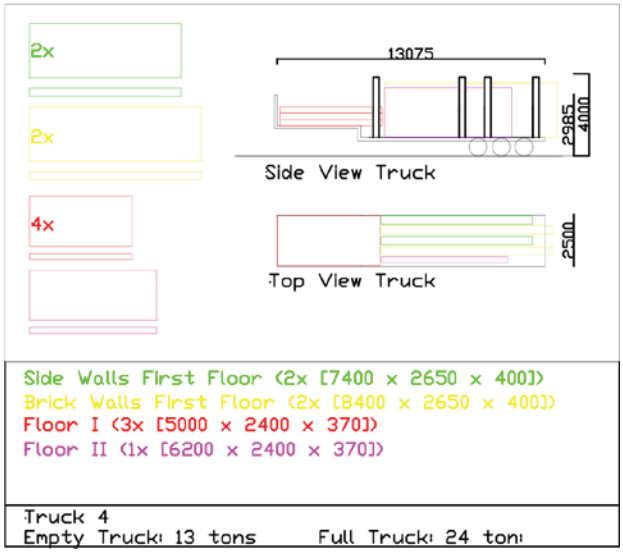
Foundation Panels House (3x [2645 x 8400 x 360])
Foundation Panels Garden (6x [2440 x 8400 x 280])
Fences

Truck 2
Empty Truck: 13 tons Full Truck: 18 ton



Side Walls Ground Floor (2x [7400 x 2650 x 400])
Brick Walls Ground Floor (2x [8400 x 2650 x 400])
Interior Wall Ground Floor I (1x [6200 x 2600 x 268])
Interior Walls Ground FLoor (4x [2600 x 2600 x 155])

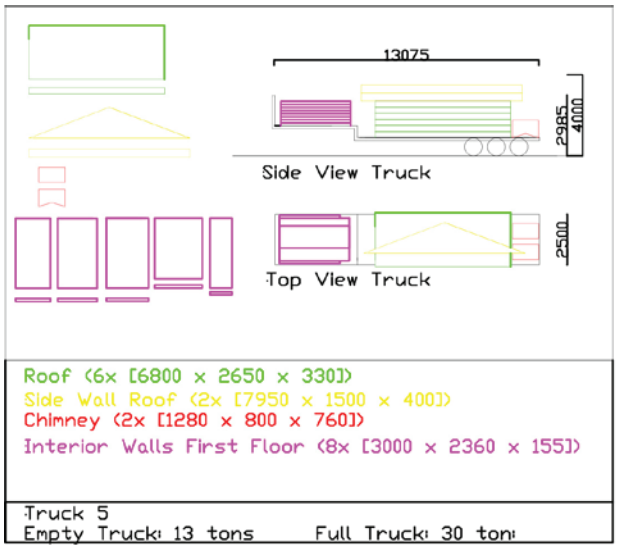
Truck 3
Empty Truck: 13 tons Full Truck: 24 ton:

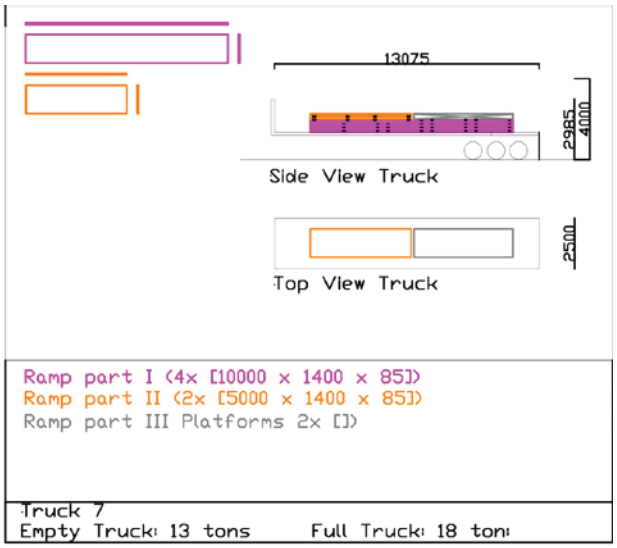


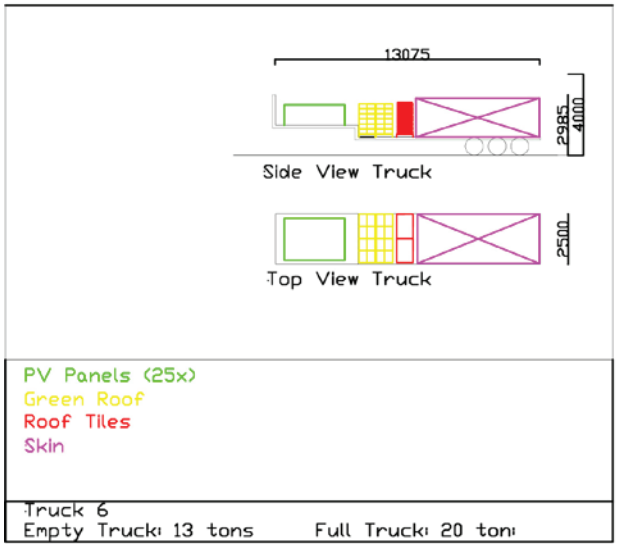
Side Walls First Floor (2x [7400 x 2650 x 400])
Brick Walls First Floor (2x [8400 x 2650 x 400])
Floor I (3x [5000 x 2400 x 370])
Floor II (1x [6200 x 2400 x 370])

Truck 4
Empty Truck: 13 tons Full Truck: 24 ton:

Figure 4.4 — *loadingschedule truck 1-4*







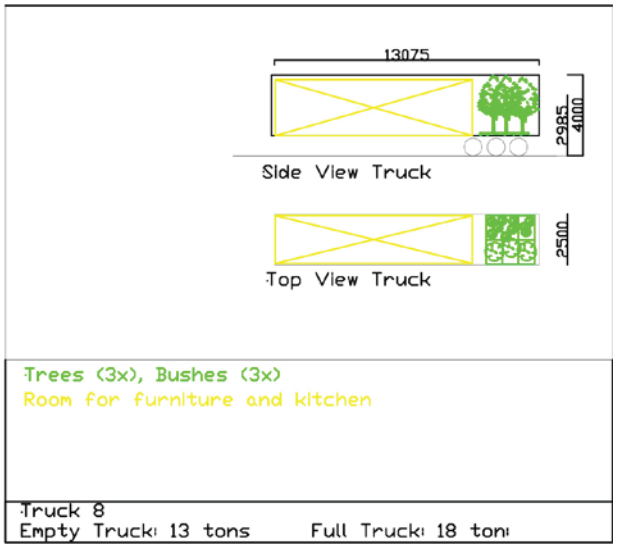


Figure 4.5 —
loading schedule truck 5-8

3 Logistic inside la Cité du Soleil

3.1 Infrastructures

Temporary structures
The temporary structures we plan to use in La Cité du Soleil area are to ensure the proper conduct of the site. The infrastructures include a tool container and a base tent. The tool container will be brought on the first truck; it contains all our hand tools and sensitive small parts from suppliers. The base tent is a simple square tent, inside all the project drawing and schedules will be collected. The briefing at the beginning of the day and the hand-over to the second shift will be held here as well as the short breaks of fifteen minutes.

Generator and lighting
During assembly and disassembly we will connect our equipment to a generator set. Moreover, some distribution panels will be set up in order to provide electricity throughout the lot.

To minimalize the energy consumption as a result of the usage of building light we have done some interventions.
We adjusted the working hours to the daylight schedules. At 05:45 the sun sets and at 21:58 it will set, therefore with hour working hours of 06:00 until 22:00 and work almost completly in daylight.
For situations where light is needed, we will bring construction lamps. But instead of the 300W halogen construction light which consumes a lot of energy, we use 50W LED construction light. They have the same intensity but are 75% less energy consuming. With the use of movable lights we only have lamps on the locations where extra light is needed, again to minimalize the usage of the energy consuming lamps.

Equipment
The 'existing' part of our design, the row house, will be completely assembled from prefabricated panels. Therefore a lot of crane movement will be needed to place the 47 elements. One in place, only a few screws and temporary supports are needed to keep the panels in place. With the construction of the glasshouse we don't want to risk damaging the platform when working with a telescopic forklift. Therefore we will use the crane to lift the heaving parts of the steel and aluminum frame which will be bolded in place be team members which are secured in the boom lift or on the roof.

Work with electricity will only be done with the use of isolated tools to prevent team member getting into contact with current. Furthermore there are fire extinguishers and a checked first aid kit to ensure safety of the people on site. Al the team members will have their own set of tools for which they are responsible. Everybody receives clear instructions to always store their tools when their work is finished in the tool container on site.

For the construction of our house we use the labour and knowledge of 50 team-members, both students and professionals. planningwize and from health and safetu point of view we will devide the teammembers in two shifts. Both shift contain the construction core team consisting of the site operator, the HS officer and one or two quality managers. The role of the quality managers will be to check continueasly during construction if the constructing follows the drawing and complies with the high standard that we hold. The second part of the shift selection consist of the student workers.During the test assembly in the Netherland the construction management team closly monitored which student workers worked on which section of the house and how they performed. After the assemblu period we appointed students expirienced and expert for particulair sections of the house. Expirienced meaning that the student worked on that section and performed good. Also the communication with the professional worker sometimes was factor which we took into account. Expert means that the student has elaborated contact with the supplier, studied all the required drawing and can work more of less a an supervisor. For each complet section of the house we assinged two student expert, one for every shift. The third section if that of the professional workers. This division is based on extensive contact with our main and subcontractor. Sometimes if works more efficient when the human resources of the contractors our diveded in two shift and sometimes the workers need to work together to execute their work.

It gives us the possibly to work overtime when needed without risking that people don't follow the working hours rules as stated in Rule 52.7.1. During the first phases we decided to have team members work on ony one activity at the time to insure the safety during crane operation. After the deadline of wind-and-water Tightness the is made the interior of the house is safe to enter which makes it possible to have people working simultaneously on the greenhouse, plumbing, interior and even the garden.

working hours

Activity	Durance (hours)	Time
Shift 1		
Work	1,75	07:00 - 08:45
Break	0,25	08:45 - 09:00
Work	1,75	09:00 - 10:45
Break	0,50	10:45 - 11:15
Work	1,75	11:15 - 13:00
Break	0,25	13:00 - 13:15
Work	1,75	13:15 - 15:00
Shift 2		
Work	1,75	15:00 - 16:45
Break	0,25	16:45 - 17:00
Work	1,75	17:00 - 18:45
Break	0,50	19:45 - 19:15
Work	1,75	19:15 - 21:00
Break	0,25	21:00 - 21:15
Work	1,75	21:15 - 23:00

Table 4.3 — *Work-hours*

Team division

Construction shift 1
[07:00 - 15:00]

Site operator
Petar Zhivkov

HS officer
Arjan Oosterhof

Quality managers
Dennis IJsselstijn, Tim Jonathan

Student workers
Todor Kesarovski
Dani Radia
Nick Kerckheart
George Xexakis
Oswaldo Heinen
Stelios Stavroulakis
Bob Bogers
Sergiu Troian
Futura Falco
Eftichia Zoidi
Jasper Spiegeler

Professional workers
Groothuis: Franc Asbroek
Groothuis: Rik ter Horst
Groothuis: Kjell Braakhuis
Groothuis: Danny Abbink
Groothuis/Tech: Peter Hinnen
Nobutec: Henri Bloem
Putman: Tjardo Roorda
Putman: Marius de Paauw
Putman: Stephen van Schie
Putman: Patrick van Schie
NL Greenlabel: Jurgen Simmelink
NL Greenlabel: Rutger Frerix
Van Dorp: Steven de Werk

Construction team 2
[15:00 - 23:00]

Site operator
Rudger de Jong

HS officer
Gini Arimbi

Quality manager
Josien Kruizinga

Student workers
Jan Portheine
Hardik Joshi
Osama Naji
Gabriele De Leo
Jasper Overduijn
Vasilis Tzimitras
Matthaios Zarmpis
Stefan Hoekstra
Carolin Bellstedt
Rianne den Ouden
Marina Fragkopoulou

Professional workers
Groothuis: Jeroen Busscher
Groothuis: Rorry van den Noort
Groothuis/Tech: Gerrit Schuurink
Nobutec: Henri Bloem
Putman: Tim de Waal
Putman: Stephen van Schie
Putman: Patrick van Schie
Nl Greenlabel: Tomas Krizan
NL Greenlabel: Michiel Hissink
Van Dorp: Steven de Werk

3.2 shift division

Shift 1

	Nr	Day 1 Name	working on	Day 2 Name	working on	Day 3 Name	working on	Day 4 Name	working on	Day 5 Name	working on
construction core team	1	**Petar**	Site Operator	**Petar**	Site Operator	**Petar**	Site Operator	**Petar**	Site Operator	**Petar**	Site Operator
	2	**Arjan**	HS Officer	**Arjan**	HS Officer	**Arjan**	HS Officer	**Arjan**	HS Officer	**Arjan**	HS Officer (PV panels)
	3	**Tim**	Quality manager	**Tim**	Quality manager	**Tim**	Quality manager			**Tim**	Quality manager
	4			**Dennis**	Quality manager	**Dennis**	Quality manager	**Dennis**	Quality manager	**Dennis**	Quality manager
Student workers	5	**George**	Foundation			**George**	Glasshouse	**George**	Glasshouse	**George**	PV panels
	6	**Dani**	Foundation	**Dani**	Panels					**Dani**	Glasshouse
	7	**Todor**	Foundation	**Todor**	Panels	**Todor**	Glasshouse	**Todor**	Glasshouse	**Todor**	PV panels
	8					**JasperS**	Glasshouse	**JasperS**	Glasshouse	**JasperS**	PV panels
	9			**Bob**	Panels	**Bob**	Glasshouse	**Bob**	Glasshouse	**Bob**	PV panels
	10	**Oswaldo**	Foundation			**Oswaldo**	Plumbing	**Oswaldo**	Plumbing	**Oswaldo**	Glasshouse
	11	**Nick**	Foundation	**Nick**	Panels						
	12									**Eftichia**	Interior
	13					**Stelios**	Electrical	**Stelios**	Electrical	**Stelios**	Interior
	14										
	15										
Subcontractors	16	**Groothuis Danny**	Foundation	**Groothuis Danny**	Panels	**Groothuis Danny**	Panels connections	**Groothuis Danny**			
	17	**Groothuis Kjell**	Foundation	**Groothuis Kjell**	Panels	**Groothuis Kjell**	Panels connections	**Groothuis Kjell**			
	18										
	19										
	20	**Putman Tjardo**	Plumbing	**Putman Tjardo**	Plumbing	**Putman Tjardo**	Plumbing	**Putman Tjardo**	Plumbing	**Putman Tjardo**	Plumbing
	21	**Putman Marius**	Plumbing	**Putman Marius**	Plumbing	**Putman Marius**	Plumbing	**Putman Marius**	Plumbing	**Putman Marius**	Plumbing
	22					**Putman Patrick**	Plumbing	**Putman Patrick**	Plumbing	**Putman Patrick**	Plumbing
	23					**Putman Stephen**	Plumbing	**Putman Stephen**	Plumbing	**Putman Stephen**	Plumbing
	24					**Nobutech Henri**	Glasshouse	**Nobutech Henri**	Glasshouse	**Nobutech Henri**	Glasshouse
	25										
	26										
	27										
	28					**Groothuis Gerrit**	Electrical	**Groothuis Gerrit**	Electrical	**Groothuis Gerrit**	Electrical
	29										
	30										

Shift 2

	Nr	Day 1 Name	working on	Day 2 Name	working on	Day 3 Name	working on	Day 4 Name	working on	Day 5 Name	working on
construction core team	1	**Rudger**	Site Operator	**Rudger**	Site Operator	**Rudger**	Site Operator	**Rudger**	Site Operator	**Rudger**	Site Operator
	2	**Gini**	HS Officer	**Gini**	HS Officer	**Gini**	HS Officer	**Gini**	HS Officer	**Gini**	HS Officer
	3	**Josien**	Quality manager	**Josien**	Quality manager	**Josien**	Quality manager			**Josien**	Quality manager
Student workers	4	**Jan Portheine**	Plumbing	**Jan Portheine**	Panels	**Jan Portheine**	Plumbing	**Jan Portheine**	Plumbing	**Jan Portheine**	Plumbing
	5	**Jasper Overduin**	Foundation	**Jasper Overduin**	Panels					**Jasper Overduin**	PV panels
	6			**Gabriele**	Panels	**Gabriele**	Glasshouse	**Gabriele**	Glasshouse	**Gabriele**	PV panels
	7	**Hardik**	Foundation								
	8	**Osama**	Foundation	**Osama**	Panels						
	9	**Stefan**	Plumbing	**Stefan**	Plumbing	**Stefan**	Plumbing	**Stefan**	Plumbing	**Stefan**	Plumbing
	10							**Vasilis**	Power Optimzers	**Vasilis**	PV panels
	11							**Marina**		**Marina**	
	12					**Matt**	Glasshouse	**Matt**	Glasshouse	**Matt**	PV panels
	13					**Caroline**	Glasshouse	**Caroline**	Glasshouse	**Caroline**	PV panels
	14										
	15										
Subcontractors	16	**Groothuis Jeroen**	Foundation	**Groothuis Jeroen**	Panels	**Groothuis Jeroen**	Panels connections	**Groothuis Jeroen**	Interior finishing		
	17	**Groothuis Rorry**	Foundation	**Groothuis Rorry**	Panels	**Groothuis Rorry**	Panels connections	**Groothuis Rorry**	Interior finishing		
	18					**Nobutech Henri**	Glasshouse	**Nobutech Henri**	Glasshouse	**Nobutech Henri**	
	19					**Groothuis Peter**	Electical	**Groothuis Peter**	Electical	**Groothuis Peter**	
	20					**Putman Tim**	Plumbing	**Putman Tim**	Plumbing	**Putman Tim**	
	21					**Putman Patrick**	Plumbing	**Putman Patrick**	Plumbing	**Putman Patrick**	
	22					**Putman Stephen**	Plumbing	**Putman Stephen**	Plumbing	**Putman Stephen**	
	23										
	24										
	25										
	26										

Phase

Site

The shift of the first day is the only shift where the briefing is not held at the beginning work

		Shift 2									
		Day 6	working on	Day 7	working on	Day 8	working on	Day 9	working on	Day 10	working on
	Nr	Name	working on	Name	working on	Name	working on	Name	working on	Name	working on
construction core team	1	Petar	Site Operator	Petar	Site Operator	Petar	Site Operator	Petar	Site Operator	Petar	Site Operator
	2	Arjan	HS Officer	Arjan	HS Officer	Arjan	HS Officer	Arjan	HS Officer	Arjan	HS Officer
	3	Tim	Quality manager	Tim	Quality manager	Tim	Quality manager	Tim	Quality manager	Tim	Quality manager
	4	Dennis	Quality manager	Dennis	Quality manager	Dennis	Quality manager	Dennis	Quality manager	Dennis	Quality manager
Student workers	5	George	Sliding door	George	Exposition	George	Interior	George	Interior	George	Interior
	6	Dani	Garden	Dani	Garden	Dani	Interior	Dani	Interior	Dani	Interior
	7	Todor	Garden			Todor	Interior	Todor	Interior	Todor	Interior
	8	JasperS	Garden	JasperS	Garden	JasperS	Interior	JasperS	Interior	JasperS	Interior
	9	Bob	Sliding door	Bob	Garden	Bob	Interior	Bob	Interior	Bob	Interior
	10	Oswaldo	Garden	Oswaldo	Garden	Oswaldo	Interior	Oswaldo	Interior	Oswaldo	Interior
	11	Nick	Sliding door	Nick	Exposition	Nick	Interior	Nick	Interior	Nick	Interior
	12	Eftichia	Interior	Eftichia	Interiour	Eftichia	Interior				
	13	Stelios	Interior	Stelios	Interiour	Stelios	Interior	Stelios	Interior	Stelios	Interior
	14	Futura	Interior	Futura	Interiour	Futura	Interior	Futura	Interior	Futura	Interior
	15			Sergiu		Sergiu		Sergiu		Sergiu	
Subcontractors	16										
	17										
	18	Groothuis Franc	Sliding door	Groothuis Franc	Sliding door						
	19	Groothuis Ric k	Sliding door	Groothuis Rick	Electrical						
	20	Putman Tjardo	Plumbing	Putman Tjardo	Plumbing	Putman Tjardo	Plumbing	Putman Tjardo	Plumbing	Putman Tjardo	Plumbing
	21	Putman Marius	Plumbing	Putman Marius	Plumbing	Putman Marius	Plumbing	Putman Marius	Plumbing	Putman Marius	Plumbing
	22	Putman Patrick	Plumbing	Putman Patrick	Plumbing	Putman Patrick	Plumbing	Putman Patrick	Plumbing	Putman Patrick	Plumbing
	23	Putman Stephen	Plumbing	Putman Stephen	Plumbing	Putman Stephen	Plumbing	Putman Stephen	Plumbing	Putman Stephen	Plumbing
	24										
	25	NL Green Jurgen	Garden	NL Green Jurgen	Garden						
	26	NL Green Rutger	Garden	NL Green Rutger	Garden						
	27	NL Green Lars	Garden	NL Green Lars	Garden						
	28	Groothuis Gerrit	Electrical	Groothuis Gerrit	Electrical						
	29			VanDorp Steven	Domotica system	VanDorp Steven	Domotica system	VanDorp Steven	Domotica system		
	30										

		Shift 2									
		Day 6	working on	Day 7	working on	Day 8	working on	Day 9	working on	Day 10	working on
	Nr	Name	working on	Name	working on	Name	working on	Name	working on	Name	working on
construction core team	1	Rudger	Site Operator	Rudger	Site Operator	Rudger	Site Operator	Rudger	Site Operator	Rudger	Site Operator
	2	Gini	HS Officer	Gini	HS Officer	Gini	HS Officer	Gini	HS Officer	Gini	HS Officer
	3	Josien	Quality manager	Josien	Quality manager	Josien	Quality manager	Josien	Quality manager	Josien	Quality manager
Student workers	4	Jan Portheine	Plumbing			Jan Portheine	Plumbing	Jan Portheine	Plumbing	Jan Portheine	Plumbing
	5	Jasper Overduin	Garden	Jasper Overduin	Garden	Jasper Overduin	Interior	Jasper Overduin	Interior	Jasper Overduin	Interior
	6	Gabriele	Garden	Gabriele	Garden	Gabriele	Interior	Gabriele	Interior	Gabriele	Interior
	7	Hardik	Garden	Hardik	Garden	Hardik	Interior		Interior		Interior
	8	Osama	Garden	Osama	Garden	Osama	Interioir	Osama	Interioir	Osama	Interioir
	9	Stefan	Plumbing			Stefan	Plumbing	Stefan	Plumbing	Stefan	Plumbing
	10	Vasilis	PV panels	Vasilis	PV panels						
	11	Marina	Interior	Marina	Interior						
	12	Matt	Sliding door	Matt	Interior	Matt	Interior	Matt	Interior	Matt	Interior
	13	Caroline	Interior	Caroline	Interior	Caroline	Interior	Caroline	Interior	Caroline	Interior
	14			Derek	Interior	Derek	Interior	Derek	Interior	Derek	Interior
	15			Jules	Interior	Jules	Interior	Jules	Interior	Jules	Interior
Subcontractors	16										
	17										
	18										
	19	Groothuis Peter									
	20	Putman Tim		Putman Tim		Putman Tim		Putman Tim		Putman Tim	
	21	Putman Patrick		Putman Patrick		Putman Patrick		Putman Patrick		Putman Patrick	
	22	Putman Stephen		Putman Stephen		Putman Stephen		Putman Stephen		Putman Stephen	
	23										
	24										
	25										
	26										

of the shift on the plot but the day before. This is because there is no base tent yet and to ensure that we can start directly. The first truck will arrive with the tool container, the tent and the foundation plates. At the same time the crane, the forklift, boom lift and other rented equipment will arrive. The equipment will be placed and installed and the fences will be put in place.

Foundations

Our house will be founded on concrete Stelcon plates of one by two meter. On the plates L-profiles are mounted in predrilled holes. The wooden foundation beams which will be attached on the profiles must be level and therefore the position where they are connected to the profiles is flexible. We will use laser measuring equipment to determine the height of each Stelcon plate.
When all the beams are in place we are ready for the foundation inspection by the SDE organization. After the inspection we place the water tanks between the foundation feet and place the ground floor panels. The placing of the floor panels is done by the rented 35 Ton crane. While the crane lifts the element four team members guided it into place with the use of ropes on the corners of the panels. When all the floor plates are in place the platform is ready, this is our first internal deadline.

Existing house

The second day we start with the placement of the wall panels of the Row house. The panels are transported on a lowered trailer on which they are placed vertical. The panels will be lifted with the crane and steered by four team members who al have a rope attached to one of the corners of the panels. On the floor panels profiles are mounted where the panels are placed upon. When a panel is temporality unsupported like the first panel, it is temporarily sustained to the floor panels. The other panels are placed directly against the previous panel. The order for the outside walls is always the first the south wall, which is furthers away from the crane, and then clockwise. This is to prevent the crane driver to have bad of no vision on the load. The interior walls is the same principle, the walls are much lighter but since the crane driver does not always see where the walls are placed we pay extra attention to the communication with the crane driver.

As soon as the floor panels of the first floor are placed one team member is secured in a safety harness and will place fences around halve a meter from the outside of the floors. After this the floor is save to enter for the rest of the team members and the first floor wall panels can be placed the same way as the ground floor panels.

After all the wall panels have been placed the support beam for the roof is placed on which the roof panels are lowered. The order for the roof panels is from the back to front and alternately north and south to prevent too much pressure from one side. Finally the tops of the two chimneys are lowered and all the heavy elements of the row house are in place, our second internal deadline.

Roof work

Just like on the first floor, also on the roof fencing will be placed as soon as the panels are placed to make it safe to work for the workers. On the Northside of the roof bitumen will be laid and the seals attached to each other with a blowtorch. On top of this crates, filled with sedum, are placed to form the green roof.
On the Southside underneath the greenhouse roof tiles will be placed on battens that are already place on the roof panels. To make the Southside of the roof safe to work when constructing the greenhouse and to prevent that roof tiles will break not all the tiles are laid at once. The open areas will be temporarily closed off with watertight foil to ensure the water-tightness. After the completion of the Glasshouse the remaining tiles are placed.
When the roofs are placed on both sides we reached our deadline for wind-and-water

tightness

Glasshouse
After the roof work is complete we start with the glasshouse. The support structure is made out of steel beams. Between the two chimneys a steel beam is placed which will support two beams that follow the angle of the roof and are attached to the south façade of the house and, through savings in the floor panels, are founded. The foundation of the glasshouse is done into steel feet that are preassembled on the concrete Stelcon foundation plates. All the steel will be lifted with the crane and steered with ropes. The mounting of the glasshouse will be done from the roof or by a worker which is secured in the basket of the boom lift. After the steel structure is in place, the aluminum window frames are placed on top of this. To make the entire glasshouse well reachable en to prevent people working outside a safe reach we will also place scaffolding against the south façade. When the window frames are placed it is time for the glass panels which are placed by crane and guided in the final position through team members on the roof and in the boom lift. From the inside the panels are connected and the sun shading is placed. After all the work on the glasshouse is completed we will finish the roof tiling on which we place the heat panels.
This is our internal deadline for the finishing of the greenhouse.

Plumbing- Electrical
All the piping and cable for are already placed in the wall and floor panels and connecting for this are made in a saving on the bottom of the panels and concealed behind skirting board. The placing of radiators, the connection of the solar boiler and other critical elements is done by team member who had extra training during the first construction on these subjects. When all systems are in place and tested the house is ready to be connected to the solar village.

Mechanical
Just like with the electric system, most of the piping is already in place. The installations are placed on the first floor and the piping runs through the chimney which is open on the inside until the cover is placed before it. This makes it relatively easy to connect the installation with the ventilation pipes.
The kitchen and the bathroom are mounted by students who had extra instruction for this during the first assembly in the Netherlands. All the tiling for the bathroom is already placed on the wall and floor panels so only the edges need to be finished.

Interior
As soon as all the water/electronic/heating and cooling systems are in place large teams will work simultaneously on the ground floor and first floor on the flooring and the walls. After this the furniture is place for the closed taut liner into the house.

Garden design and plot
As soon as green roof is completed the Northside of the plot is free of crane motion and the north side of the platform is safe to work. As soon as the greenhouse is ready also the Southside of the platform is ready and garden work can start. The trees are placed in the closed taut liner to prevent leaves flying off during transport. They are transported on the plot with the forklift.

Site cleaning
When construction is done we will remove the fences around the plot and clean the area. The tools are stored in the container outside the competition area.

Quality control
During the assembly period we assigned three team members as quality managers.

Their main focus will be to control that the placed panels and other assembled element are corresponding with the designed location and placing. For example the height of the platform has a direct impact on the fitting of the glasshouse which thereafter has an impact on the fitting of the sliding doors. To prevent problems that will occur in a late phase of the assembly, three quality managers will inspect the construction continually. As a tool for the inspection we designed a process control sheet (see appendix ….) this sheet is linked to our detailed internal assembly and disassembly planning. For each critical action the aspects which need to be controlled are described and also the acceptance criteria. This way we try to leave nothing to chance.

3.3 Waste Management

The home of Prêt-à-Loger will be constructed mainly by prefabricated panels in order the waste to be held to a minimum and materials to be recyclable.
The concrete foundation is prefabricated and reusable after the competition so no waste is expected here.
All the walls, floors and the roof will be a combination of prefabricated panels. During transportations the open flatliner trailers will be completely covered with canvas which is specially designed for the trailers and reusable. This ensures that we don´t need to use additional plastic to cover the panels against the elements. The glasshouse frame will be prefabricated and very robust; therefore almost nog packaging material is needed for this. Between elements that are packed horizontal there is some material, mostly wood, to prevent the element of damaging each other. We are striving to break as less as possible of this material so it is reusable for the same purpose when we put the elements back on the trailers during disassembly.

During assembly and disassembly, however, there will be some losses due to cut electric cables and minor adjustments to the frame itself (like chipping or widening holes). During the construction we also expect some waste done by the workers on the site such as organic material (such as fruits and vegetables during eating) and also some plastic packaging waste. We will collect and separate all the waste three containers in our operational area which will be emptied at the end of each shift.

During the exhibition we will do maintenance and cleaning on the PV panels. We will rinse them with clear water without chemicals to prevent toxic material reaching the soil.

4 Assembly / Disassembly schedules

4.1 Assembly- Day-to-day planning

Day 1 – shift 1: Site preparation / Foundation (16th June 2014 07:00-15:00)
1.1 Arrival cherry picker
1.2 Arrival Truck #1
1.3 Setting up the building site, Container, Tent, Tools etc.
1.4 Placing the concrete foundation plates
1.5 Levelling and mounting the foundation beams

Day 1 – shift 2: Foundation (16th June 2014 15:00 - 23:00)
1.6 Placing ground floor plates
1.7 placing temporary fencing and securing the platform

Day 2 shift 1: Construction 'Existing house' (17th June 2014 07:00-15:00)
2.1 Assembly side walls ground floor
2.2 Assembly interior walls ground floor

Day 2 shift 2: Construction 'Existing house' (17th June 2014 15:00 - 23:00)
2.3 Placing floor panels ground floor
2.4 Placing fences first floor
2.5 Assembly side walls first floor
2.6 Assembly interior walls first floor

Day 3 – shift 1: Construction 'Existing house'(18th June 2014 07:00-15:00)
3.1 Assembly interior walls first floor
3.2 Assembly top walls
3.3 Placing roof plates

Day 3 – shift 2: Construction 'Existing house' / Roof work (18th June 2014 15:00 - 23:00)
3.4 Placing roof plates
3.5 Placing chimneys
3.6 Start with Green roof

Day 4 – shift 1: Roof work / Glass house/ Plumbing - Electronic (19th June 2014 07:00-15:00)
4.1.1 Finishing Green roof
4.1.2 Assembly steel frame Glass house
4.1.3 Placing Heat Recovery Box
4.2 Connecting the water system
4.3 Connecting the plumbing

Day 4 – shift 2: Glasshouse/ P lumbing - Electronic (19th June 2014 15:00 - 23:00)
4.1.1 Assembly steel frame greenhouse
4.4 Connecting the electronic system
4.5 Testing the water en electronic system

Table 4.4 — *Assembly schedule*

Day 5 – shift 1: Glasshouse/ Mechanical (20th June 2014 07:00-15:00)
5.1.1 Placing aluminium frames on the Glass house
5.1.2 Placing the solar boiler
5.1.3 Garden design North side
5.2.1 Placing and connecting the radiators
5.2.2 Installation bathroom

Day 5 – shift 2: Glasshouse/ Mechanical (20th June 2014 15:00 - 23:00)
5.1.1 Placing aluminium frames on the Glass house
5.1.2 Garden design North side
5.3.1 Installing ventilation system
5.3.2 Installation kitchen

Day 6 – shift 1: Glasshouse Interior /Garden (21th June 2014 07:00-15:00)
6.1.1 Placing PV and glass panels on the Glass house
6.1.2 Paint and Finishing
6.1.3 Garden north side

Day 6 – shift 2: Glasshouse/ Interior (21th June 2014 15:00 - 23:00)
6.1.1 Placing PV and glass panels on the Glass house
6.1.2 Paint and Finishing
6.1.3 Garden North/South

Day 7 – shift 1: Glasshouse / Interior/Garden (21th June 2014 07:00-15:00)
7.1.1 Placing PV and glass panels on the Glass house
7.1.2 Placing the floors
7.1.3 Garden Southside
7.2 Placing sliding doors in the Glass house

Day 7 – shift 2: Glasshouse/ Interior / Garden (21th June 2014 **15:00 - 23:00**)
7.1.1 Placing PV and glass panels on the Glass house
7.1.2 Placing the floors
7.1.3 Garden design Southside
7.2 Placing sliding doors in the Glass house

Day 8 – shift 1: Interior / Garden (22th June 2014 07:00-15:00
8.1.1 Placing the furniture
8.1.2 Garden design Southside

Day 8 – shift 2: Interior / Garden (22th June 2014 15:00 - 23:00)
8.1.1 Placing the furniture
8.1.2 Garden design Southside

Day 9: Shift 1: Interior (23st June 2014 07:00-15:00)
9.1 Preparing exposition

Day 9 – shift 2: Interior (23nd June 2014 15:00 - 23:00)
9.1 Preparing exposition

Day 10: Interior / Site cleaning (24rd June 201407:00-15:00)
10.1.1 Preparation exposition
10.1.2 Removing fences

Day 10: Interior / Site cleaning (24th June 2014 15:00 - 23:00)
10.1.1 Preparation exposition
10.2 House delivery

Assembly activities

Task Mode	Task Name
SW01	SITE WORK: Arrival truck Nr. 1
SW02	SITE WORK: Placing the container
SW03	SITE WORK: Setting up the tent
SW04	SITE WORK: Connecting powerboxes and electricity
SW05	SITE WORK: placing fences around the lot
FO01	FOUNDATION: Measure the location for the foundation
FO02	FOUNDATION: Mounting the profiles on the Stelcon (on truck)
FO03	FOUNDATION: Placing the Stelcon plates
FO04	FOUNDATIONS: Request foundation inspection with SDE organisation
FO05	FOUNDATION: placing plumbing on the foundation beams
FO06	FOUNDATION: connect the water tanks
FO07	FOUNDATION: Leveling and mounting the foundation beams
FO08	Shift tranfer briefing
FO09	INSPECTION BY SDE ORGANISATION
FO10	FOUNDATION: Placing the water tanks and PCM box
	Arrival truck Nr. 2
FO11	FOUNDATION: Placing the house floor panels
FO12	FOUNDATION: Placing the Southside floor panels
FO13	FOUNDATION: Placing the Northside floor panels
FO14	FOUNDATION: connecting the piping of the panels with eachother
FO15	FOUNDATION: Placing the fences around the platform
	Arrival truck Nr. 3
EH01	EXISTING HOUSE: Assembly Southwall groundfloor + support
EH02	EXISTING HOUSE: mount chimneys on East and West wall
EH03	EXISTING HOUSE: Assembly Westwall groundfloor + support
EH04	EXISTING HOUSE: Assembly Northwall groundfloor + support
EH05	EXISTING HOUSE: Assembly Eastwall groundfloor + support
EH06	EXISTING HOUSE: coupling the water connection of the panels
EH07	EXISTING HOUSE: Removing of temporary support
EH08	EXISTING HOUSE: Placing the stairs
EH09	EXISTING HOUSE: Assembly interior walls groundfloor
	Arrival truck Nr. 4
EH10	EXISTING HOUSE: Mounting feet for fences on floor panels
EH11	EXISTING HOUSE: Placing floor panels first floor
EH12	EXISTING HOUSE: Placing fences around the first floor and cover staircase
EH13	EXISTING HOUSE: Assembly Southwall firstfloor + support
EH14	EXISTING HOUSE: Mount chimneys on East and West wall
EH15	EXISTING HOUSE: Assembly Westwall firstfloor + support
EH16	EXISTING HOUSE: Assembly Northwall firstfloor + support
	Shift tranfer briefing
EH17	EXISTING HOUSE: Assembly Eastwall firstfloor + support
EH18	EXISTING HOUSE: Placing interior walls first floor
	Arrival truck Nr. 5
EH19	EXISTING HOUSE: Placing side walls tips
EH20	EXISTING HOUSE: Removing of temporary support
EH21	EXISTING HOUSE: placing the outside floors
EH22	EXISTING HOUSE: Placing the roofbeam

EH23	EXISTING HOUSE: Placing the roofpanels
EH24	EXISTING HOUSE: placing the safety fences on the roof
EH25	EXISTING HOUSE: placing the Chimneys
EH26	EXISTING HOUSE: Filling of caps between panels
EH27	EXISTING HOUSE: carpentry panel connections
EH28	EXSITING HOUSE: placing of door and framing
EH29	EXISTINT HOUSE: placing the setting the doors
EH30	EXISTING HOUSE: placement side walls greenhouse
EH31	EXISTING HOUSE: placing of the windowsills
EH32	EXISTING HOUSE: placing the plints
EH33	EXISITNG HOUSE: placing of the sliding doors
	Arrival truck Nr. 7
EH34	EXISTING HOUSE: placement of raingutters
EH35	EXISTING HOUSE: placement of the ramps
EH36	EXISITNG HOUSE: placing and mounting all the permanent fences
	Arrival truck Nr. 6
GR01	GREENROOF: placing and burning the Bitumen
GR02	GREENROOF: placing the sedum crates
GR03	GREENROOF: placing the covers of the Solatubes
GS01	GLASSHOUSE STEEL: setting up scaffolding
GS02	GLASSHOUSE STEEL: getting the boomlift in place
GS03	GLASSHOUSE STEEL: placing and leveling the main coloms
GS04	GLASSHOUSE STEEL: placing façade truss
GS05	GLASSHOUSE STEEL: placing the roofbeam
GS06	GLASSHOUSE STEEL: placing the 4 connecting beams
GS07	GLASSHOUSE STEEL: placing the horizontal beams
GS08	GLASSHOUSE STEEL: complete the frontside
GA01	GLASSHOUSE ALU: placing top support and gutter
GA02	GLASSHOUSE ALU: placing the front windowframing
GA03	GLASSHOUSE ALU: placing the top windowsframing
	Shift tranfer briefing
GA04	GLASSHOUSE ALU: placing the side connection and polycarbonaat
GP01	GLASSHOUSE PANELS: placing the power optimizers
GP02	GLASSHOUSE PANELS: placing the PV panels
GP03	GLASSHOUSE PANELS: connecting the PV panels
GP04	GLASSHOUSE PANELS: placing the windows (top- and frontside)
EL01	ELECTRIC: connecting the panel connections
EL02	ELECTRIC: placing the wall power boxes
EL03	ELECTRIC: Installing the meter in the technical room
EL04	ELECTRIC: placing the sensors for the DOMOTICA system
EL05	ELECTRIC: connecting the PV panels with the house
EL06	ELECTIC: connecting the lights on the north and south facade
EL07	ELECTRIC: making the light connection in the glasshouse
EL08	ELECTRIC: Final check electricity
PL01	PLUMBING: placing the ketel

dule

PL02	PLUMBING: connecting hot/cold water day 1
PL03	PLUMBING: connecting hot/cold water day 2
PL04	PLUMBING: Placing the heat recovery installation
PL05	PLUMBING: connecting hot/cold water day 3
PL06	PLUMBING: Installing the WTW unit (water)
PL07	PLUMBING: Placing the sanitary
PL08	PLUMBING: Placement and connecting of the radiators day 1
PL09	PLUMBING: Placement and connecting of the radiators day 2
PL10	PLUMBING: Place the energie panels
PL11	PLUMBING: connecting energie panels
PL12	PLUMBING: Placement and connecting of the solar boiler
PL13	PLUMBING: Connecting the rainwatergutter with the grey water tank
PL14	PLUMBING: connecting Rainwinners
PL15	PLUMBING: REQUEST FOR EARLY WATER DELIVERY!
PL16	PLUMBING: Water delivery
PL17	PLUMBING: Filling of boiler
PL18	PLUMBING: Filling of the Rainwinners
PL19	PLUMBING: connecting the water
PL20	PLUMBING: testing and adjusting the water system
MC01	MECHANICAL: Installation of the Heat recovery unit
MC02	MECHANICAL: Installing of the PCM box
MC03	MECHANICAL: placing ventilation canels day 1
MC04	MECHANICAL: placing ventilation canels day 2
MC05	MECHANICAL: Controlling of the ventilation system
MC06	MECHINICAL: placement of the CO2 sensors for the DOMOTICA system
DM01	DOMOTICA: initialing Domotica system
DM02	DOMOTICA: Testing light
DM03	DOMOTICA: Testing ventilation
DM04	DOMOTICA: Test heating and cooling
DM05	DOMOTICA: Controlling complete system
	Morning briefing
GN01	GARDEN NORTH: plank flooring Northside
GN02	GARDEN NORTH: assembly of the borders
GN03	GARDEN NORTH: placing the plant nets on the façade
GN04	GARDEN NORTH: Placing the fence
GN05	GARDEN NORTH: placing the greenery
GN06	GARDEN NORTH: placement tree's
GN07	GARDEN NORTH: putting in the gravel
	Morning briefing
GS01	GARDEN SOUTH: plank flooring Southside
GS02	GARDEN SOUTH: assembly of the borders
GS03	GARDEN SOUTH: placing the palisade east
GS04	GARDEN SOUTH: placing the palisade west
GS05	GARDEN SOUTH: placement rainwinners
GS06	GARDEN SOUTH: placing the tree's
GS07	GARDEN SOUTH: placing the greenery
GS08	GARDEN: final check garden

IN01	INTERIOR: Wall finishing first floor
IN02	INTERIOR: placement of the Sunshading
IN03	INTERIOR: placement of the Solatubes
IN04	INTERIOR: Wall finishing groundfloor
IN05	INTERIOR: Cleaning complete house for floors
IN06	INTERIOR: Flooring first floor
IN07	INTERIOR: Flooring ground floor
IN08	INTERIOR: installing Kitchen
IN09	INTERIOR: placing the furniture first floor
IN10	INTERIOR: placing furniture ground floor
IN11	INTERIOR: placement and installing the washing combination
IN12	INTERIOR: placing the decoration
IN13	INTERIOR: fine tuning
IN14	INTERIOR: Cleaning first floor
IN15	INTERIOR: Cleaning ground floor
IN16	INTERIOR: final check interior
EX01	EXHIBTION: placement of the wood panels outside
EX02	EXHIBITION: placing the prints on the sides
EX03	EXHIBTION: placement of information signs
EX04	EXHIBITION: installing the Mediaroom
EX05	EXHIBITION: Final control for all exhibition elements
SW06	SITE WORK: cleaning all the heavy constructive tools in container
SW07	SITE WORK: Loading container on closed truck
SW08	SITE WORK: clean the complete site
SW09	SITE WORK: Disconnecting constructive connections
SW10	SITE WORK: storage of all construction elements and tools in storage area
HD01	HOUSE DELIVERY

Activity	Shift	Human resource	Responsable company	Phase	Deadline
				Site preparation	
Arrival truck #1	1	2			
Placing tent and container	1	2	Prèt-à-Loger		
Controling electricty and water	1	2	Prèt-à-Loger		
	1			**Foundation**	
Placing foundation plates	1	4	Groothuis		
leveling and mounting beams	1	6	Groothuis		
FOUNDATION INSPECTION BY SDE	1/2		Groothuis		
Arrival truck #2	2	2	Groothuis		
Placing ground floor plates	2	4	Groothuis		
fencing the platform	2	6	Groothuis		
					Platform ready
				Construction existing house	
Arrival truck #3	1	2	Groothuis		
Assembly side walls ground floor	1	4	Groothuis		
Assembly interior walls ground floor	1	4	Groothuis		
Arrival truck #4	1	2	Groothuis		
Placing floor panels first floor	2	4	Groothuis		
Placing fences on the first floor	2	2	Groothuis		
Assembly side walls first floor	2	4	Groothuis		
Assembly interior walls first floor	1/2	4	Groothuis		
Arrival truck #5	1	2	Groothuis		
Assembly top walls	1	4	Groothuis		
Placing roofpanels	1/2	4	Groothuis		
				Roofwork	
Placing sedumcrates Greenroof North	2	4	Prèt-à-Loger		
Placing solatubes roofcovers	2	2	Prèt-à-Loger		
					Wind-and-water tight
				Glasshouse	
Arrival truck #6	1	2			
Placing steel structure	1/2	4	Nobutech		
Placing aluminium frames	1/2	4	Nobutech		
Placing glass and PV panels	1/2	4	Nobutech		
Placing sliding doors	2	4	Prèt-à-Loger		
					Glasshouse ready
				Electronics	
coupling the panel connections	1	2	Groothuis-Tech		
Installing the technical room	1	2	Groothuis-Tech		
Installing the PV panels	1	2	Groothuis-Tech		
Making light connecting in Glasshouse	2	2	Groothuis-Tech		
Control and testing System	2	2	Groothuis-Tech		
				Plumbing	
Installing plumbing to the foundation		2	Putman/Stefan		
Placing and connecting the watertanks		2	Putman/Stefan		
Coupling the water connections		2	Putman/Stefan		
Connecting the hot/cold water		2	Putman/Stefan		
Placing and connecting the radiators		2	Putman/Stefan		
Placing the boiler		4	Putman/Stefan		
connecting the sanitary		2	Putman/Stefan		
Connecting the heat panels		1	Putman/Stefan		
Placing the solar boiler		4	Putman/Stefan		
Fillilling the radiator		2	Putman		
Rainwater gutters					
					Connection to Solar Village
				Mechanical	
Placing Heat Recovery Box	1	2	Putman		
Placing the PCM box	1	2	Putman		
Connecting the PCM & WTW unit	2	2	Prèt-à-Loger (Stefan)		
Connecting the ventilation system	2	2	Prèt-à-Loger (Stefan)		
Installing the Domotica system	2	2	Van Dorp		
					Heating and Cooling ready
				Interior	
Arrival truck #7	1	2			
Paint and Finishing	1/2	6	Prèt-à-Loger		
Flooring	1/2	6	Prèt-à-Loger		
Furniture	1/2	8	Prèt-à-Loger		
Preparing exposition	1/2	6	Prèt-à-Loger		
					Inside finished
				Garden design & Plot	
Garden Northside	1/	4	NL greenlabel		
Garden Southside	1/	4	NL greenlabel		
				Site cleaning	
Removing tent and container	1/	4	Prèt-à-Loger		
Site cleanup	1/	8	Prèt-à-Loger		
					House delivery

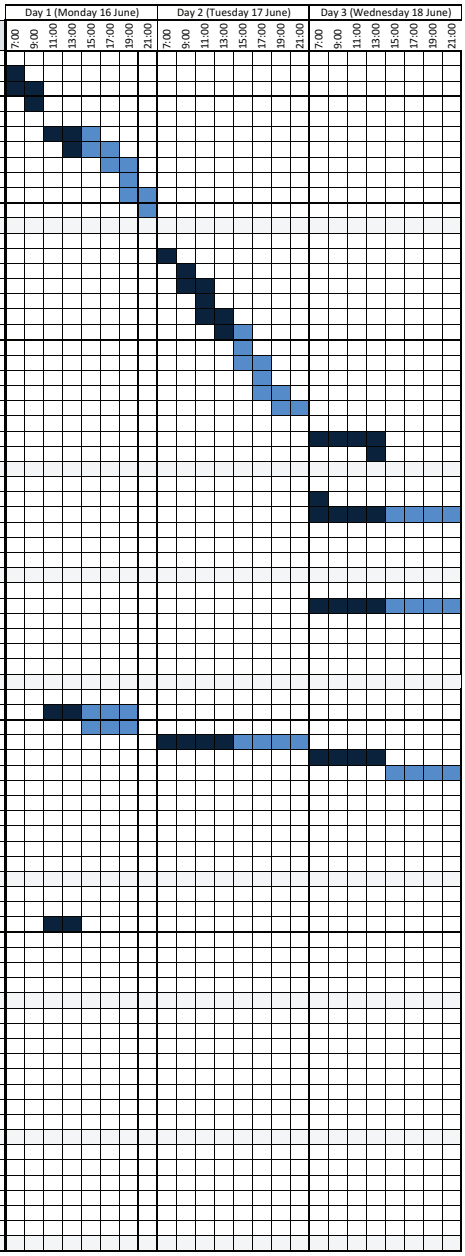
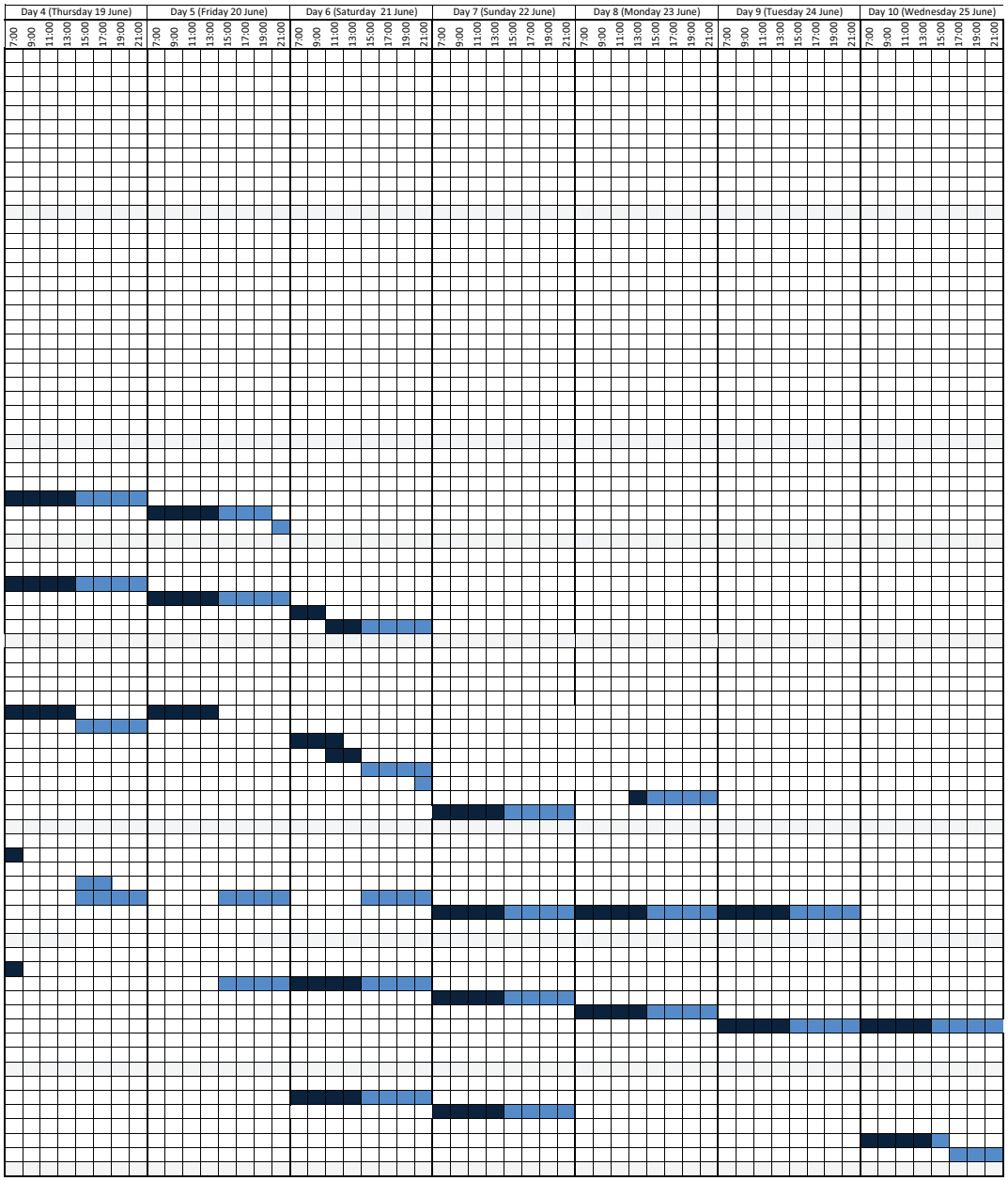


Table 4.5 — *Disassembly schedule*

Actions	Dates
Planned deadline platform ready (includes foundation)	16.06.2014
Planned deadline wind-and-water tight	18.06.2014
Planned deadline for electrical connection to village grid	20.06.2014
Planned deadline for glasshouse completion	21.06.2014
Planned deadline for interior completion	24.06.2014
Planned deadline for house delivery	25.06.2014


Day 4 (Thursday 19 June)
Day 5 (Friday 20 June)
Day 6 (Saturday 21 June)
Day 7 (Sunday 22 June)
Day 8 (Monday 23 June)
Day 9 (Tuesday 24 June)
Day 10 (Wednesday 25 June)
7:00
9:00
11:00
13:00
15:00
17:00
19:00
21:00

4.3 Disassembly- Day-to-day planning

Day 1 – shift 1 : Site preparations / disconnecting the house / Garden (15th July 2014 06:00-1400)
1.1 placing the container and setting up the tent
1.2.1. Removing furniture
1.2.2 Disconnecting electrical and water system
1.2.3 Disconnecting heating and cooling system
1.2.4 Removing kitchen
1.2.5 Removing large elements Southside garden

Day 1 – shift 2 : Dismantle the Glasshouse / Garden (15th July 2014 14:00-22:00)
1.4.1 Removing large elements Northside Garden
1.4.2 Removing roof tiling and solar panels roof Southside
1.5. Disconnecting PV panels
1.6 Removing PV and glass panels Glasshouse

Day 2 – shift 1 Dismantle the Glass House(16th July 2014 07:00-15:00)
2.1 RemovinPV and Glass panels of GlassHouse

Day 2 – Shift 2: Dismantle the house (16th July 2014 14:00-22:00)
2.2 Removing the Aluminium frame of the Glasshouse

Day 3 – shift 1 Dismantle the Glass house (17th July 2014 07:00-15:00)
2.1.1 Removing the steel frame of the Greenhouse

Day 3 – Shift 2: Dismantle the house (17th July 2014 14:00-22:00)
2.2.1 Removing the steel frame of the Glass house
2.2.2 Removing crates from Green roof

Day 4– shift 1: Disassembling the Row house (18th July 2014 06:00-14:00)
3.1 Removing the Chimneys
3.2 Removing the roof panels
3.3 Removing the top walls
3.4 Removing Interior walls first floor

Day 4 – shift 2: Disassembling the Row house (18th July 2014 06:00-14:00)
3.5 Removing side walls first floor
3.6 Removing floor panels ground floor
3.7 Removing water tanks
3.8 Removing foundation beams
3.9 Removing Stelcon plates

Day 5 – shift 1: Disassembling the Row house (19th July 2014 06:00-14:00)
4.1 Removing the Stelcon plates
4.2 Loading the container on the truck

Day 5 – shift 2: Disassembling the Row house (19th July 2014 06:00-14:00)
4.3.1 Removing the fences
4.3.2 Loading the container on the trailer
4.4 Cleaning the lot

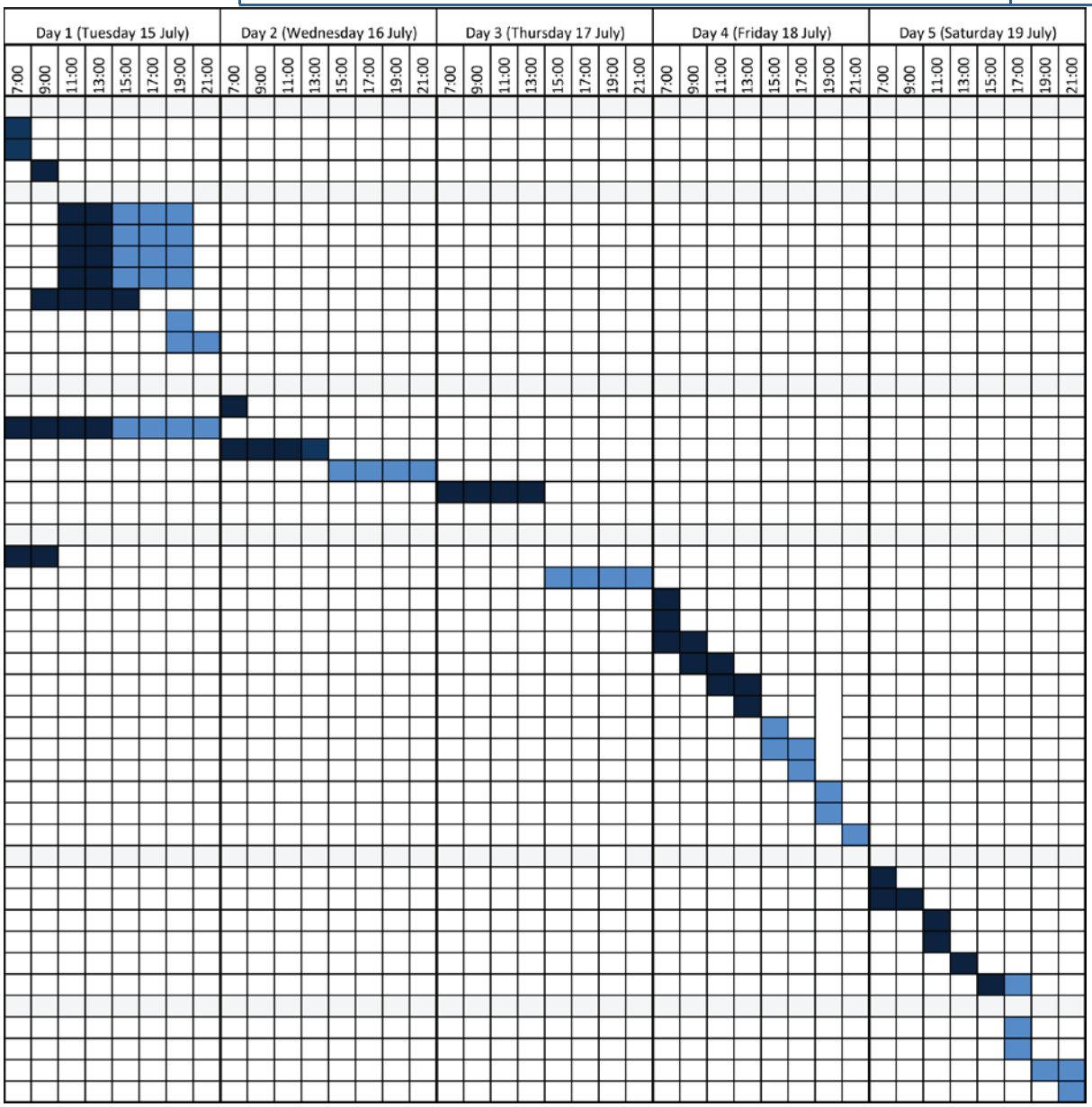
Disassembly activities

Task code	Task Name	Duration
	Arrival truck 1	15 mins
SW01	SITE WORK: Placing of the container	20 mins
SW02	SITE WORK: Setting up the tent	45 mins
IN01	INTERIOR: Taking out the furniture	360 mins
PL01	PLUMBING: Disconnect bathroom	120 mins
IN02	INTERIOR: Disconnect kitchen	360 mins
EL01	ELECTRICAL: Disconnect electrical system	700 mins
PL02	PLUMBING: disconnecting the water system	700 mins
GR01	GARDEN: disassemble the gardens	700 mins
EH01	EXISTING HOUSE: placing fences on the roof	60 mins
	Arrival Truck #2	15 mins
EH02	EXISTING HOUSE: Removing the ramps	60 mins
	Arrival Truck #3	15 mins
EH03	EXISTING HOUSE: Removing the tiles of the roof	180 mins
GP01	GLASSHOUSE PANELS: Disconnection of PV panels	120 mins
GP02	GLASSHOUSE PANELS: Taking out the PV AND Glass panels	420 mins
GA01	GLASSHOUSE ALU: Removing the aluminium frame	700 mins
GS01	GLASSHOUSE STEEL: Removing the Steelframe	500 mins
EH04	EXISTING HOUSE: Removing crates from the greenroof	180 mins
	Arrival Truck #4	15 mins
EH05	EXISTING HOUSE: Removing chimney	60 mins
EH06	EXISTING HOUSE: Removing the roof panels	160 mins
EH07	EXISTING HOUSE: Removing Top side walls	40 mins
EH08	EXISTING HOUSE: Removing interior walls first floor	140 mins
	Arrival truck #5	15 mins
EH09	EXISTING HOUSE: Removing side walls first floor	120 mins
EH10	EXISTING HOUSE: Removing floor panels firstfloor	80 mins
	Arrival truck #6	15 mins
EH11	EXISTING HOUSE: removing interior walls groundfloor	100 mins
EH12	EXISTING HOUSE: Removing stairs	60 mins
EH13	EXISTING HOUSE: removing sidewalls groundfloor	80 mins
	Arrival truck #7	15 mins
EH14	FOUNDATION: Removing floor groundfloor	180 mins
EH15	FOUNDATIONS: Removing water tanks	60 mins
PL03	PLUMBING: disconnect plumbing under floor panels	240 mins
	Arrival truck #8	15 mins
FO01	FOUNDATION: Removing foundation beams	60 mins
FO02	FOUNDATIONS: Removing Stelcon plates	270 mins
SW03	SITE WORK: Loading container on truck	30 mins
SW04	SITE WORK: disassemble the tent	45 mins
SW05	SITE WORK: Clean the lot	180 mins
	Final Check	60 mins

Activity	Group	Human resource students	Human resource professionals	Phase	Deadline
				Site preparation	
Arrival Closed Truck #1	1	2	2		
Placing of the container	1	4	2		
Setting up the tent	1	2	2		
	1			**Disconnecting the house**	
Taking out the furniture	1	10	0		
Disconnect bathroom	1	4	2		
Disconnect kitchen	1	4	2		
Disconnect electrical and water system	1	2	2		
Removing trees and plant from garder	1	6	1		
Arrival Truck #2	1	2	2		
Removing the ramps	2	4	2		
					House disconnected
	2			**Dismantle the Glass House**	
Arrival Truck #3	2	2	2		
Disconnection of PV panels	1	2	4		
Taking out the PV&Glass panels	2	4	2		
Removing the aluminium frame	1	4	2		
Removing the Steelframe	2	4	2		
					Glass house Dismantled
				Dismantle the Row house	
Removing the tiles of the roof	2	4	1		
Removing crates from the greenroof	1	4	1		
Arrival Truck #4	1	2	2		
Removing chimney	1	4	2		
Removing the roof panels	1	4	2		
Removing Top side walls	1	4	2		
Removing interior walls first floor	1	4	2		
Arrival truck #5		2	2		
Removing side walls first floor	2	4	2		
Removing floor panels firstfloor	2	4	2		
Arrival truck #6	2	2	2		
Removing stairs	2	4	2		
removing interior walls groundfloor	2	4	2		
removing sidewalls groundfloor	2	4	2		**Rowhouse Dismantled**
				Dismantle the Foundation	
Arrival truck #7	1	2	2		
Removing floor groundfloor	1	4	2		
Removing water tanks	1	4	2		
Arrival truck #8	1	2	2		
Removing foundation beams	1	6	2		
Removing Stelcon plates	1/2	6	2		
				Plot cleaning	
Loading container on truck	2	4	2		
disassemble the tent	2	2	0		
Clean the lot	2	6	0		
Final Check	2	6	0		

Table 4.6 —
Disassembly chart

Actions	Dates
Planned deadline for house disconnection	15.07.2014
Planned deadline Glasshouse disassambled	16.07.2014


Day 1 (Tuesday 15 July)
Day 2 (Wednesday 16 July)
Day 3 (Thursday 17 July)
Day 4 (Friday 18 July)
Day 5 (Saturday 19 July)
7:00
9:00
11:00
13:00
15:00
17:00
19:00
21:00

EQUIPMENT RENTAL CHART
TEAM DEL

CATEGORIE 1 : MOBILE CRANE

PLEASE COMPLETE THE ASSEMBLY & DISASSEMBLY CHARTS

CATEGORIE 2 : CONSTRUCTION EQUIPMENT

HANDLING			
DESIGNATION	REFERENCE	U	QUANTITY NEEDED
Forklift	H.FL.01	u	Not Needed
Telehandler	H.TH.01	u	1

ELEVATION			
DESIGNATION	REFERENCE	U	QUANTITY NEEDED
Boom Lift	E.BL.01	u	1

CATEGORIE 3 : OTHER EQUIPMENT

EQUIPMENT			
DESIGNATION	REFERENCE	U	QUANTITY NEEDED
Pallet Truck	O.OE.01	u	0
Individual Platform 2,90m to 3,60m	O.OE.02	u	2
Scaffolding 5 m	O.OE.03	u	2
Fences HERAS (including plots)	O.OE.04	m	90m

Table 4.7 —
Equipment rental chart



ASSEMBLY CHART
TEAM TU DELFT

DAY 1 - 16.06.2014	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®	T1						T2							T3		
Cranes	35 Tn															
Trucks in Matelots			T2							T3						

DAY 2 - 17.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T3			T4					T5							T6	
Cranes								35 Tn																
Trucks in Matelots								T4				T5							T6					
Cranes for storage area																								

DAY 3 - 18.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T6															T8	
Cranes								35 Tn																
Trucks in Matelots																			T8				T6	
Cranes for storage area																								

DAY 4 - 19.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T8				T6												
Cranes								35 Tn																
Trucks in Matelots								T6																
Cranes for storage area																								

DAY 5 - 20.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T6				T8												
Cranes								35 Tn																
Trucks in Matelots								T8																
Cranes for storage area																								

DAY 6 - 21.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T8													T7		T8	
Cranes								35 Tn																
Trucks in Matelots																	T7				T8			
Cranes for storage area																								

DAY 7 - 22.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T8																
Cranes																								
Trucks in Matelots																								
Cranes for storage area																								

DAY 8 - 23.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T8																
Cranes																								
Trucks in Matelots																								
Cranes for storage area																								

DAY 9 - 24.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T8																
Cranes																								
Trucks in Matelots																								
Cranes for storage area																								

DAY 10 - 25.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T8																
Cranes																								
Trucks in Matelots																								
Cranes for storage area																								

DAY 11 - 26.06.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	INSPECTION DAY																							

Table 4.8 —
Assembly Chart

DISASSEMBLY CHART
TEAM TU DELFT

DAY 1 - 15.07.2014	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®	T8														T7	
Cranes																
Trucks in Matelots											T7					
Cranes for storage area																

DAY 2 - 16.07.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T7	T6															
Cranes								35 Tn																
Trucks in Matelots								T6																
Cranes for storage area																								

DAY 3 - 17.07.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T6														T5		
Cranes								35 Tn																
Trucks in Matelots																		T5						
Cranes for storage area																								

DAY 4 - 18.07.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T5				T4					T3						T2	
Cranes								35 Tn																
Trucks in Matelots								T4					T3						T2					
Cranes for storage area																								

DAY 5 - 19.07.2014	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Trucks in CDS®								T2						T1										
Cranes								35 Tn																
Trucks in Matelots										T1														
Cranes for storage area																								

Trucks in Matelots	**Trucks which are waiting in Allée des Matelots along la Cité du Soleil®**

USAGE OF THE CRANE during **ASSEMBLY**	
Crane capacity	*Usage time*
35 Tn	95 Hours

USAGE OF THE CRANE during **DISASSEMBLY**	
Crane capacity	*Usage time*
35 Tn	64 Hours

Table 4.9 —
Dissembly Chart

SITE OPERATION CHART
TEAM TU Delft

0. GENERAL INFORMATION		FUNCTION	CONSTRUCTION WORKING TEAM	NAME	TELEPHONE NUMBER
	1	Site Operations Coordinators	Working Team A	Petar Zhivkov	31616377994
	2		Working Team B	Rudger de Jong	31653344898
	3		Working Team Overtime	Tim Jonathan	31619193421

1. MODULES AND MAIN COMPONENTS		NAME	DIMENSIONS [m]	WEIGHT [kg]	MACHINERY USE FOR UNLOADING/LOADING
	1	Foundations	1.0x2.0	800	crane
	2	Wall panels	2.65x8.4	1800	crane
	3	Floor panels	2.44x8.4	1000	crane
	4	Roof panels	2.66 x 2.4	800	crane
	5	Interior wall panels	2.5 x 3.4	330	crane
	6	Steel glass house substructure	2.5x6.0	120	crane
	7	aluminium glass house structure	3.0 x 6.0	100	crane
	8	PV and Glass panels	1.2 x 1.5	35	crane
	9	glass panels (glass doors)	3.0 x 6.0	360	crane

2. VEHICULES (Trucks, Vans, etc.)		TYPE	DIMENSIONS [m] (Tractor unit + Trailer)	WEIGHT [kg] (Truck + Loading)
	1	Truck + flatbed trailer	18 x 4,00 x 2,5	30.000
	2	Truck + Lowered trailer	18 x 4,00 x 2,5	18.000
	3	Truck + flatbed trailer	18 x 4,00 x 2,5	24.000
	4	Truck + flatbed trailer	18 x 4,00 x 2,5	24.000
	5	Truck + flatbed trailer	18 x 4,00 x 2,5	30.000
	6	Truck + flatbed trailer	18 x 4,00 x 2,5	20.000
	7	Truck + flatbed trailer	18 x 4,00 x 2,5	18.000
	8	Closed Tautliner	18 x 4,00 x 2,5	18.000

3. CRANES		CAPACITY	USAGE TIME
	1	35 ton crane	206 Hours
	...		

4. GENERAL DESCRIPTION OF THE PHASES			PHASE	MATERIAL AND EQUIPMENT RESOURCES	HUMAN RESOURCES	DURATION
	ASSEMBLY	1	Site preparations	Brooms, insulated handtools, voltage measuring	6	4 hours
		2	Foundations	Laser measure tool, Screwgun, English key, screws	6	12 hours
		3	Construction Row House	Screw gun, hammer, Temporary supports, Fences, screws, nails	4	32 hours
		4	Roofwork	Screw gun , Screws, Blowtorch, Watertight tape, Lifting crates	6	16 hours
		5	Construction Green House	Screw gun, Screws, Waterpas, Handheld drill, vacuum glass lifter	4	48 hours
		6	Water and Electronics	Insulated handtools, ampere measure, electrical tape, Screw gun	4	8 hours
		7	Climate Controle	Insulated handtools, Power saw	4	8 hours
		8	Interior	Wallpaper table, glue, knife, jig saw, hammer	8	32 hours
		9	Garden Design	wheelbarrow, shovel, watering can	6	32 hours
		10	Site Cleaning	Broom, vacuum cleaner	4	4 hours
	DISASSEMBLY	1	Site preparations	Brooms, insulated handtools, voltage measuring	8	4 hours
		2	Disconnecting the house	Insulated handtools, ampere measure, Screw gun, Power saw	14	8 hours
		3	Dismantle the Glasshouse	Screw gun, Handheld drill, vacuum glass lifter, Knife	4	16 hours
		4	Dismantle the Rowhouse	Screw gun, hammer, Temporary supports, Fences	4	20 hours
		5	Dismantle the foundation	Laser measure tool, Screwgun, English key	6	16 hours
		6	Site cleaning	Broom, vacuum cleaner	6	4 hours
		7				
		8				
		9				
		...				

Table 4.10 —
Site Operation Chart

4.5 Process Control Sheet

As a tool for the inspection we created a process control sheet, directly related to our detailed internal assembly and disassembly planning.

PROJECT: HOME WITH A SKIN

CONSTRUCTION PROCESS CONTROL SHEET

LOCATION: | Revision:

DATE:

CONTROL OF PROCESSES

PROCESS FOLLOW UP: | **COD:** | **PHASE:**

CODE	ACTIVITIES	ASPECTS TO BE CONTROLLED	ACCEPTANCE CRITERIA	METHOD, WORK DESCRIPTION	FRECUENCY	REGISTRY		CONTROL POINT		INSPECTION, TESTS		COMMENTS
						NAME	COD	YES	NO	APROVED	NOT APROVED	
SW05	SITE WORK: placing fences around the lot	completness, firmness	all the fences placed and placed in the right way?	By hand and by eye	once							
FO01	FOUNDATION: Measure the location for the foundation	Correnponse with the drawing	Measured location is the same as the drawings	With measurment tools	once							
FO03	FOUNDATION: Placing the Stelcon plates	is the measured path followed	Is the location of the stelcons the same as drawings	By eye	once							
FO04	FOUNDATIONS: Request foundation inspection with SDE organisation	Double check if it happens on time	Make sure that it is done by Site Operator	Communicate	once							
FO07	FOUNDATION: Leveling and mounting the foundation beams	The correct height	Make sure that the beams are level and not to high	Measurement tools	once							
FO10	INSPECTION BY SDE ORGANISATION	Make sure we are ready for inspection	When jury coms the foundation is acceptable		once							
FO11	FOUNDATION: Placing the house floor panels	Right location, right height	The height of the panels is correct	Measurement tools, drawings	once							
FO12	FOUNDATION: Placing the Southside floor panels	Right location, right height	The height of the panels is correct	Measurement tools, drawings	once							
FO13	FOUNDATION: Placing the Northside floor panels	Right location, right height	The height of the panels is correct	Measurement tools, drawings	once							
FO15	FOUNDATION: Placing the fences around the platform	Fences are all in place and secured	If the situation is safe	eye	once							
EH01-EH09	EXISTING HOUSE: Assembly Southwall groundfloor + support	Right angle, right location	the panels are level and in the right place	Measurement tools, drawings	Every panel							
EH08	EXISTING HOUSE: Placing the stairs	No space between steps?	the finising is allright and the stairs is constructed oke	Eye	once							
EH12	EXISTING HOUSE: Placing fences around the first floor and cover staircase	Fences are all in place and secured	The situation is safe	Eye	once							
EH13-EH20	EXISTING HOUSE: Assembly Southwall firstfloor + support	Right angle, right location	the panels are level and in the right place	Measurement tools, drawings	Every panel							
EH24	EXISTING HOUSE: placing the safety fences on the roof	Fences are all in place and secured	The situation is safe	Eye	once							
EH28	EXSITING HOUSE: placing of doors and framing	rigth size and finishing	The doors are in the right place and placed correctly	eye, drawings	Every frame							
EH33	EXISTINT HOUSE: placing the sliding doors	Open en close fluently	The doors are hung correctly and function oke	Test	every door							
EH34	EXISTING HOUSE: placement of the raingutters	Are they on the right location	The locations is corrent	eye, drawings	once							
EH30	EXISTING HOUSE: placement side walls greenhouse	Are they in the right place and right height	The height of the panels is correct	Measurement tools, drawings	Twice							
EH31	EXISTING HOUSE: placing of the windowsills	right location, no space between windows?	are they placed in the right place and place correctly	By hand and by eye	Every Sill							
EH36	EXISTING HOUSE: placement of the ramps	Right location, right height	there is no gap between the ramps and the platform	By hand and by eye	twice							
EH36	EXISITNG HOUSE: placing and mounting all the permanent fences	Fences are all in place and secured	The location is the same as the drawings	Eye	once							
GS03	GLASSHOUSE STEEL: placing and leveling the main coloms	Correct location and level	the main structure is placed corrent and level	eye, drawings	Continuously							
GA01	GLASSHOUSE ALU: placing top support and gutter	Correct location and level	the location is the same as the drawings	eye, drawings	Twice							
GA02	GLASSHOUSE ALU: placing the front windowframing	Correct location and level	the location is the same as the drawings	eye, drawings	Once							
GA04	GLASSHOUSE ALU: placing the side connection and polycarbonaat	Correct placement and good finishing	No gaps, all screws are in	Eyes	Twice							
GP01	GLASSHOUSE PANELS: placing the power optimizers	Right optimizer on the right location	All optimizers are in good condition and in the right place	eye, drawings	Once							
GP02	GLASSHOUSE PANELS: placing the PV panels	Corrent placement and no damage	The panels are in place the mounted corrently	By hand and by eye	Continuously							
GP04	GLASSHOUSE PANELS: placing the windows (top- and frontside)	Corrent placement and no damage	The windows are in place the mounted corrently	By hand and by eye	Continuously							
EL04	ELECTRIC: placing the sensors for the DOMOTICA system	Corrent location and no damage	All sensors are in place and in good condition	eye, drawings	Once							
EL06	ELECTIC: connecting the lights on the north and south facade	the right light on corrent location	The lights are installed as designed	eye, drawings	twice							
EL08	ELECTRIC: Final check electricity	Double check if everything functions	Multiple test give positive result	Measurment tools	multiple times							
PL04	PLUMBING: Placing the heat recovery installation	Corrent location	The heat recovery unit is place on the right location	eye, drawings	Once							
PL07	PLUMBING: Placing the sanitary	Corrent location and no damage	All sanitary is in place, level and undamages	eye, drawings	Once							
PL10	PLUMBING: Place the energy panels	Corrent location	The energie panel is place on the right location	eye, drawings	Once							
PL14	PLUMBING: connecting Rainwinners	Water tightness	No water leacking after test	eyes, and hands	Once							
PL15	PLUMBING: REQUEST FOR EARLY WATER DELIVERY!	Double check if it happens on time	Make sure that it is done by Site Operator	Communicate	once							
PL16	PLUMBING: Water delivery	Make sure we are ready for delivery	make sure the right people are on the site	communicate	once							
PL20	PLUMBING: testing water system	Double check if everything functions	Multiple test give positive result	Measurment tools	multiple times							
MC06	MECHINICAL: placement of the CO2 sensors for the DOMOTICA system	Corrent location and no damage	All sensors are in place and in good condition	eye, drawings	Once							
DM05	DOMOTICA: Controlling complete system	Double check if everything functions	Multiple test give positive result	Measurment tools	multiple times							
GN04	GARDEN NORTH: Placing the fence	Corrent location	The fences are placed on the same locations as the design	eye, drawings	Once							
GN05	GARDEN NORTH: placing the greenery	Correct greenery and in good condition	it al looks good	eyes	Continuously							
GN06	GARDEN NORTH: placement tree's	Correct location and good condition	it al looks good and according to drawing	eye, drawings	once							
GS01	GARDEN SOUTH: plank flooring Southside	Correct location and good finishing	it al looks good and according to drawing	eye, drawings	Once							
GS05	GARDEN SOUTH: placement rainwinners	Correct location	It fits in the designed furniture	eye, drawings	once							
GS06	GARDEN SOUTH: placing the tree's	Correct location and good condition	it al looks good and according to drawing	eye, drawings	once							
GS07	GARDEN SOUTH: placing the greenery	Correct greenery and in good condition	it al looks good	eyes	Continuously							
	GARDEN: final check garden	Everything is in place and finished	It is the most beautifull garden you have ever seen	Eyes and imagination	Once							
IN01	INTERIOR: Wall finishing first floor	Wall finishing is finished	All the finishing is smooth and the right colour	Lamp, eyes and hands	Continuously							
IN02	INTERIOR: placement of the Sunshading	Correct location and good finishing	Shading is installed correctly and slides smooth	Measument, eyes, hands	Three times							
IN03	INTERIOR: placement of the Solatubes	Correct location and good finishing	They are installed correctly and undamaged	Measument, eyes, hands	Three times							
IN04	INTERIOR: Wall finishing groundfloor	Wall finishing is finished	All the finishing is smooth and the right colour	Lamp, eyes and hands	Continuously							
IN06	INTERIOR: Flooring first floor	Floor is placed correcty	No gaps, crack or other damage	eyes, hands	Multiple times							
IN07	INTERIOR: Flooring ground floor	Floor is placed correcty	No gaps, crack or other damage	eyes, hands	Multiple times							
IN08	INTERIOR: installing Kitchen	Kitchen placement and finishing	Everythings is placed as on drawing and functions	eyes, drawings	once							
IN12	INTERIOR: placing the decoration	Right location of items	all decorative elements are in good condition and in place	eyes	multiple times							
IN16	INTERIOR: final check interior	Finishing is right	Everythings is placed as planned and look nice	eyes	Continuously							
EX01	EXHIBITION: placement of the wood panels outside	Panels are placed correct and level	No seems, caps or crack. The panels are level and place firm	Measument, eyes, hands	Once							
EX02	EXHIBITION: placing the prints on the sides	Banners are place tight and on the right location	No foulds and nice finishing	eyes	eight times							
EX03	EXHIBITION: placement of information signs	Right location	Same location as planed by exhibition team	eyes, drawings	multiples times							
EX04	EXHIBITION: installing the Mediaroom	Everything looks good and functions	Beam functions, finishing is oke. No cabels in sight	eyes	Once							

1 Health and Safety checklist

Legal content	Location in manual or drawings
Name and address of SDE 2014, HS Coordinator, Prevention authorities, Team	10.2
Number of workers	10.5.3
Contact information of the Site Operations Coordinator	10.2
Description of works (Phase description)	10.4.1
First aid procedure	10.12.2 & 10.12.3
Name and number of first aid certificated worker	10.12.1 &10.16.2
Description of the Team's first aid kit.	10.12.4
Description of hygiene conditions (toilet, changing room, restroom…)	10.4.16
Detailed description of operating modes	10.4.9
Risk assessment – risks generated by other	10.7
Risk assessment – risks generated by environment	10.7
Risk assessment – risks generated on other	10.7
Risk assessment – self generated risks	10.7 (all types of risks combined in this set of tables)
Procedures to adapt collective protection	10.8

2 General data of the project

2.1 Stakeholders

HS team Coordinator & SO Operations Coordinator

Name: Petar Zhivkov MSc
Address: De Vlouw 16
Zipcode: 2611 EX
City: Delft
Phone: (+31) 6 16 37 79 94
Email: zhivkovpetar@gmail.com

Master degree in CIvil Engineering and Geodesy from the university of architecture in Sofia, Bulgaria.

Safety officers

Name: Gini Arimbi
Address: Roland Holstlaan 355
Zip code: 2624 HK
City: Delft
Phone: (+31) 6 16 59 93 97
Email: gini.arimbi@gmail.com

Name: Arjan Oosterhof
Address: Balthasar van der Polweg 316
Zip code: 2628 AZ
City: Delft
Phone: (+31) 6 33 88 72 09
Email: ajoosterhof89@gmail.com

Name: Rudger de Jong
Address: Oudraadtweg 15
Zip code: 2612 SL
City: Delft
Phone: (+31) 6 53 34 48 98
Email: rudgerdejong@hotmail.com

Back-up safety officer

Name: Jan Portheine
Address: Koornmarkt 81b
Zip code: 2611 ED
City: Delft
Phone: (+31) 6 13 73 72 15
Email: j.o.portheine@student.tudelft.nl

SDE 2014 Organization

Manager: M. Mat
Email: jerome.mat@solardecathlon2014.fr
Address: Cours Louis Lumiere 94 300 Vincennes - France
Telephone: 00 33 (0)1 40 50 29 34
Fax: 00 33 (0)1 40 50 29 10

Prevention Authorities

Stakeholder: CARSAT
Address: 9 rue Porte de Buc
78035 Versailles
Cedex 20
Telephone: 0033 (0)1 39 53 4 1 41
Fax: 00 33 (0)139 51 06 24
Manager: M. Taccoen

Stakeholder: French Labour Inspection (DIRECCTE)
Address: La Diagonale Building
34 avenue du Centre
78 182 Saint Quentin-en-Yvelines
Cedex 20
Telephone: 0033 (0)1 61 37 10 00
Fax: 00 33 (0)1 61 3 7 10 01
Manager: dd-78.direction@direccte.gouv.fr

Stakeholder: OPPBTP
Address: 1 rue des Mazieres
Clos de l'Agora
91000 Evry
Telephone: 0033 (0)1 71 63 70 00
Fax: 00 33 (0)1 71 6 3 70 01

Health & Safety Coordinators (Bureau VERITAS)

SPS Design Coordinator
Manager: C. Peyronel
Email: christophe.peyronel@fr.bureauveritas.com
Address: 17A, avenue Robert Schuman 13235 Marseille Cedex 2
Telephone: 00 33 (0)4 96 17 13 50
Fax: 00 33 (0)4 91 56 18 73

SPS Realisation Coordinator
Manager: B. Ianelli
Email: bruno.ianelli@fr.bureauveritas.com
Address: Immeuble le FLorestan, 2 boulevard Vauban
Telephone: 00 33 (0)1 39 44 69 57
Fax: 00 33 (0)1 30 43 34 57

2.2 Construction sites

The Netherlands

Name: Groothuis B.V.
Address: Ootmarsumseweg 12
Zip code: 7615 PL
City: Harbrinkhoek

France

Name: La Cité Du Soleil
Address: allée des Matelots
Zip code: 78000
City: Versailles

3 Health and Safety Plan Objectives

- Give a clear overview for all team members and SDE14 organization of all Heal & Safety related issues
- Give instructions how to (dis)assemble in a safe way (HS Drawings)
- Give instructions how to react when an accident occurs (first AID, evacuation etc.)
- Reduce the risk of accidents (protection, analysis, measures etc.)
- Learn from accidents (incident report)

The aim of the Health and Safety Plan is to inform al workers, students and professionals, as much as possible on this issue. The information and training should help avoid risks on the constructions sites in Harbrinkhoek and Versailles. The HS Plan shall at all time be available for everyone at the construction site. The HS team coordinator and officers are responsible for meeting the requirements of the plan, but all team members share this responsibility also. All team members agreed on the terms and conditions of the HS Plan and shall therefore stick to it at all time.

4 Conditions of the Site

4.1 Constructive process

Site preparation

The shift of the first day is the only shift where the briefing is not held at the beginning of the shift on the plot but the day before. This is because there is no base tent yet and to ensure that we can start directly.

The first truck will arrive with the toolcontainer, the tent and the foundation plates. At the same time the crane, the forklift, boom lift and other rented equipment will arrive. The equipement will be placinga and installed and the fences will be put in place.

Foundations

Our house will be founded on concrete Stelcon plates of one by two meter. On the plates L-profiles are mounted in predrilled holes. The wooden foundation beams which will be attached on the profiles must be level and therefore the position where they are connected to the profiles is flexible. We will use laser measuring equipment to determine the height of each Stelcon plate.

When all the beams are in place we are ready for the foundation inspection by the SDE organisation. After the inspection we place the water tanks between the foundation feet and place the ground floor panels. The placing of the floor panels is done by the rented 35 Ton crane. While the crane lifts the element four team members guided it into place with the use of ropes on the corners of the panels. When all the floor plates are in place the platform is ready, this is our first internal deadline.

Construction Row house

The second day we start with the placement of the wall panels of the Row house. The panels are transported on a lowered trailer on which they are placed vertical. The panels will be lifted with the crane and steered by four team members who al have a rope attached to one of the corners of the panels. On the floor panels profiles are mounted where the panels are placed upon. When a panel is temporality unsupported like the first panel, it is temporarily sustained to the floor panels. The other panels are placed directly against the previous panel. The order for the outside walls is always the first the south wall, which is furthers away from the crane, and then clockwise. This is to prevent the crane driver to have bad of no vision on the load. The interior walls is the same principle, the walls are much lighter but since the crane driver does not always see where the walls are placed we pay extra attention to the communication with the crane driver.

As soon as the floor panels of the first floor are placed one team member is secured in a safety harness and will place fences around halve a meter from the outside of the floors. After this the floor is save to enter for the rest of the team members and the first floor wall panels can be placed the same way as the ground floor panels.

After all the wall panels have been placed the support beam for the roof is placed on which the roof panels are lowered. The order for the roof panels is from the back to front and alternately north and south to prevent too much pressure from one side. Finally the tops of the two chimneys are lowered and all the heavy elements of the row house are in place, our second internal deadline.

Roof work

Just like on the first floor, also on the roof fencing will be placed as soon as the panels are placed to make it safe to work for the workers. On the Northside of the roof bitumen will be laid and the seals attached to eachother with a blowtorch. On top of this crates, filled with sedum, are placed to form the green roof.

On the Southside underneath the greenhouse roof tiles will be placed on battens that are already place on the roof panels. To make the Southside of the roof safe to work when constructing the greenhouse and to prevent that roof tiles will break not all the tiles are laid at once. The open areas will be temporarily closed off with watertight foil to ensure the water-tightness. After the completion of the Glasshouse the remaining tiles are placed.

When the roofs are placed on both sides we reached our deadline for wind-and-water tightness

Glasshouse

After the roof work is complete we start with the glasshouse. The support structure is made out of steel beams. Between the two chimneys a steel beam is placed which will support two beams that follow the angle of the roof and are attached to the south façade of the house and, trough savings in the floor panels, are founded. The foundation of the glasshouse is done into steel feet that are preassembled on the concrete Stelcon foundation plates. All the steel will be lifted with the crane and steered with ropes. The mounting of the glasshouse will be done from the roof or by a worker which is secured in the basket of the boom lift. After the steel structure is in place, the aluminum window frames are placed on top of this. To make the entire glasshouse well reachable en to prevent people working outside a safe reach we will also place scaffolding against the south façade. When the window frames are placed it is time for the glass panels which are placed by crane and guided in the final position through team members on the roof and in the boom lift. From the inside the panels are connected and the sun shading is placed. After all the work on the glasshouse is completed we will finish the roof tiling on which we place the heat panels.

This is our internal deadline for the finishing of the greenhouse.

Water and electronic systems
All the piping and cable for are already placed in the wall and floor panels and connecting for this are made in a saving on the bottom of the panels and concealed behind skirting board. The placing of radiators, the connection of the solar boiler and other critical elements is done by team member who had extra training during the first construction on these subjects. When all systems are in place and tested the house is ready to be connected to the solar village.

Climate control and Kitchen/ Bathroom
Just like with the electric system, most of the piping is already in place. The installations are placed on the first floor and the piping runs through the chimney which is open on the inside until the cover is placed before it. This makes it relativly easy to connect the installation with the ventilation pipes.
The kitchen and the bathroom are mounted by students who had extra instruction for this during the first assembly in the Netherlands. All the tiling for the bathroom is already placed on the wall and floor panels so only the edges need to be finished.

Interior
As soon as all the water/electronic/heating and cooling systems are in place large teams will work simultaneously on the ground floor and first floor on the flooring and the walls. After this the furniture is place for the closed taut liner into the house.

Garden design and plot
As soon as green roof is completed the Northside of the plot is free of crane motion and the north side of the platform is safe to work. As soon as the greenhouse is ready also the Southside of the platform is ready and garden work can start. The trees are placed in the closed taut liner to prevent leaves flying off during transport. They are transported on the plot with the forklift.

Site cleaning
When construction is done we will remove the fences around the plot and clean the area. The tools are stored in the container outside the competition area.

Maintenance

For the PV-panels to perform as best as possible they should be as clean as possible all time. Therefore during the exposition the PV-panels should be cleaned with water. To do this in a safe way we need a rigid ladder and an installation for a safety harness.
To replace any damaged outer wall brick plates we shall bring spare bricks. They can easily be replaced without machinery, just a knife and glue.

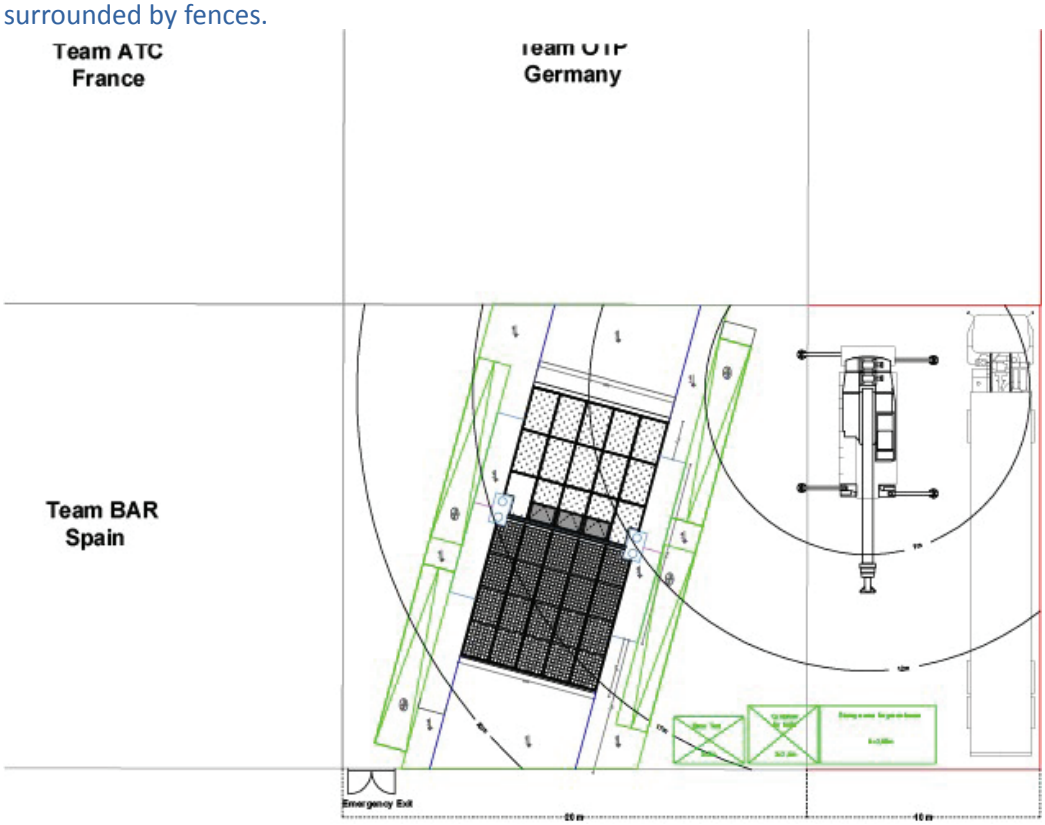
Disassembly
Disassembly shall happen in the exact reversed order as the assembly. After all installations and small components are disconnected, all prefab panels shall be unscrewed and hoisted back onto the trucks.

4.2 Type and characteristics of the materials and elements

Type	Material
Foundation	Prefab concrete with poured in steel beams
Ground floor	Prefab wooden panels with insulation
First floor	Prefab wooden panels
Wall	Prefab wooden panels with insulation, brick outer layer
Roof	Prefab wooden panels with insulation, roof tiling
Greenhouse main structure	Steel beams
Greenhouse sub structure	Aluminium profiles
Greenhouse cover	Glass with integrated PV-panels
Water tanks	Plastic
Roofing	Roof tiles and a grass type
PCM-box	Aluminium
Garden	Wooden decks, plants, gravel

4.3 Site description

The construction site is situated at the south side of the gardens of Versailles. The entire area with all the construction sites and utilities is called the Solar Village. Every competing team will get a lot of 20 by 20 meters with an additional 10 meter on one side for the trucks and crane. The entire lot, so including the truck and crane area, will be surrounded by fences.



4.4 Climate description

Versailles:

	Aver-age max T	aver-age min T	Average sun hours per day	Average rainy days per month	Average mm's rain per month	UV index	Aver-age wind speed (kmh)	Aver-age wind direc-tion
July	24	14	8	9	31-60	UV 6 - 8	16	W
Augus-tus	23	13	7	10	31-60	UV 6 - 8	14,5	W

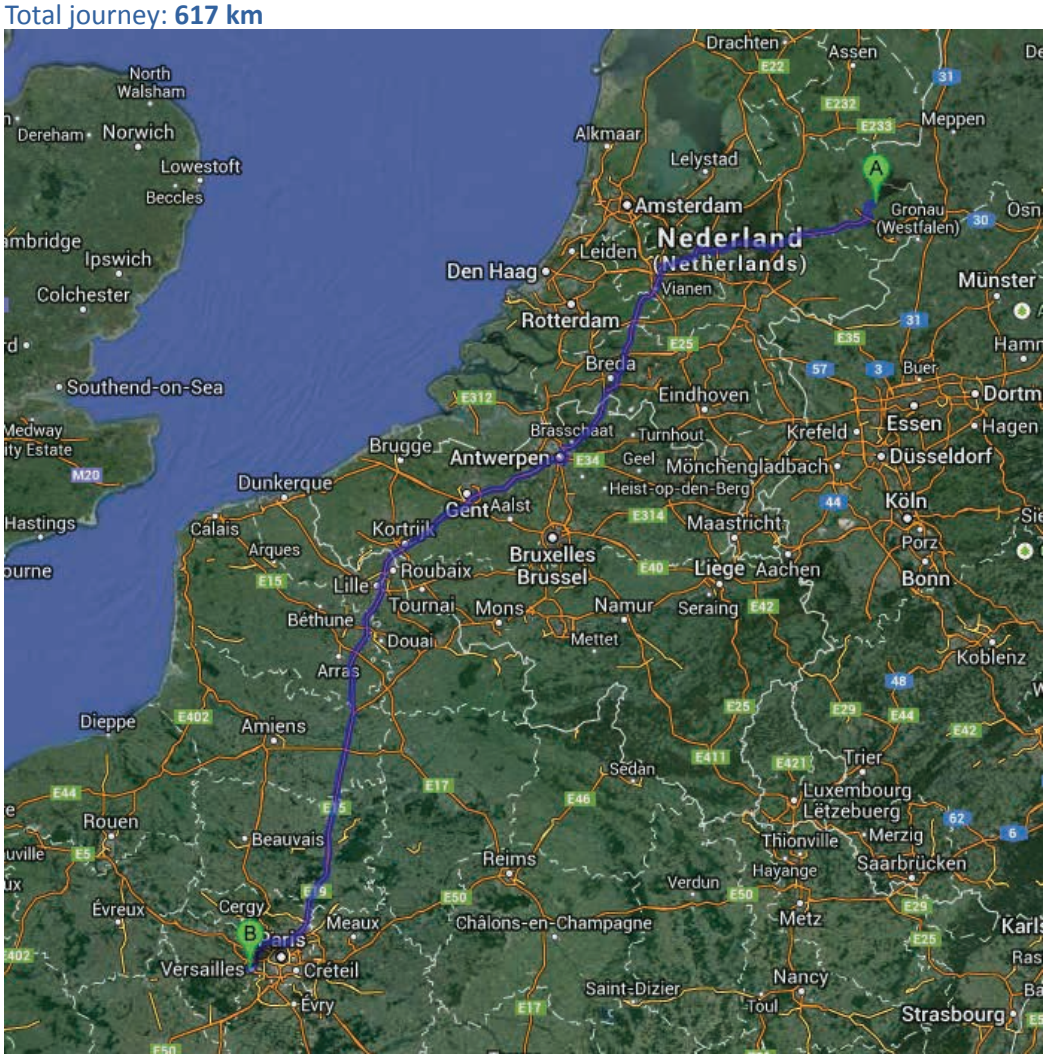
Source: http://www.klimaatinfo.nl/frankrijk/versailles.htm4.5 Accesses and paths for vehicles

Month	Day	Week day	Sun Rise Time	Sun Set Time	Daylight hours
Assembly					
June	16	Monday	4:46	20:56	16:10
June	17	Tuesday	4:46	20:56	16:10
June	18	Wednes-day	4:46	20:57	16:11
June	19	Thursday	4:46	20:57	16:11
June	20	Friday	4:46	20:57	16:11
June	21	Saturday	4:47	20:58	16:11
June	22	Sunday	4:47	20:58	16:11
June	23	Monday	4:47	20:58	16:11
June	24	Tuesday	4:47	20:58	16:11
June	25	Wednes-day	4:48	20:58	16:10
Disassembly					
July	15	Tuesday	5:02	20:51	15:49
July	16	Wednes-day	5:03	20:50	15:47
July	17	Thursday	5:04	20:49	15:45
July	18	Friday	5:05	20:48	15:43
July	19	Saturday	5:06	20:47	15:41

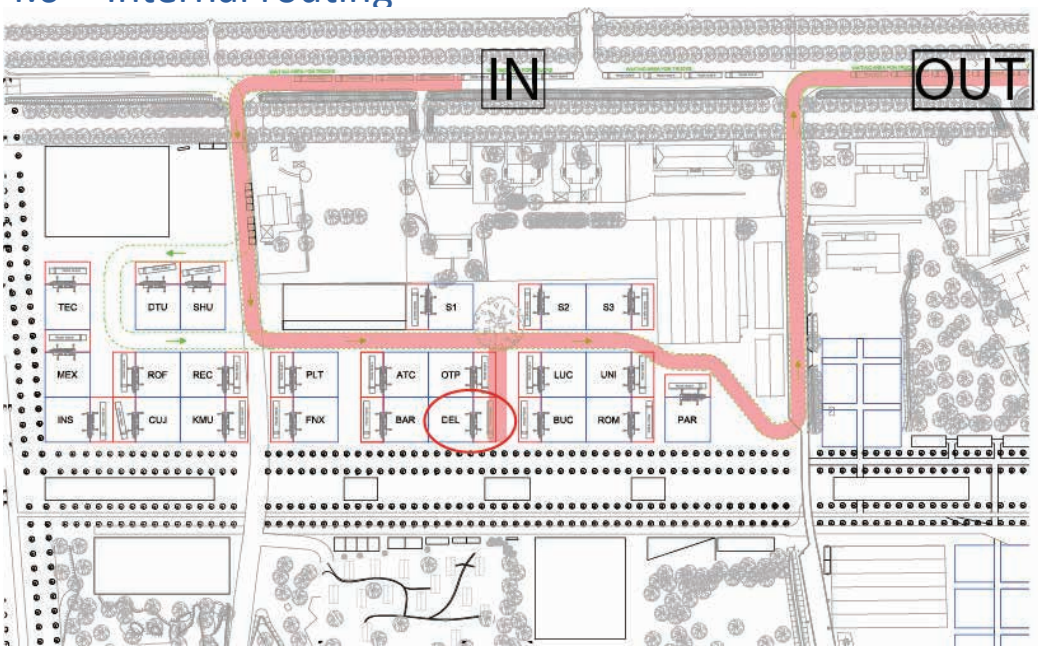
Source: http://www.timebie.com/sun/paris_france.php

4.5 Accesses and paths for vehicles

External routing
Starting point:
Name: Groothuis B.V.
Address: Ootmarsumseweg 12
Zip code: 7615 PL
City: Harbrinkhoek
Finishing point:
Name: La Cite Du Soleil
Address: Route de Saint-Cyr
Zip code: 78000
City: Versailles
Total journey: **617 km**



4.6 Internal routing



4.7 Determining factors for the house placing

The house has the same orientation as the original house in Honselersdijk, nearly north to south. It is orientated in a way the PV-panels are at the south side. Therefore the house is not situated with its walls parallel to the lot sides, this is not convenient but it is simulating the real situation. Besides that the surface in Versailles is not completely leveled as it is in our situation.

Therefore determining factors are the angle compared to the lot and the slope the site has. In order to establish the correct position measuring shall take place allong all three axis. The x and y axis (length and width) can be done with standard measuring tape. The z axis will be done with a laser meter, which gives the most accurate position possible.

4.8 Overlaps with the affected services and other circumstances or activities of the environment, able to cause risks during the construction

We have to respect the restrictions of our lot and therefore respecting the areas of our neighbouring teams. We've got two direct neighbours: the 'BAR' and 'OTP' team. We do not only need to respect the neighbouring lots, but also need to respect the 'neutral' ground in between. Trucks of all teams shall pass by, accidents can (partly) be prevented by paying attention to other teams as well. The safety officers can play a role in this as well.

4.9 Planned activities

Task code	Task Name	Duration	Start	Finish
	Morning briefing	10 mins	Mon 16-6-14 8:00	Mon 16-6-14 8:10
SW01	SITE WORK: Arrival truck Nr. 1	15 mins	Mon 16-6-14 8:00	Mon 16-6-14 8:15
SW02	SITE WORK: Placing the container	10 mins	Mon 16-6-14 8:15	Mon 16-6-14 8:25
SW03	SITE WORK: Setting up the tent	45 mins	Mon 16-6-14 8:15	Mon 16-6-14 9:00
SW04	SITE WORK: Connecting powerboxes and electricity	15 mins	Mon 16-6-14 8:25	Mon 16-6-14 8:40
SW05	SITE WORK: placing fences around the lot	180 mins	Mon 16-6-14 8:10	Mon 16-6-14 12:10
FO01	FOUNDATION: Measure the location for the foundation	20 mins	Mon 16-6-14 9:00	Mon 16-6-14 9:20
FO02	FOUNDATION: Mounting the profiles on the Stelcon (on truck)	120 mins	Mon 16-6-14 9:20	Mon 16-6-14 12:20
FO03	FOUNDATION: Placing the Stelcon plates	150 mins	Mon 16-6-14 10:30	Mon 16-6-14 14:00
FO04	FOUNDATIONS: Request foundation inspection with SDE organisation			
FO05	FOUNDATION: placing plumbing on the foundation beams	240 mins		
FO06	FOUNDATION: connect the water tanks	60 mins		
FO07	FOUNDATION: Leveling and mounting the beams	120 mins	Mon 16-6-14 12:30	Mon 16-6-14 14:30
	Shift tranfer briefing	10 mins	Mon 16-6-14 14:00	Mon 16-6-14 14:10
	INSPECTION BY SDE ORGANISATION	120 mins	Mon 16-6-14 14:30	Mon 16-6-14 16:31
FO08	FOUNDATION: Placing the water tanks and PCM box	36 mins	Mon 16-6-14 12:30	Mon 16-6-14 13:06
	Arrival truck Nr. 2	15 mins	Mon 16-6-14 13:15	Mon 16-6-14 13:30
FO09	FOUNDATION: Placing the house floor panels	60 mins	Mon 16-6-14 16:30	Mon 16-6-14 17:30
FO10	FOUNDATION: Placing the Southside floor panels	45 mins	Mon 16-6-14 18:30	Mon 16-6-14 19:15
FO11	FOUNDATION: Placing the Northside floor panels	30 mins	Mon 16-6-14 19:15	Mon 16-6-14 19:45
FO12	FOUNDATION: connecting the piping of the panels with eachother	180 mins		
FO13	FOUNDATION: Placing the fences around the platform	60 mins	Mon 16-6-14 19:45	Mon 16-6-14 20:45
	Arrival truck Nr. 3	15 mins	Mon 16-6-14 21:00	Mon 16-6-14 21:15
	Morning briefing	10 mins	Tue 17-6-14 7:00	Tue 17-6-14 7:10
EH01	EXISTING HOUSE: Assembly Southwall groundfloor + support	20 mins	Tue 17-6-14 7:10	Tue 17-6-14 7:30
EH02	EXISTING HOUSE: mount chimneys on East and West wall	30 mins	Tue 17-6-14 7:30	Tue 17-6-14 8:00
EH03	EXISTING HOUSE: Assembly Westwall groundfloor + support	20 mins	Tue 17-6-14 8:00	Tue 17-6-14 8:20
EH04	EXISTING HOUSE: Assembly Northwall groundfloor + support	20 mins	Tue 17-6-14 8:20	Tue 17-6-14 8:40
EH05	EXISTING HOUSE: Assembly Eastwall groundfloor + support	20 mins	Tue 17-6-14 8:40	Tue 17-6-14 9:00
EH06	EXISTING HOUSE: coupling the water connection of the panels	120 mins	Tue 17-6-14 7:10	Tue 17-6-14 9:10
EH07	EXISTING HOUSE: Removing of temporary support	15 mins	Tue 17-6-14 9:00	Tue 17-6-14 9:15
EH08	EXISTING HOUSE: Placing the stairs	60 mins	Tue 17-6-14 9:15	Tue 17-6-14 10:15
EH09	EXISTING HOUSE: Assembly interior walls groundfloor	60 mins	Tue 17-6-14 9:00	Tue 17-6-14 10:00
	Arrival truck Nr. 4	15 mins	Tue 17-6-14 10:15	Tue 17-6-14 10:30
EH10	EXISTING HOUSE: Mounting feet for fences on floor panels	60 mins	Tue 17-6-14 10:30	Tue 17-6-14 12:30
EH11	EXISTING HOUSE: Placing floor panels first floor	60 mins	Tue 17-6-14 11:30	Tue 17-6-14 12:30
EH12	EXISTING HOUSE: Placing fences around the first floor and cover staircase	60 mins	Tue 17-6-14 12:30	Tue 17-6-14 13:30
EH13	EXISTING HOUSE: Assembly Southwall firstfloor + support	20 mins	Tue 17-6-14 13:30	Tue 17-6-14 13:50
EH14	EXISTING HOUSE: Mount chimneys on East and West wall	30 mins	Tue 17-6-14 13:50	Tue 17-6-14 14:20
EH15	EXISTING HOUSE: Assembly Westwall firstfloor + support	20 mins	Tue 17-6-14 14:20	Tue 17-6-14 14:40
EH16	EXISTING HOUSE: Assembly Northwall firstfloor + support	20 mins	Tue 17-6-14 14:40	Tue 17-6-14 15:01
	Shift tranfer briefing	10 mins	Tue 17-6-14 14:00	Tue 17-6-14 14:10
EH17	EXISTING HOUSE: Assembly Eastwall firstfloor + support	20 mins	Tue 17-6-14 15:01	Tue 17-6-14 15:21
EH18	EXISTING HOUSE: Placing interior walls first floor	108 mins	Tue 17-6-14 15:21	Tue 17-6-14 17:09
	Arrival truck Nr. 5	15 mins	Tue 17-6-14 17:09	Tue 17-6-14 17:24
EH19	EXISTING HOUSE: Placing side walls tips	30 mins	Tue 17-6-14 17:24	Tue 17-6-14 17:54
EH20	EXISTING HOUSE: Removing of temporary support	20 mins	Tue 17-6-14 17:54	Tue 17-6-14 18:14
EH21	EXISTING HOUSE: placing the outside floors	30 mins	Tue 17-6-14 18:14	Tue 17-6-14 19:44
EH22	EXISTING HOUSE: Placing the roofbeam	10 mins	Tue 17-6-14 19:44	Tue 17-6-14 19:54
EH23	EXISTING HOUSE: Placing the roofpanels	95 mins	Tue 17-6-14 19:54	Tue 17-6-14 21:29
EH24	EXISTING HOUSE: placing the safety fences on the roof	60 mins	Tue 17-6-14 21:29	Tue 17-6-14 22:29
EH25	EXISTING HOUSE: placing the Chimneys	29 mins	Tue 17-6-14 22:29	Tue 17-6-14 22:58

EH26	EXISTING HOUSE: Filling of caps between panels	420 mins	Wed 18-6-14 6:10	Wed 18-6-14 14:10
EH27	EXSITING HOUSE: placing of ceiling mediaroom	120 mins	Thu 19-6-14 6:10	Thu 19-6-14 8:10
EH28	EXSITING HOUSE: placing of door and framing	360 mins	Thu 19-6-14 8:10	Thu 19-6-14 15:11
EH29	EXISTING HOUSE: placement of the raingutters			
EH30	EXISTINT HOUSE: placing the setting the doors			
EH31	EXISTING HOUSE: placement side walls greenhouse			
EH32	EXISTING HOUSE: carpentry panel connections			
EH33	EXISTING HOUSE: placing the plints			
EH34	EXISTING HOUSE: placing of the windowsills	120 mins		
EH35	EXISITNG HOUSE: placing of the sliding doors	420 mins		
	Arrival truck Nr. 7	15 mins		
EH36	EXISTING HOUSE: placement of the ramps	240 mins		
EH37	EXISITNG HOUSE: placing and mounting all the permanent fences	180 mins		
	Arrival truck Nr. 6	15 mins	Tue 17-6-14 21:00	Tue 17-6-14 21:15
	Morning briefing	10 mins	Wed 18-6-14 6:00	Wed 18-6-14 6:10
GR01	GREENROOF: placing and burning the Bitumen	90 mins	Wed 18-6-14 6:10	Wed 18-6-14 7:40
GR02	GREENROOF: placing the sedum crates	90 mins	Wed 18-6-14 8:30	Wed 18-6-14 10:00
GR03	GREENROOF: placing the covers of the Solatubes	30 mins	Wed 18-6-14 10:00	Wed 18-6-14 10:30
GS01	GLASSHOUSE STEEL: setting up scaffolding	30 mins	Wed 18-6-14 7:10	Wed 18-6-14 7:40
GS02	GLASSHOUSE STEEL: getting the boomlift in place	15 mins	Wed 18-6-14 7:10	Wed 18-6-14 7:25
GS03	GLASSHOUSE STEEL: placing and leveling the main coloms	90 mins	Wed 18-6-14 7:40	Wed 18-6-14 9:10
GS04	GLASSHOUSE STEEL: placing façade truss	60 mins	Wed 18-6-14 9:10	Wed 18-6-14 10:10
GS05	GLASSHOUSE STEEL: placing the roofbeam	60 mins	Wed 18-6-14 10:10	Wed 18-6-14 12:10
GS06	GLASSHOUSE STEEL: placing the 4 connecting beams	120 mins	Wed 18-6-14 12:10	Wed 18-6-14 14:10
GS07	GLASSHOUSE STEEL: placing the horizontal beams	120 mins	Wed 18-6-14 14:10	Wed 18-6-14 16:11
GS08	GLASSHOUSE STEEL: complete the frontside	60 mins	Wed 18-6-14 16:11	Wed 18-6-14 17:11
GA01	GLASSHOUSE ALU: placing top support and gutter	60 mins	Thu 19-6-14 7:10	Thu 19-6-14 8:10
GA02	GLASSHOUSE ALU: placing the front windowframing	180 mins	Thu 19-6-14 8:10	Thu 19-6-14 12:10
	Shift tranfer briefing	10 mins	Wed 18-6-14 14:00	Wed 18-6-14 14:10
GA03	GLASSHOUSE ALU: placing the top windowsframing	240 mins	Thu 19-6-14 12:10	Thu 19-6-14 16:11
GA04	GLASSHOUSE ALU: placing the side connection and polycarbonaat	240 mins	Thu 19-6-14 16:11	Thu 19-6-14 21:11
	Morning briefing	10 mins	Fri 20-6-14 7:00	Fri 20-6-14 7:10
GP01	GLASSHOUSE PANELS: placing the power optimizers	180 mins	Fri 20-6-14 7:10	Fri 20-6-14 10:10
GP02	GLASSHOUSE PANELS: placing the PV panels	750 mins	Fri 20-6-14 8:00	Fri 20-6-14 22:31
GP03	GLASSHOUSE PANELS: connecting the PV panels	420 mins	Fri 20-6-14 10:00	Fri 20-6-14 18:01
GP04	GLASSHOUSE PANELS: placing the windows (top- and frontside)	240 mins	Fri 20-6-14 7:10	Fri 20-6-14 12:10
EL01	ELECTRIC: connecting the panel connections	600 mins	Wed 18-6-14 7:10	Wed 18-6-14 18:11
EL02	ELECTRIC: placing the wall power boxes	90 mins	Wed 18-6-14 18:11	Wed 18-6-14 20:41
EL03	ELECTRIC: Installing the meter in the technical room	600 mins	Thu 19-6-14 7:10	Thu 19-6-14 18:11
EL04	ELECTRIC: placing the sensors for the DOMOTICA system	60 mins	Thu 19-6-14 18:11	Thu 19-6-14 20:11
EL05	ELECTRIC: connecting the PV panels with the house	180 mins	Fri 20-6-14 22:31	Sat 21-6-14 9:31
EL06	ELECTIC: connecting the lights on the north and south facade	90 mins	Sat 21-6-14 9:31	Sat 21-6-14 12:01
EL07	ELECTRIC: making the light connection in the glasshouse	60 mins	Sat 21-6-14 12:01	Sat 21-6-14 13:01
EL08	ELECTRIC: Final check electricity	120 mins	Sat 21-6-14 13:01	Sat 21-6-14 15:02
PL01	PLUMBING: placing the ketel	60 mins	Wed 18-6-14 7:10	Wed 18-6-14 8:10
PL02	PLUMBING: connecting hot/cold water day 1	350 mins	Wed 18-6-14 8:10	Wed 18-6-14 15:01
PL03	PLUMBING: connecting hot/cold water day 2	350 mins	Thu 19-6-14 7:10	Thu 19-6-14 14:00
PL04	PLUMBING: Placing the heat recovery installation	60 mins	Thu 19-6-14 14:00	Thu 19-6-14 15:01
PL05	PLUMBING: connecting hot/cold water day 3	350 mins	Fri 20-6-14 7:10	Fri 20-6-14 14:00
PL06	PLUMBING: Installing the WTW unit (water)	60 mins	Fri 20-6-14 14:00	Fri 20-6-14 15:01
PL07	PLUMBING: Placing the sanitary	350 mins	Sat 21-6-14 7:10	Sat 21-6-14 14:00
PL08	PLUMBING: Placement and connecting of the radiators day 1	120 mins	Thu 19-6-14 14:41	Thu 19-6-14 16:42
PL09	PLUMBING: Placement and connecting of the radiators day 2	120 mins	Thu 19-6-14 14:41	Thu 19-6-14 16:42

PL10	PLUMBING: Place the energie panels	90 mins	Thu 19-6-14 7:10	Thu 19-6-14 8:40
PL11	PLUMBING: connecting energie panels			
PL12	PLUMBING: Placement and connecting of the solar boiler	45 mins	Thu 19-6-14 7:55	Thu 19-6-14 8:40
PL13	PLUMBING: Connecting the rainwatergutter with the grey water tank	60 mins	Thu 19-6-14 11:10	Thu 19-6-14 12:10
PL14	PLUMBING: connecting Rainwinners			
PL15	PLUMBING: REQUEST FOR EARLY WATER DELIVERY!	30 mins	Thu 19-6-14 19:41	Thu 19-6-14 20:11
PL16	PLUMBING: Water delivery	30 mins		
PL17	PLUMBING: Filling of boiler	60 mins		
PL18	PLUMBING: Filling of the Rainwinners	60 mins		
PL19	PLUMBING: connecting the water			
PL20	PLUMBING: testing water system			
MC01	MECHANICAL: Installation of the Heat recovery unit	120 mins	Fri 20-6-14 8:40	Fri 20-6-14 11:40
MC02	MECHANICAL: Installing of the PCM box	60 mins	Fri 20-6-14 10:55	Fri 20-6-14 11:55
MC03	MECHANICAL: placing ventilation canels day 1	90 mins	Fri 20-6-14 7:10	Fri 20-6-14 8:40
MC04	MECHANICAL: placing ventilation canels day 2			
MC05	MECHANICAL: Controlling of the ventilation system	30 mins	Fri 20-6-14 15:11	Fri 20-6-14 15:41
MC06	MECHINICAL: placement of the CO2 sensors for the DOMOTICA system	30 mins	Fri 20-6-14 11:55	Fri 20-6-14 12:25
DM01	DOMOTICA: initialing Domotica system	120 mins	Fri 20-6-14 12:25	Fri 20-6-14 14:25
DM02	DOMOTICA: Testing light			
DM03	DOMOTICA: Testing ventilation			
DM04	DOMOTICA: Test heating and cooling			
DM05	DOMOTICA: Controlling complete system			
	Morning briefing	10 mins	Sat 21-6-14 7:00	Sat 21-6-14 7:10
GN01	GARDEN NORTH: plank flooring Northside	240 mins	Sat 21-6-14 6:10	Sat 21-6-14 10:10
GN02	GARDEN NORTH: assembly of the borders	60 mins	Sat 21-6-14 11:10	Sat 21-6-14 12:10
GN03	GARDEN NORTH: placing the plant nets on the façade	60 mins	Sat 21-6-14 12:10	Sat 21-6-14 13:10
GN04	GARDEN NORTH: Placing the fence	60 mins	Sat 21-6-14 13:10	Sat 21-6-14 14:10
GN05	GARDEN NORTH: placing the greenery	240 mins	Sat 21-6-14 14:30	Sat 21-6-14 19:31
GN06	GARDEN NORTH: placement tree's	60 mins	Sat 21-6-14 19:30	Sat 21-6-14 20:30
GN07	GARDEN NORTH: putting in the gravel	60 mins	Sat 21-6-14 20:30	Sat 21-6-14 21:30
	Morning briefing	10 mins	Sun 22-6-14 6:00	Sun 22-6-14 6:10
GS01	GARDEN SOUTH: plank flooring Southside	360 mins	Sun 22-6-14 6:10	Sun 22-6-14 13:10
GS02	GARDEN SOUTH: assembly of the borders	60 mins	Sun 22-6-14 13:10	Sun 22-6-14 14:10
GS03	GARDEN SOUTH: placing the palisade east	120 mins	Sun 22-6-14 14:11	Sun 22-6-14 16:12
GS04	GARDEN SOUTH: placing the palisade west	120 mins	Sun 22-6-14 14:11	Sun 22-6-14 16:12
GS05	GARDEN SOUTH: placement rainwinners	120 mins	Sun 22-6-14 16:11	Sun 22-6-14 18:11
GS06	GARDEN SOUTH: placing the tree's	60 mins	Sun 22-6-14 16:11	Sun 22-6-14 17:11
GS07	GARDEN SOUTH: placing the greenery	180 mins	Sun 22-6-14 17:11	Sun 22-6-14 21:11
	GARDEN: final check garden	30 mins	Sun 22-6-14 21:11	Sun 22-6-14 21:41
IN01	INTERIOR: Wall finishing first floor	450 mins	Sat 21-6-14 9:10	Sat 21-6-14 17:41
IN02	INTERIOR: placement of the Sunshading			
IN03	INTERIOR: placement of the Solatubes			
IN04	INTERIOR: Wall finishing groundfloor	450 mins	Sat 21-6-14 9:10	Sat 21-6-14 17:41
IN05	INTERIOR: Cleaning complete house for floors			
IN06	INTERIOR: Flooring first floor	450 mins	Sat 21-6-14 18:41	Sun 22-6-14 10:11
IN07	INTERIOR: Flooring ground floor	450 mins	Sat 21-6-14 18:41	Sun 22-6-14 10:11
IN08	INTERIOR: installing Kitchen			
IN09	INTERIOR: placing the furniture first floor	450 mins	Tue 24-6-14 6:10	Tue 24-6-14 14:40
IN10	INTERIOR: placing furniture ground floor			
IN11	INTERIOR: placement and installing the washing combination	20 mins	Fri 20-6-14 8:10	Fri 20-6-14 8:30
IN12	INTERIOR: placing the decoration	180 mins	Tue 24-6-14 14:42	Tue 24-6-14 17:43
IN13	INTERIOR: fine tuning	120 mins	Tue 24-6-14 18:42	Tue 24-6-14 20:42
IN14	INTERIOR: Cleaning first floor			



IN15	INTERIOR: Cleaning ground floor			
IN16	INTERIOR: final check interior	60 mins	Tue 24-6-14 20:42	Tue 24-6-14 21:42
EX01	EXHIBITION: placement of the wood panels outside	360 mins	Mon 23-6-14 6:10	Mon 23-6-14 13:10
EX02	EXHIBITION: placing the prints on the sides	240 mins	Mon 23-6-14 13:10	Mon 23-6-14 17:11
EX03	EXHIBTION: placement of information signs	120 mins	Mon 23-6-14 17:11	Mon 23-6-14 20:11
EX04	EXHIBITION: installing the Mediaroom	90 mins	Mon 23-6-14 20:11	Mon 23-6-14 21:41
SW06	SITE WORK: cleaning all the heavy constructive tools in container	120 mins	Wed 25-6-14 14:00	Wed 25-6-14 16:01
SW07	SITE WORK: Loading container on closed truck	20 mins	Sat 21-6-14 20:00	Sat 21-6-14 20:20
SW08	SITE WORK: Disconnecting constructive connections	60 mins	Wed 25-6-14 16:01	Wed 25-6-14 17:01
SW09	SITE WORK: storage of all construction elements and tools in storage area	90 mins	Wed 25-6-14 17:01	Wed 25-6-14 19:31
SW10	SITE WORK: Site cleaning	120 mins	Wed 25-6-14 19:31	Wed 25-6-14 21:31
	HOUSE DELIVERY	30 mins	Wed 25-6-14 21:31	Wed 25-6-14 22:01

4.10 Trades whose intervention is affected by the risk prevention

Prior to the construction, all personnel are required to health and safety trainings. The function of the H&S trainings is to give sufficient knowledge to work with safety precautions. In addition, the work trainings will also be conducted make the workers become familiar with the use of tools and equipment and to know the installation procedure.
During the construction site, safety office will be present on every shift. Before the start of the working shift, safety briefing will be conducted to make emphasize on safety precautions and discussed the potential hazard. The health and safety officer will conduct safety inspection in every working shift to ensure that the construction hazard can be eliminated. If problems occurred, the health and safety officer with the site manager are responsible to stop the work. If there are further problems, the health and safety team will coordinate with the SDE Organizer to solve the problems.

4.11 Auxiliary resources planned for the construction

Resource	Where	When	Activities
Truck	Truck area (east)	During deliveries	Delivering and picking up material
35 ton crane	Truck area (east)	Prefab Casco and greenhouse	Unloading and loading trucks, putting elements in place
Boom lift	On site	Roof works	Safely working on heights
Vaccuum gas lifter	On site	During green house construction	Moving glass and PV panels
Base tent	On the lot (south)	During all construction	Personnel, coordination
Tool storage	On the lot (south)	During all construction	Storage of tools, PPE etc.
Tele handler	On site	During all construction	Loading and unloading trucks
Lights	On the lot and crane/truck area	After sunset	All activities during night

4.12 Machinery planned for the construction

Machinery	Where	When	Activities
Hand & power tools*	Tool storage	During installation of panels, greenhouse, installations	

* Tools for Groothuis:

Tool	Amount
Compressor	2
Air hoses	
Nail gun	2
Staple gun	2
Crowbar	2
Temporary supports (strut)	8
Impact wrench (on electricity)	2
Handheld drill (on battery)	4
Impact wrench (on battery)	4
Belt screw machine	2
Cut-off saw	1
Handheld circular saw	2
Total station	1
Digital waterpas	1
Vial waterpas	1
Masonry line	
Recipro saw	1
Screw clamp	6
40 meter cord reel	4
15 meter extension cord	4
Construction lamps	
Scaffolding stairs 4 steps	2
Scaffolding stairs 5 steps	2
Ladder 2 x 12 steps	2

4.13 Construction site installations

Installation	Where	When	Activities
Water supply	On site	During all constructions and breaks	Refresh workers, clean equipment etc.
Electricity supply	On site	During all the constructions	All activities with electrical equipment

4.14 Characteristics table for the stocks

The construction materials, tools, and equipment will be placed in the designated storage area. It will be divided into tool storage and material storage. Both of them will be located in the south of the lot. The wood panels for the house will be delivered just in time prior to construction so it will minimize the need for storage area.

These are the following rules for storage and stocks area:

- The construction materials, tools, and equipment will be placed in the designated storage area. It will be divided into tool storage and material storage. Both of them will be located in the south of the lot.
- The wood panels for the house will be delivered just in time prior to construction so it will minimize the need for storage area.
- Materials, equipment and appliances must be stored carefully in their respective locations. When selecting these sites, the main wind direction must be taken into account.
- Debris, construction debris and packaging materials should be placed in specifically designated places for such materials.
- Tools, wood and other building materials should not be left in transit areas to avoid risks of falls.
- The wood on which there are protruding nails and other dangerous objects must be treated quickly and removed from the construction site.

4.15 Information on hazardous products

The following products shall be on the site during construction. Since they can cause additional risks they are supposed to be kept in the site storage when not used.

No	Product	Activity	Hazard
1	Gas burner	Install bitumen	Fire, explosion
2	Paint	Possible finishing	Poisonous
3	Glue	Restore brick	Poisonous
4	Argon gas	Filling the energy panels	Suffication in case of extreme high density

4.16 Hygiene conditions

All of the construction facilities will be ventilated, illuminated, and kept in constant of cleanliness.
Changing Room and Rest Area

For changing room and rest area, there will be a tent on the site lot with the dimension of 3x2 meters. It will consist of benches for sufficient number of people sitting inside. This tent will only be used as a rest area, change room, and meeting area. For hanging clothes, lockers cannot be provided to the limited space on the site construction. However, it will be replaced by providing sufficient clothes hook.

Cleaning and Hygiene

Waste removal will be performed on daily to maintain required environmental cleanliness. This is also to protect the safety and health of workers and keep the approaches and exits to the construction site clean. Disposal of hazardous waste will be treated in a certain way. For cleaning and hygiene purpose on the construction site, appropriate liquid soap and towel rolls will be provided.

Drinking Water
Fresh drinkable water will be provided for each worker with the amount of 3 litres per person.

Toilet
There will not be any toilets on the site lot. Workers can use the toilets placed by the organization, which are situated in the Cité du Soleil area. A worker can go to toilet only during breaks due to H&S reasons.

Lunch Room
For H&S reason, lunch will be took place outside the construction site. In the lunch area, there will be sufficient number of chairs which must be cleaned after meal.

5 ACTIVITIES FOR RISK PREVENTION

5.1 Construction plan: determination of work effective timing

Pret a loger shall work in two shifts of 8 hours, of which 7 working hours and 1 hour break. In general:

Activity	Durance (hours)	Time	
Shift 1			
Work	1,75	07:00 - 08:45	
Break	0,25	08:45 - 09:00	
Work	1,75	09:00 - 10:45	
Break	0,50	10:45 - 11:15	
Work	1,75	11:15 - 13:00	
Break	0,25	13:00 - 13:15	
Work	1,75	13:15 - 15:00	
Work transfer shifts	0,50 max	14:30 - 15:00	
Shift 2			
Work	1,75	14:00 - 16:45	
Break	0,25	16:45 - 17:00	
Work	1,75	17:00 - 18:45	
Break	0,50	18:45 - 19:15	
Work	1,75	19:15 - 21:00	
Break	0,25	21:00 - 21:15	
Work	1,75	21:15 - 23:00	
Total	**16**		

The sun will set between 20:47 (19th July) and 20:58 (21st June). Therefore around 20:30 lighting is required to continue assembly and/or disassembly.

The breaks of 15 minutes shall be short coffee and smoking breakes outside our site. The South side of our site gives great opportunity for this, since overthere is shade from the trees. The 30 minute breaks can give the workers the opportunity to leave the site completely and go somewhere else.

5.2 Overlaps and incompatibilities in the construction

Overlaps activities can results in higher risks during the construction assembly or disassembly. The critical phase which consisted of two or more activities should be identified and additional precautions should be made. Parallel activities are displayed in the planning of the Site Operations Chapter. The Site Operator and HS officers control these activities on site to make sure these activities happen in a safe way.

5.3 Number of Team members taking part in the construction

We shall make use of two teams, each team has a site operator, health & safety officer, quality controller and two Groothuis constructors. The teams are divided in a way both teams have an equal amount of first AID certificated workers, and students who are trained for a specific activity. An overview of the certificates some of the students have can be found in chapter 10.16.

Students

Site operator:	Petar Zhivkov (First Aid)
	Rudger de Jong (First Aid)
HS officer:	Arjan Oosterhof (First Aid)
	Gini Arimbi (First Aid)
Quality managers:	Dennis IJsselstijn (First Aid)
	Tim Jonathan (First Aid)
	Josien Kruizinga (First Aid)
Workers:	Todor Kesarovski
	Daniel Radia
	Nick Kerckheart
	George Xexakis
	Oswaldo Heinen (First Aid)
	Stelios Stavroulakis
	Bob Bogers (First Aid)
	Sergiu Troian
	Futura Falco
	Eftichia Zoidi
	Jasper Spiegeler
	Jan Portheine (First Aid)
	Hardik Joshi
	Osama Naji
	Gabriele De Leo
	Jasper Overduijn (First Aid)
	Vasilis Tzimitras
	Matthaios Zarmpis
	Stefan Hoekstra
	Carolin Bellstedt
	Marina Fragkopoulou
	Derek van den Berg
	Jules Gallissian
	Laurence Gibbons
	David Jacome Polit

The division of shifts (working hours) can be found in the site operations report and in the ‘Working conditions file’.

5.4 Contracting planned

In the appendix of the HS report all statements can be found in which all companies state their professional workers received specific training, medical examinations and comply with the HS plan of the students team.

Company	Name	Position	Activities
Era Contour	R. Vermaire	Project manager	Supervising, construction
Van Dorp	Steven de Werk	Installer	Installing Demotica system
Groothuis	K. Braakhuis	Carpenter	Placing of the panels/ house construction, boomlifting
	R. van den Noort	Carpenter	Placing of the panels/ house construction, boom and fork-lifting
	J. Busscher	Carpenter	Placing of the panels/ house construction, boomlifting
	D. Abbink	Carpenter	Placing of the panels/ house construction, boom and fork-lifting
	H. ter Horst	Eletrical engineer	Installing PV Panels
	P. Hinnen	Electrician	Installing electrics
	G. Schuurink	Electrician	Installing electrics
	F. Asbroek	Supervisor	Supervising, construction
NL Green label	R. Frerix	Gardener	Creating the garden
	M. Hissink	Gardener	Creating the garden
	L. Grims	Gardener	Creating the garden
	J. Simmelink	Gardener	Creating the garden
	T. Krizan	Designer	Creating the garden
Nobutec	H. Bloem	Construction worker	Constructing the steel and aluminum frame
Putman	M.S. de Paauw	Installer	Installing installtions
	S.A. van Schie	Installer	Installing installtions
	P.G. van Schie	Installer	Installing installtions
	T.D. de Waal	Installer	Installing installtions
	T. Roorda	Installer	Installing installtions

5.5 Health & Safety instructions for the students

To prepare the team to work in an healthy and safe way we arranged two HS trainings. One general HS training was done via a lecture by Petar Zhivkov, the HS Team Coordinator, based on our HS Plan. Attendance of students was obligatory, for those who missed the lecture we videotaped it. To test the knowledge of the students they had to perform an online questionairy.

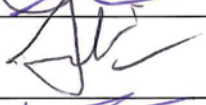
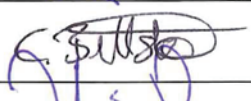
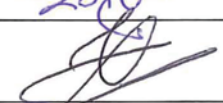
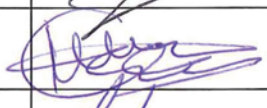
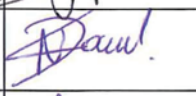
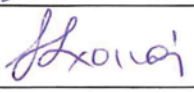
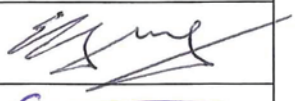
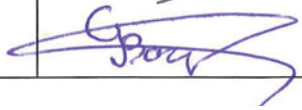
The second training was given at the Groothuis office. They displayed a training video made by TBI called ‘werk veilig werk samen’. Attendance to this training was obligatory before students were allowed on the construction site. Attendance list is not completed yet, since not every student has participated yet in the constructing process in Harbrinkhoek.

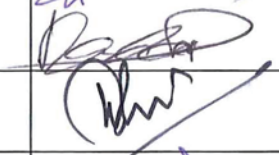
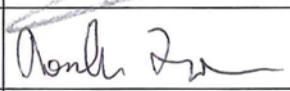
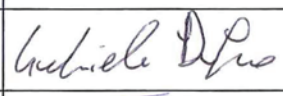
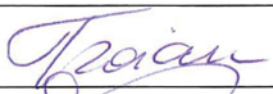
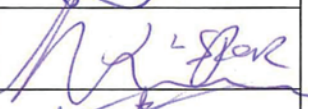
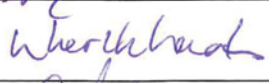
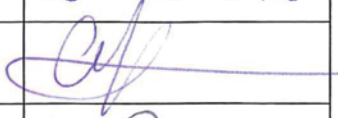
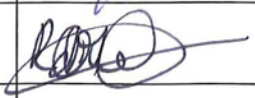
Sign up list

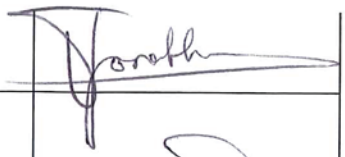
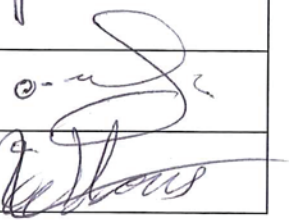
31.03.2014

Delft, The Netherlands

By signing this list you confirm that you received the Health and Safety plan briefing on 31.03.2014, given by Petar Zhivkov (H&S coordinator for team Prêt-à-Loger).

1	Petar	Zhivkov	Site Operations & HS team coordinator	
2	Rudger	De Jong	Site Operations	
3	Arjan	Oosterhof	HS Officer	
4	Gini	Arimbi	HS Officer	
5	Todor	Kesarovski	Worker	
6	Carolin	Bellstedt	Worker	
7	David	Jacome Polit	Worker	
8	Eftychia	Zoidi	Worker	
9	George	Xexakis	Worker	
10	Maria	Anastasaki	Worker	
11	Marina	Fragkopoulou	Worker	
12	Matthaios	Zarmpis	Worker	
13	Nicki	Kandalepa	Worker	
14	Stavroula	Schoina	Worker	
15	Stelios	Stavroulakis	Worker	
16	Vania	Gatsiou	Worker	

17	Vasilis	Tzimitras	Worker	
18	Daniel	Radai	Worker	
19	Hardik	Joshi	Worker	
20	Shree Harsha	Muralidhar	Worker	
21	Shreya	Parmar	Worker	
22	Davide	Zanon	Worker	
23	Futura	Falco	Worker	
24	Gabriele	De Leo	Worker	
25	Sergiu	Troian	Worker	
26	Bob	Bogers	Worker	
27	Dennis	IJsselstijn	Worker	
28	Derek	van den Berg	Worker	
29	Jan	Portheine	Worker	
30	Jasper	Overduin	Worker	
31	Jasper	Spiegeler	Worker	
32	Josien	Kruizinga	Worker	
33	Maarten	Bruinsma	Worker	
34	Marie-Louise	de Kruiff	Worker	
35	Nick	Kerckhaert	Worker	
36	Oswaldo	Heinen	Worker	
37	Rianne	Den Ouden	Worker	
38	Stefan	Hoekstra	Worker	

39	Tim	Jonathan	Worker	
40	Tim	Ras	Worker	
41	Osama	Naji	Worker	
42	Laurence	Gibbons	Worker	

LUCA DE STEFANO

Minyoung Kwon

Sevan Manukyan

ANIL ANANDA

Dimitra Tasoula

Esti Tichelaar



TBI-Groothuis Health & Safety Video Training:

All students who received specific construction training at the TBI-Groothuis company first received a Health & Safety training in the form of an instruction video. This video was produced by TBI and is called 'Werk veilig werk samen'.

I hereby state all students on the list below received this Health & Safety training.

Date: 24-04-2014 Name: F. Asbroek

Function: Bedrijfsleider Bouwelementen (supervisor)

Signature: F. Asbroek

Petar Zhivkov
Rudger de Jong
Arjan Oosterhof
Gini Arimbi
Dennis IJsselstijn
Tim Jonathan
Josien Kruizinga
Todor Kesarovski
Daniel Radia
Nick Kerckheart
George Xexakis
Oswaldo Heinen
Stelios Stavroulakis
Bob Bogers
Sergiu Troian
Futura Falco
Eftichia Zoidi
Jasper Spiegeler
Jan Portheine
Hardik Joshi
Osama Naji
Gabriele De Leo
Jasper Overduijn)
Vasilis Tzimitras
Matthaios Zarmpis
Stefan Hoekstra
Carolin Bellstedt
Marina Fragkopoulou
Derek van den Berg
Jules Gallissian
Laurence Gibbons
David Jacome Polit

6 CRITICAL WORK PHASES FOR RISK PREVENTION

The following tables are the summary of high risk activities during construction. The details can be found under chapter 10.7.2.

	Name of Activity	Risk	Collective Protection	Prevention Procedure
1	Unloading Material	Hit by vehicles	Markings and protection of work areas	Certified crane and forklift operator
		Hit by the moving equipments	limiting on-foot personnel to activity areas where devices and trucks are operating	Calculation of crane lifting capacity
		Fall of objects because of collapse	following of the traffic rules and being guided by visual or appropriate means of communication	Checking of lifting tools equipment
		People hit by objects collapsed during lifted	clear communication procedure for lifting	Compliance with maximum speed of vehicle
		Stepping on objects	people walking in front and behind of the truck	Ensure sufficient rest for workers in the shift
		People might step on object	marking of hazardous zones	Compliance with maximum load for manual handling
		Accidents caused by living beings	physical closure of access points outside working hours	
		Error caused by driver		
		Trapped by vehicles		
		People trapped by moving vehicles		

	Name of Activity	Risk	Collective Protection	Prevention Procedure
2	Construction and Disassembly of House (Ground Floor)	Knocked by objects or tools	Markings and protection of work areas	Certified crane and forklift operator
		Hand injury from tools	clear communication procedure for lifting	Compliance with maximum speed of vehicle
		Fall of objects because of collapse	people walking in front and behind of the truck	Compliance with hand tools user manual
		people hit by objects collapsed during lifted	marking of hazardous zones	Keep the site clean from unused material or tools
		Fall of objects because they come loose	physical closure of access points outside working hours	Ensure sufficient rest for workers in the shift
		Hit by material because of loose		Compliance with maximum load for manual handling
		Fall of persons at the same level		
		People fall because of tripping		
		Fall of persons from different level		
		Fall from upper level		
		Colliding with objects in motion		
		Hit by moving equipment		
		Stepping on object		
		People step on dangerous object		
3	Construction and Disassembly of House (Roof)	Knocked by objects or tools	Markings and protection of work areas	Certified crane and forklift operator
		Hand injury from tools	limiting on-foot personnel to activity areas where devices and trucks are operating	Compliance with maximum speed of vehicle
		Fall of objects because of collapse	following of the traffic rules and being guided by visual or appropriate means of communication	Compliance with hand tools user manual
		people hit by objects collapsed during lifted	clear communication procedure for lifting	Keep the site clean from unused material or tools
		Fall of persons at the same level	people walking in front and behind of the truck	Ensure sufficient rest for workers in the shift
		People fall because of tripping	marking of hazardous zones	Compliance with maximum load for manual handling
		Fall of persons from different level	physical closure of access points outside working hours	
		Fall from upper level	protection from falls from heights and from falling objects onto traffic areas and onto work platforms	
		Stepping on object	provide boom lift	
		People step on dangerous object	provide railing for roof works	
		Exposure to extreme environmental temperatures		
		Exposure to heat from the sun		

	Name of Activity	Risk	Collective Protection	Prevention Procedure
4	Construction and Disassembly of Glasshouse PV Panels	Knocked by objects or tools	Markings and protection of work areas	Electrical works will be completed by trained worker
		Hand injury from tools	clear communication procedure for lifting	Keep the site clean from unused material or tools
		Fall of objects because of collapse	marking of hazardous zones	Ensure sufficient rest for workers in the shift
		people hit by objects collapsed during lifted	physical closure of access points outside working hours	Compliance with electrical tools user manual
		Fall of persons at the same level	protection from falls from heights and from falling objects onto traffic areas and onto work platforms	Compliance with maximum load for manual handling
		People fall because of tripping	provide boom lift	Compliance with hand tools user manual
		Fall of persons from different level	provide railing for roof works	
		Fall from upper level	any action on the machine must be done after neutralising command control	
		Colliding with objects in motion		
		Hit by moving equipment		
		Stepping on object		
		People step on dangerous object		
		Exposure to extreme environmental temperatures		
		Exposure to heat from the sun		
		Exposure to electric connections		
		Exposure from electrical sources		

	Name of Activity	Risk	Collective Protection	Prevention Procedure
5	Electrical Installation	Knocked by objects or tools	Markings and protection of work areas	Plumbing works will be completed by trained worker
		Hand injury from tools	clear communication procedure for lifting	Keep the site clean from unused material or tools
		Fall of objects because of collapse	marking of hazardous zones	Ensure sufficient rest for workers in the shift
		people hit by objects collapsed during lifted	physical closure of access points outside working hours	Keep the site clean from unused material or tools
		Fall of persons at the same level	protection from falls from heights and from falling objects onto traffic areas and onto work platforms	Ensure sufficient rest for workers in the shift
		People fall because of tripping	any action on the machine must be done after neutralising command control	
		Fall of persons from different level		
		Fall from upper level		
		Colliding with objects in motion		
		Hit by moving equipment		
		Exposure to electric connections		
		Exposure from electrical sources		

6	Maintenance of PV Panels	Knocked by objects or tools	marking of hazardous zones	Compliance with maximum load for manual handling
		Hand injury from tools	protection from falls from heights and from falling objects onto traffic areas and onto work platforms	Keep the site clean from unused material or tools
		Fall of persons from different level	provide boom lift	Ensure sufficient rest for workers in the shift
		Fall from upper level	provide railing for roof works	Compliance with hand tools user manual
		Exposure to extreme environmental temperatures	any action on the machine must be done after neutralising command control	
		Exposure to heat from the sun		

7 Risk identification and efficacy evaluation of the adopted protections

7.1 Location and identification of the areas where the works involving special risks will be developed

The access to the construction site will be restricted. Only limited number of personnel will be given the permit to enter the construction site. Special signs will be put in the hazardous work area as a special precaution to the workers. The movements of trucks and crane will be guided by workers. The tools, equipment, and materials will be stored in a designated storage area.

7.2 Risks identification and efficiency evaluation of the adopted protections

Each of the construction activities will be identified. The risk identifications will be done to see the potential hazard in each activity. The probability of the occurrence will be classified into remote, possible, and certain.

Several procedures will be chosen to overcome the associated risks. The procedures are categorize as collective protection, individual protection, preventive procedures and signs.

Those activities will determine the severity of the risk. From that, the level of consequence of the risk and risk qualification can be determined.

Probability of Event	Determined Precaution	Consequence of the Risk	Risk Qualification with Precaution Applied
R Remote	**Ci** Collective Protection	**L** Slight Injury	**T** Trivial Risk
P Possible	**Pi** Individual Protection	**G** Serious Injury	**To** Tolerable Risk
C Certain	**PP** Preventive Procedures	**Mo** Fatal Injury	**M** Moderate Risk
	S Signs		**I** Important Risk
			In Intolerable Risk

1	Name of Activity : Setting Up Construction Site																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Stepping on object People might step on object			X		X		X	X			X					Self Generated Risks
	2	Fall of objects because of collapse People hit by objects col-lapsed during lifted		X			X	X	X		X			X				Risk generated by others
	3	Knocked by objects or tools Fingers are pinched by the tools		X			X		X	X			X					Self generated risks
	4	Colliding with objects in motion Hit by the moving equip-ments	X			X			X	X			X					Risk generated on others
	5	Accidents caused by living beings Error caused by driver	X					X	X	X			X					Risk generated by others
	6	Exposure to electric connec-tions During setting up the elec-tricity source		X		X		X	X	X			X					Risk generated by others
	7	Flying fragments or particles From wood particle			X		X			X			X					Risk generated by others

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, limiting on-foot personnel to activity areas where devices and trucks are operat-ing, following of the traffic rules and being guided by visual or appropriate means of communication, clear communica-tion procedure for lifting, people walking in front and behind of the truck, marking of hazardous zones, physical closure of access points outside working hours, any action on the machine must be done after neutralising command control	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass	
	Signs	
	PPE, construction site entry, speed limit sign, danger of falling object, danger of tripping hazard, electricity hazard	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum load for manual handling
	C	Compliance with H&S storaged material
	D	Organize the tools and equipment with labelllings
	E	Electrical works will be completed by trained worker
	F	Compliance with maximum speed of vehicle
	G	Ensure sufficient rest for workers in the shift

2	Name of Activity : Unloading Material																		
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Hit by vehicles Hit by the moving equip-ments	X					X	X	X			X					Risk generated by others
	2	Fall of objects because of collapse People hit by objects col-lapsed during lifted		X			X	X	X		X			X				Risk generated by others
	3	Stepping on objects People might step on object			X		X		X	X			X					Self generated risks
	4	Accidents caused by living beings Error caused by driver	X					X	X	X			X					Risk generated by others
	5	Trapped by vehicles People trapped by moving vehicles	X						X		X			X				Risk generated on others

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, limiting on-foot personnel to activity areas where devices and trucks are operat-ing, following of the traffic rules and being guided by visual or appropriate means of communication, clear communica-tion procedure for lifting, people walking in front and behind of the truck, marking of hazardous zones, physical closure of access points outside working hours	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass	
	Signs	
	PPE, construction site entry, speed limit sign, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	Certified crane operator
	B	Calculation of crane lifting capacity
	C	Checking of lifting tools equipment
	D	Compliance with maximum speed of vehicle
	E	Ensure sufficient rest for workers in the shift
	F	Compliance with maximum load for manual handling

3	Name of Activity : Foundation Assembly																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self Generated Risks
	2	Fall of objects because of collapse People hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Colliding with objects in motion Hit by moving equipment		X			X		X	X			X					Risk generated on others
	5	Stepping on object People step on dangerous object	X			X			X	X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, limiting on-foot personnel to activity areas where devices and trucks are operat-ing, following of the traffic rules and being guided by visual or appropriate means of communication, clear communica-tion procedure for lifting, people walking in front and behind of the truck,marking of hazardous zones, physical closure of access points outside working hours	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	certified crane operator
	B	Compliance with maximum speed of vehicle
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift
	F	Compliance with maximum load for manual handling

4	Name of Activity : Assembly of Panels (Ground Floor)																		
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self Generated Risks
	2	Fall of objects because they come loose Hit by material because of loose		X			X		X	X			X					Risk generated by others
	3	Fall of objects because of collapse People hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	4	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X						X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object					X			X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, people walking in front and behind of the truck,marking of hazardous zones, physical closure of access points outside working hours	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum speed of vehicle
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift
	F	Compliance with maximum load for manual handling

5	Name of Activity : Assembly of Walls and Stairs (Ground Floor)																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Hit by vehicles Hit by the moving equip-ments	X					X	X	X			X					Risk generated by others
	2	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self Generated Risks
	3	Fall of objects because they come loose Hit by material because of loose		X			X		X	X			X					Risk generated by others
	4	Fall of objects because of collapse People hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	5	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	6	Colliding with objects in motion Hit by moving equipment	X						X	X			X					Risk generated on others
	7	Stepping on object People step on dangerous object					X			X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, limiting on-foot personnel to activity areas where devices and trucks are operat-ing, following of the traffic rules and being guided by visual or appropriate means of communication, clear communica-tion procedure for lifting, people walking in front and behind of the truck,marking of hazardous zones, physical closure of access points outside working hours	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass	
	Signs	
	PPE, construction site entry, speed limit sign, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum speed of vehicle
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift
	F	Compliance with maximum load for manual handling
	G	Ensure sufficient rest for workers in the shift
	H	Compliance with maximum load for manual handling

6	Name of Activity : Assembly of Panels (First Floor)																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Hit by vehicles Hit by the moving equip-ments	X					X	X	X			X					Risk generated by others
	2	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self Generated Risks
	3	Fall of objects because they come loose Hit by material because of loose		X			X		X	X			X					Risk generated by others
	4	Fall of objects because of collapse People hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	5	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	6	Fall of persons from differ-ent level Fall from upper level		X		X	X		X		X			X				Self generated risks
	7	Stepping on object People step on dangerous object					X			X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, limiting on-foot personnel to activity areas where devices and trucks are operat-ing, following of the traffic rules and being guided by visual or appropriate means of communication, clear communica-tion procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protec-tion from falls from heights and from falling objects onto traffic areas and onto work platforms	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass, safety harness, beware of working in heights	
	Signs	
	PPE, construction site entry, speed limit sign, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum speed of vehicle
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift
	F	Compliance with maximum load for manual handling
	G	Ensure sufficient rest for workers in the shift
	H	Compliance with maximum load for manual handling

7	Name of Activity : Assembly of Walls (First Floor)																		
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self Generated Risks
	2	Fall of objects because they come loose Hit by material because of loose		X			X		X	X			X					Risk generated by others
	3	Fall of objects because of collapse People hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	4	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	5	Fall of persons from differ-ent level Fall from upper level		X		X	X		X		X			X				Self generated risks
	6	Stepping on object People step on dangerous object					X			X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass, safety harness, beware of working in heights	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum speed of vehicle
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift
	F	Compliance with maximum load for manual handling
	G	Ensure sufficient rest for workers in the shift
	H	Compliance with maximum load for manual handling

8	Name of Activity : Assembly of House (Roof)																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Hit by vehicles Hit by the moving equip-ments	X					X	X	X			X					Risk generated by others
	2	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self Generated Risks
	3	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X			X	X		X		X			X				Risk generated by others
	4	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	5	Fall of persons from differ-ent level Fall from upper level		X		X	X		X		X			X				Self generated risks
	6	Stepping on object People step on dangerous object		X				X	X	X			X					Self generated risks
	7	Exposure to extreme envi-ronmental temperatures Exposure to heat from the sun			X		X			X			X					Risk generated by environment

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, limiting on-foot personnel to activity areas where devices and trucks are op-erating, following of the traffic rules and being guided by visual or appropriate means of communication, clear com-munication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms, provide boom lift, provide railing for roof works	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, speed limit sign, danger of falling object, danger of tripping hazard, beware of working in heights	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum speed of vehicle
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift
	F	Compliance with maximum load for manual handling

9	Name of Activity : Assembly of Green Roof and Solar Tubes																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Hit by vehicles Hit by the moving equip-ments	X					X	X	X			X					Risk generated by others
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self Generated Risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X			X	X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X		X	X		X		X			X				Self generated risks
	5	Stepping on object People step on dangerous object		X				X	X	X			X					Self generated risks
	6	Fire Fire from bitumen burning																Self generated risks
	7	Exposure to extreme envi-ronmental temperatures Exposure to heat from the sun			X		X			X			X					Risk generated by environment

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, limiting on-foot personnel to activity areas where devices and trucks are op-erating, following of the traffic rules and being guided by visual or appropriate means of communication, clear com-munication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms, provide boom lift, provide railing for roof works	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, speed limit sign, danger of falling object, danger of tripping hazard, beware of working in heights	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum speed of vehicle
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift
	F	Compliance with maximum load for manual handling

10	Name of Activity : Glass House Frame Construction																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X			X	X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X		X	X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object		X				X	X	X			X					Self generated risks
	7	Exposure to extreme envi-ronmental temperatures Exposure to heat from the sun			X		X			X			X					Risk generated by environment

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas,clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms, provide boom lift	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, speed limit sign, danger of falling object, danger of tripping hazard, beware of working in heights	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum load for manual handling
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift

11	Name of Activity : Glass House Glass Installation																		
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X			X	X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X		X	X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object		X				X	X	X			X					Self generated risks
	7	Exposure to extreme envi-ronmental temperatures Exposure to heat from the sun			X		X			X			X					Risk generated by environment

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms, provide boom lift	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard, beware of working in heights	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum load for manual handling
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift

12	Name of Activity : PV Panel Installation																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X			X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object			X				X	X			X					Self generated risks
	7	Exposure to extreme envi-ronmental temperatures Exposure to heat from the sun			X		X			X			X					Risk generated by environment
	8	Exposure to electric connec-tions Exposure from electrical sources		X		X		X	X	X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic ar-eas and onto work platforms, provide boom lift, provide railing for roof works, any action on the machine must be done after neutralising command control	
	Individual Protective Equipment	
	Hard hat, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard, beware of working in heights, electrical hazard	
	Prevention Procedure	
	A	Electrical works will be completed by trained worker
	B	Keep the site clean from unused material or tools
	C	Ensure sufficient rest for workers in the shift
	D	Compliance with electrical tools user manual
	E	Compliance with maximum load for manual handling
	F	Compliance with hand tools user manual

13	Name of Activity : Electrical Installation																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X			X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Exposure to electric connec-tions Exposure from electrical sources			X				X	X			X					Risk generated by environment

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms, any action on the machine must be done after neutralising command control	
	Individual Protective Equipment	
	Hard hat, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard, beware of working in heights, electrical hazard	
	Prevention Procedure	
	A	Electrical works will be completed by trained worker
	B	Keep the site clean from unused material or tools
	C	Ensure sufficient rest for workers in the shift
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift

14	Name of Activity : Plumbing and Water Installation																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X			X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object			X				X	X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas,clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms	
	Individual Protective Equipment	
	Hard hat, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard, beware of working in heights	
	Prevention Procedure	
	A	Plumbing works will be completed by trained worker
	B	Keep the site clean from unused material or tools
	C	Ensure sufficient rest for workers in the shift
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift

15	Name of Activity : Bathroom Installation																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X			X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object			X				X	X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms	
	Individual Protective Equipment	
	Hard hat, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	Keep the site clean from unused material or tools
	B	Ensure sufficient rest for workers in the shift
	C	Compliance with hand tools user manual
	D	Compliance with maximum load for manual handling

16	Name of Activity : Kitchen Installation																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X			X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object			X				X	X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms	
	Individual Protective Equipment	
	Hard hat, safety boots, gloves, safety glass	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	Keep the site clean from unused material or tools
	B	Ensure sufficient rest for workers in the shift
	C	Compliance with hand tools user manual
	D	Compliance with maximum load for manual handling

17	Name of Activity : Heating / Cooling and Radiators Installation																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X			X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object			X				X	X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms	
	Individual Protective Equipment	
	PPE, construction site entry, danger of falling object, danger of tripping hazard	
	Signs	
	Beware of loads, speed limit sign, beware of moving object, beware of trip hazard	
	Prevention Procedure	
	A	Keep the site clean from unused material or tools
	B	Ensure sufficient rest for workers in the shift
	C	Compliance with hand tools user manual
	D	Compliance with maximum load for manual handling

18	Name of Activity : Walls Installation																		
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X			X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object			X				X	X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms	
	Individual Protective Equipment	
	Hard hat, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	Keep the site clean from unused material or tools
	B	Ensure sufficient rest for workers in the shift
	C	Compliance with hand tools user manual
	D	Compliance with maximum load for manual handling

19	Name of Activity : Furniture Installation and Appliances																		
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X			X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object			X				X	X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms, providing lifting cart	
	Individual Protective Equipment	
	Hard hat, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	Compliance with maximum load for manual handling
	B	Keep the site clean from unused material or tools
	C	Ensure sufficient rest for workers in the shift
	D	Compliance with hand tools user manual

20	Name of Activity : Garden Works																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	5	Stepping on object People step on dangerous object			X				X	X			X					Self generated risks
Risk Prevention	**Collective Protection**																	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, providing lifting cart																	
	Individual Protective Equipment																	
	Hard hat, safety boots, gloves, safety glass																	
	Signs																	
	PPE, danger of falling object, danger of tripping hazard																	
	Prevention Procedure																	
	A	Compliance with maximum load for manual handling																
	B	Keep the site clean from unused material or tools																
	C	Ensure sufficient rest for workers in the shift																
	D	Compliance with hand tools user manual																

21	Name of Activity : Maintenance of Cleaning the House																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of persons at the same level People fall because of tripping		X			X		X		X			X				Self generated risks
Risk Prevention	**Collective Protection**																	
	Marking of hazardous zones																	
	Individual Protective Equipment																	
	Hard hat, safety boots, gloves, safety glass, safety harness																	
	Signs																	
	PPE, danger of falling object, danger of tripping hazard, beware of working in heights																	
	Prevention Procedure																	
	A	Compliance with maximum load for manual handling																
	B	Keep the site clean from unused material or tools																
	C	Ensure sufficient rest for workers in the shift																
	D	Compliance with hand tools user manual																

22	Name of Activity : Maintenance of PV Panel																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools			X		X		X	X			X					Self generated risks
		Hand injury from tools																
	2	Fall of persons from differ-ent level		X			X		X		X			X				Self generated risks
		Fall from upper level																
	3	Exposure to extreme envi-ronmental temperatures			X		X			X			X					Risk generated by environment
		Exposure to heat from the sun																

Risk Prevention		
	Collective Protection	
	Marking of hazardous zones,protection from falls from heights and from falling objects onto traffic areas and onto work platforms, provide boom lift, provide railing for roof works, any action on the machine must be done after neutralising command control	
	Individual Protective Equipment	
	Hard hat, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, danger of falling object, danger of tripping hazard, beware of working in heights, electricity hazard	
	Prevention Procedure	
	A	Compliance with maximum load for manual handling
	B	Keep the site clean from unused material or tools
	C	Ensure sufficient rest for workers in the shift
	D	Compliance with hand tools user manual

23	Name of Activity : Disassembly of electrical Installation																		
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X			X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Exposure to electric connec-tions Exposure from electrical sources			X				X	X			X					Risk generated by others

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms, any action on the machine must be done after neutralising command control	
	Individual Protective Equipment	
	Hard hat, safety boots, gloves, safety glass, safety harness	
	Signs	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms	
	Prevention Procedure	
	A	Electrical works will be completed by trained worker
	B	Keep the site clean from unused material or tools
	C	Ensure sufficient rest for workers in the shift
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift

24	Name of Activity : Removal of Appliances																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X			X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object			X				X	X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms, providing lifting cart	
	Individual Protective Equipment	
	Hard hat, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	Compliance with maximum load for manual handling
	B	Keep the site clean from unused material or tools
	C	Ensure sufficient rest for workers in the shift
	D	Compliance with hand tools user manual

25	Name of Activity : Disassembly of PV Panel																		
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X			X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object			X				X	X			X					Self generated risks
	7	Exposure to extreme envi-ronmental temperatures Exposure to heat from the sun			X		X			X			X					Risk generated by environment
	8	Exposure to electric connec-tions Exposure from electrical sources		X		X		X	X	X			X					Risk generated by others

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic ar-eas and onto work platforms, provide boom lift, provide railing for roof works, any action on the machine must be done after neutralising command control	
	Individual Protective Equipment	
	Hard hat, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard, beware of working in heights, electrical hazard	
	Prevention Procedure	
	A	Electrical works will be completed by trained worker
	B	Keep the site clean from unused material or tools
	C	Ensure sufficient rest for workers in the shift
	D	Compliance with electrical tools user manual
	E	Compliance with maximum load for manual handling
	F	Compliance with hand tools user manual

26	Name of Activity : Disassembly of Glass House Glass																		
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X			X	X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X		X	X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object		X				X	X	X			X					Self generated risks
	7	Exposure to extreme envi-ronmental temperatures Exposure to heat from the sun			X		X			X			X					Risk generated by environment

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms, provide boom lift	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard, beware of working in heights	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum load for manual handling
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift

27	Name of Activity : Disassembly of Glass House Frame																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X			X	X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X		X	X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object		X				X	X	X			X					Self generated risks
	7	Exposure to extreme envi-ronmental temperatures Exposure to heat from the sun			X		X			X			X					Risk generated by environment

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas,clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms, provide boom lift	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard, beware of working in heights	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum load for manual handling
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift

28	Name of Activity : Disassembly of House (Roof)																		
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X			X	X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X		X	X		X		X			X				Self generated risks
	5	Stepping on object People step on dangerous object		X				X	X	X			X					Self generated risks
	6	Exposure to extreme envi-ronmental temperatures Exposure to heat from the sun			X		X			X			X					Risk generated by environment

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms, provide boom lift, provide railing for roof works	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard, beware of working in heights	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum speed of vehicle
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift
	F	Compliance with maximum load for manual handling

29	Name of Activity : Disassembly of House (First Floor)																		
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X			X	X		X		X			X				Risk generated by others
	3	Fall of objects because they come loose Hit by material because of loose		X			X		X	X			X					Risk generated by others
	4	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	6	Fall of persons from differ-ent level Fall from upper level		X		X	X		X		X			X				Self generated risks
	7	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	8	Stepping on object People step on dangerous object		X				X	X	X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours, protection from falls from heights and from falling objects onto traffic areas and onto work platforms	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard, beware of working in heights	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum speed of vehicle
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift
	F	Compliance with maximum load for manual handling

30	Name of Activity : Disassembly of House (Ground Floor)																		
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because they come loose Hit by material because of loose		X			X		X	X			X					Risk generated by others
	3	Fall of objects because of collapse People hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	4	Fall of persons at the same level People fall because of tripping		X			X		X	X			X					Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X						X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object					X			X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, clear communication procedure for lifting, marking of hazardous zones, physical closure of access points outside working hours	
	Individual Protective Equipment	
	Hard hat, construction unfirom, safety boots, gloves, safety glass	
	Signs	
	PPE, construction site entry, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	Certified crane operator
	B	Compliance with maximum speed of vehicle
	C	Compliance with hand tools user manual
	D	Keep the site clean from unused material or tools
	E	Ensure sufficient rest for workers in the shift
	F	Compliance with maximum load for manual handling

31	Name of Activity : Disassembly of Foundation																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse People hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Colliding with objects in motion Hit by moving equipment		X			X		X	X			X					Risk generated on others
	5	Stepping on object People step on dangerous object	X			X			X	X			X					Self generated risks
	Collective Protection																	
	Markings and protection of work areas, limiting on-foot personnel to activity areas where devices and trucks are operat-ing, following of the traffic rules and being guided by visual or appropriate means of communication, clear communica-tion procedure for lifting, people walking in front and behind of the truck,marking of hazardous zones, physical closure of access points outside working hours																	
Risk Prevention	**Individual Protective Equipment**																	
	Hard hat, construction unfirom, safety boots, gloves, safety glass																	
	Signs																	
	PPE, construction site entry, danger of falling object, danger of tripping hazard																	
	Prevention Procedure																	
	A	Certified crane operator																
	B	Compliance with maximum speed of vehicle																
	C	Compliance with hand tools user manual																
	D	Keep the site clean from unused material or tools																
	E	Ensure sufficient rest for workers in the shift																
	F	Compliance with maximum load for manual handling																

32	Name of Activity : Clearing and Finishing the Site																	
Risk Identification	No	Risk Identification and Its Causes	Probability of Event			Determined Precaution				Conse-quence of the Risk			Risk qualification with precaution applied					Risk Assess-ment
			R	P	C	Ci	Pi	PP	S	L	G	Mo	T	To	M	I	In	
	1	Knocked by objects or tools Hand injury from tools			X		X		X	X			X					Self generated risks
	2	Fall of objects because of collapse people hit by objects col-lapsed during lifted	X				X		X		X			X				Risk generated by others
	3	Fall of persons at the same level People fall because of tripping		X					X	X			X					Self generated risks
	4	Fall of persons from differ-ent level Fall from upper level		X			X		X		X			X				Self generated risks
	5	Colliding with objects in motion Hit by moving equipment	X			X			X	X			X					Risk generated on others
	6	Stepping on object People step on dangerous object			X				X	X			X					Self generated risks

Risk Prevention		
	Collective Protection	
	Markings and protection of work areas, limiting on-foot personnel to activity areas where devices and trucks are operat-ing, following of the traffic rules and being guided by visual or appropriate means of communication, clear communica-tion procedure for lifting, people walking in front and behind of the truck,marking of hazardous zones, physical closure of access points outside working hours	
	Individual Protective Equipment	
	Hard hat, safety boots, gloves, safety glass, safety harness	
	Signs	
	PPE, danger of falling object, danger of tripping hazard	
	Prevention Procedure	
	A	Compliance with maximum load for manual handling
	B	Keep the site clean from unused material or tools
	C	Ensure sufficient rest for workers in the shift
	D	Compliance with hand tools user manual

8 Collective protections to use

Collective protection should be treated in a careful way to ensure safe condition before, during, and after the work performed. This collective protection consists of scaffolding, safety harness, individual platform, and fences. The collective protection should meet the following conditions : it should be implemented prior to the onset of any risk, and should be evaluated before the disassembly. The safety officer will responsible to determine the appropriate time to assemble the collective protection and to do disassembly.

Always be implemented prior to the onset of any risk
Collective protection should be installed before the work which contains risk is applied. As an illustration, before someone going to work on height, the scaffolding should need to be properly installed.

- The safety officer will determine whether the scaffolding is safe enough for people to climb it.
- During working on height, perimeter fences should be installed in all sides to prevent people falling.
- The safety harness should be checked visually prior to usage to indicate if there is defects such as crack, excessive wear, and other damages. The structure of the anchoring point should also be inspected.

Be adapted and sufficient to allow for the completion of various works safely and without dismantling by the Contractor, by its sub-contractors or by companies

- During working on the roof, people should always wear safety harness before the fences is installed completely on the roof.
- During the installation of the glass house, to reach places that cannot be reached by the scaffolding, people should use the boom lift instead.
- When in used, the scaffolding should be kept clear of any debris and obstacles.
- The scaffolding should not be accessed until the brake are locked to prevent movement.
- The scaffolding cannot never be moved when there is still anyone working on the platform.
- The scaffolding cannot be climbed from the outside.

Meet the following conditions to do the disassembly of group protection

- Unless prior to special agreement, the authorized personnel to disassemble is only the person in charge of installing/using/maintenance of a temporary group protection. The people who are going to disassembly the group protection are the people who have received prior training to do such jobs. These people are students, professional workers and HS officers.
- Elimination of the risk related to the advancement of work. Only if when certain high risk activities have been finished, the group protection can be disassembly. For instance, after the roof work is finished then the roof fences can be disassembly.
- The group protection of the overall work is already on site. As an example, en sure that the safety harness is already provided during the disassembly of safety fences on the roof.
- There are sufficient safety measures for the remaining work
- Another temporary device or safety measures of with the equal efficiency have been implemented on site.

Collective protection for risk of Electrocution:

- The operator shall be equipped with all the necessary individual protection equipment
- The equipment used must keep the exposure of workers to mechanical vibrations to a minimum
- The operating zones for equipment must be compared with the characteristics of the equipment to avoid any risk of tilting
- Any action on the machine must be done after neutralising command controls.

Collective protection for risk of collision and crushing by machines / operating equipment:

- Delimitation of work area
- Priority allocation of one-way traffic paths and lanes
- Separation of vehicles and pedestrian movement, equipment gear
- Following the traffic rules and being guided by visual or appropriate means of communication
- Limiting on-foot personnel to activity areas where devices and trucks are operating

As soon as the platform of the foundation is installed temporary fences shall be installed, this shall also be done for the first floor and the roof. The temporary fencing is necessary to close off the floor untill the permanent fence or wall is installed, or untill the rooftiling is done.

The fence can be installed 30 cm from the edge so there still is space left over to install the permanent fence or wall without having to remove the temporary fence.

Collective protection should be treated in a careful way to ensure safe condition before, during, and after the work performed. This collective protection consists of scaffolding, safety harness, individual platform, and fences. The collective protection should meet the following conditions : it should be implemented prior to the onset of any risk, and should be evaluated before the disassembly. The safety officer will responsible to determine the appropriate time to assemble the collective protection and to do disassembly.

Protection	Where	When	Activity
First AID bag	In the Base tent	At all time, also exposition	During injuries
Signage	Throughout the site	During all construction	All construction activities
Ladder	In the tool storage	During construction and maintenance	Safe working on heights
Warning tape	In the tool storage	During all construction	Warn for unsafe areas
Lock out tag out	In the tool storage	During electrical work	Warn for unsafe situation
Sun-shelter	At site, out of range of construction activities	During construction	Resting place
Fences/railing	In the tool storage	During construction of casco and roof	During construction of first floor and roof, making sure no accidents occur
Site fence	Around the entire area, lot and truck area	During all construction	For all construction activities

9 Individual protection resources to use PPE

During the construction process, the use of personal protective equipment is mandatory. The PPE are classified into the standard PPE and special PPE. Standard PPE is used for all construction workers during all time. Special PPE is needed in certain condition such as working in night shift and working at heights. Additional special PPE also will be required for worker who perform specific task and need extra protective equipment.

- Standard PPE for working in construction site:

1. Hard hat
2. Safety glass
3. Construction uniform (a shirt with sleeves and long trousers)
4. Safety boots with ankle supports
5. Safety gloves
6. Earplugs
7. Reflecting jacket

- Special PPE:

1. Safety harness (for working at heights)
2. Dust mask

Technical specifications on the individual protection can be found in the appendix of the HS Plan.

9.1 Signposting of the risks and services

No	Safety Sign	Location	Picture
1	First aid kit	Health and safety tent	
2	Construc-tion site entry	Construction site	
3	General danger	Construction site	
4	Fire extin-guisher	Construction site	

5	Electrical hazard	Construction site	
6	Head protection obligatory	Construction site	
7	Work uniform obligatory	Construction site	
8	Foot protection obligatory	Construction site	

9	Eye protection obligatory	Construction site	
10	Hand protection obligatory	Construction site	
11	Electrical connection to the ground	Construction site	
12	Obligatory to use handrail	Construction site	
13	Moving equipment danger	Construction site	

14	Direction to assembly point	Assembly Point	
15	Safety harness obligatory for working in heights	Construction site	
16	Danger of falling object	Construction site	
17	Danger of falling	Construction site	
18	Danger of tripping hazard	Construction site	

10 Safe working procedures of every Team member

Personal Protective Equipment
At all time all team members should were the appropriate PPE on site. Being present on the lot without the appropriate PPE shall not be tolerated. The appropriate PPE depends on the activity the team members is doing. A spectator, only walking around at the safe zones, does not need the same PPE as a team member installing elements.

Alcohol/drugs policy
The use of alcohol and/or drugs shall not be tolerated on the construction site. Team members are expected to arrive sober at their shift. Also, smoking on site is not allowed.

Authority to be on site
Only team members (and other persons) who are doing their shift are allowed on site. If not, permission of the HS officer and/or HS team coordinator should be granted. Off course PPE is obligated.

Cleaning
All team members are expected to clean up their own mess or at least communicate it to let someone else do it. Garbage on site can cause more risk of accidents, this should be at all time be prevented. Garbage should be disposed at the right way at the garbage disposal of the Solar Village.

Night time
Doing construction during night time (± the last 2 hours of shift 2) should at all time being performed with the construction lights on. Without correct and adequate lighting construction work is not permitted. Also, during night time all workers walking at darker areas should were reflecting vests.

Tool handling
All team members should only use the tools in the way they are trained or instructed to do so. Misusing tools can cause accidents and shall not be tolerated.

First AID and evacuation
When accidents occur and first AID and/or evacuation should take place, the HS officer and/or HS team coordinator should be informed. From that moment the First AID and/or evacuation procedures shall be applied.

Health and medical circumstances
The HS officers and HS team coordinator are informed about the medical situations of all team members, they shall take this into account. But first of all, all team members are responsible for their own health. Not feeling well (or any other situation) should be communicated towards the HS officer and/or HS team coordinator. In order to stay healthy all team members should drink enough, find shade when possible, apply sun protector, sleep enough, eat enough (good) etc.

11 Machinery and auxiliary resources

Information on the machinery and auxiliary resources can be found in 10.4.11 and 10.4.12

12 Planned Measures in case of accident

The measures discussed shall also be applied during the test disassembly and assembly in The Netherlands.

12.1 General info on First AID and emergencies

BHV certificate (dutch course):
Arjan Oosterhof
Bob Bogers
Rudger de Jong
Jan Portheine
Josien Kruizinga
Dennis Ijsselstein
Oswaldo Heinen
Jasper Overduin
Tim Jonathan

EHBO certificate (english course):
Gini Arimbi
Petar Zhivkov

Important (emergency) numbers

The Netherlands:	General emergency number:	112
	Police (non-emergency):	0900 8844
Belgium (transport):	General emergency number:	112
	Medical emergency:	100
	Police:	101
	Fire brigade:	100
France:	General emergency number:	112 (speaking: cent-douze)
	Medical emergency:	15
	Police:	17
	Fire brigade:	18

12.2 Emergency Procedure in case of an Accident

1. Subject

Management of accidents during the competition. This document is applicable from the beginning of the supplying until the complete withdrawal of each prototype.

2. Scope

These instructions apply to all participants of the SOLAR DECATHLON EUROPE 2014.

3. Analyse the Situation

-For minor injuries (cuts, bruises, etc), when the victim is capable of walking on his / her own :

- The victim must be accompanied to the first aid centre (8 am – 8 pm).
- The SDE observer will define who will go to the medical centre, with the victim.
- The SDE observer will alert by phone, prior to the arrival of the victim.
- The first aid centre will be alerted prior to the arrival of the victim, by the SDE observer.
- SDE 2014 on call service n : XX XX XX XX XX

-If the injury is serious and / or the victim is unable to walk on his / her own, see points 4 to 7.

4. Protect

In case of accident(s), the first witness must above all, prevent further accidents.

- Analyse the circumstances of the accident in order to identify any residual risks (suffocation, electrical risks, falling objects, fire outbreak, etc)
- Protect yourself, protect (or make them protected) all third parts and the victim (electrical lockout, safety delimitation, etc)
- Only move the victim if there is a continuing risk of serious and imminent dan ger.

5. Examine

Even if the person closed to the accident is a trained first worker, the victim should not be moved. Identify:

- If the victim is conscious (by speaking to him / her)
- If there is any visible bleeding
- The type of injury : burn, cut, foreign object, pain, etc

6. Raise the Alarm

Between 8 am and 8 pm, if the victim is on the worksite, the SDE Observer alert the first aid centre.

- Depending on the seriousness of the accident, the first aid team will attend the accident on site.
- The first aid worker will call the emergency services (18 or 112) which will be responsible for guiding the emergency services arriving via the entrance number 1 or the service entrance of the site.
- A vehicle of SDE Organization will be made available for SDE members in order to guide the emergency services close to the place of the accident.

Between 8 am and 8 pm, if the victim is already in the first aid centre.

- The first aid worker will call the external emergency services (18 or 112).
- The first aid worker will also quickly notify the SDE organization which will be responsible for guiding the emergency services arriving via the entrance numebr 1 or the service entrance of the site.

Outside working hours of the first aid team.

- The team alerts the SDE observer.
- The SDE Observer stops the work and alert the SDE organization.
- The closest member of the SDE Organization, trained in first-aid, goes to the spot.
- He is responsible for calling the emergency services (18 or 112) and report to the SDE organization.
- If needed, he may ask someone around to bring him back the automated external defibrillator (AED) available in the first aid centre.
- The SDE organization is in charge of guiding the emergency service arriving via the entrance number 1 or the service entrance of the site.

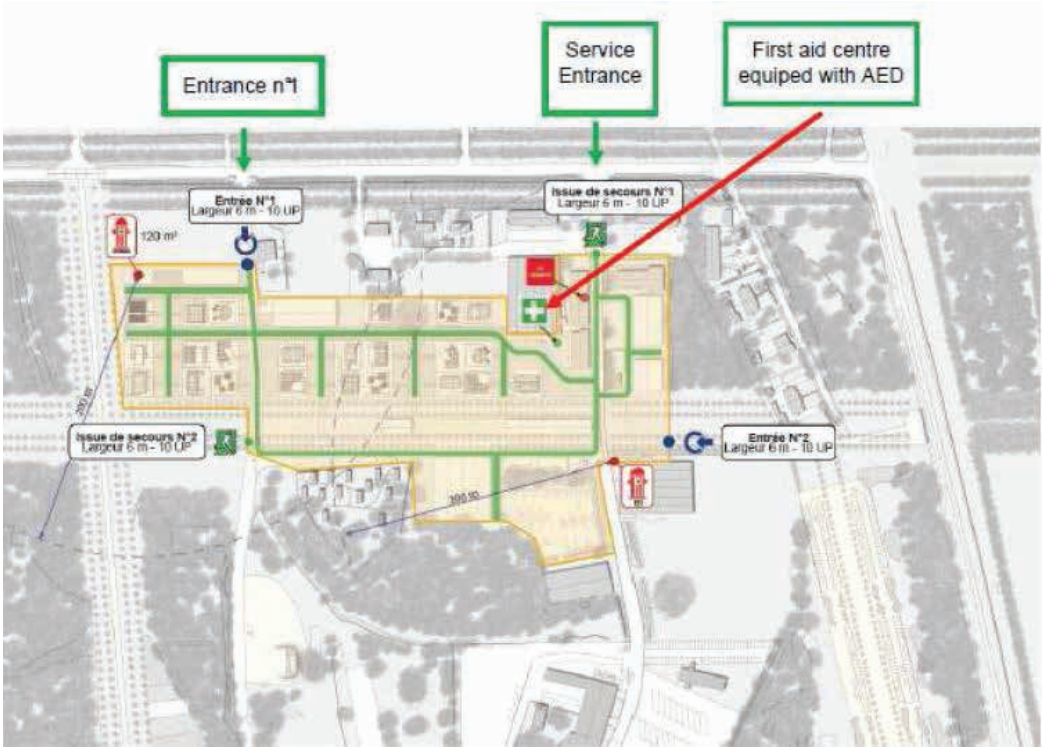
7. First Aid

In all cases, stay with the victim and reassure him / her until the emergency services arrives.

If you are a trained first aid worker, provide the first aid.

8. Exercise

An exercise may be set up to by the SDE Organization to train everyone one the procedures.



To avoid worsening the situation think before your act and protect: yourself, the victim(s), others. You can do this for example by informing those around, marking out the area, cutting of electricity, do not move the victim(s) if not necessary, inform emergency services etc.

Inform or let someone inform one of the health and safety officers or one of the first aiders on site. Stay or leave someone with the victim(s).

Immediately alert the emergency services if first AID is needed.

While awaiting the arrival of emergency services, do not move any injured peron(s) except if there is imminent danger, comfort the victim(s), and do not give them anything to drink.

When calling the emergency services: call 112 on cellphone or 18 on a hard line. You should say:
1) Your name, number and the address:

CITE DU SOLEIL 2014
Domaine du chateau de Versailles
Allée des Matelots
VERSAILLES

2) Specify the nature of the accident including the position of the victim(s)
3) Report the number of injured persons and their condition
4) Arrange a meeting place and send someone to the entrance to direct the emergency services

Never end the call first, let them do it.

12.3 Emergency procedure in case of Fire

1. Subject

Fire response procedure and definition of an “emergency response” team.

2. Scope

These instructions apply to all participants of the SOLAR DECATHLON 2014.

3. Prevention Measures

- Smoking is strictly prohibited on site.
- Before beginning any work, identify emergency evacuation areas, fire extinguishing equipment and all emergency withdrawal areas.
- Always ensure that roads are clear in order to make the access easier for the emergency services. For all work requiring closing a road, a request must be submitted to SDE2014 Organization via on the call system.

For teams carrying out work with a fire hazard:

- Work concerned: welding, grinding, blowtorch work, and any other work that may generate heat or sparks.
- Safety measures: operating procedure and related risk assessment.
- Equipment: compliant and in good condition, presence of an ABC fire extinguisher near the hot spot, welding stations and all other electrical equipment properly grounded.
- Collective and personal protective equipment : protect the work area (placement of torpaulins, cordon off the area if other activities are carried out in the same area, etc), personal protective equipment adapted to the work in question.
- Worksite environment : ensure that there are no aggravating factors in the worksite environment (solvent storage, painting, lower level, etc).
- Vigilance : A Trained fire watch person (this may be the team’s Safety Officer) will monitor the fire risk and may intervene at any time. For two hours following the work, a dedicated person of the SDE2014 Organization, equipped with a phone, will conduct patrol rounds to ensure that no fires have started at any of listed points.
- Inspection: audits will be often carried out by SDE2014 Organization in order to check knowledge of these instructions.

4. In Case of a Fire Breaks Out:

Anyone who witnesses the outbreak of a fire must immediately use the available fire-fighting equipment with the assistance of any other staff that may be present in the area. At the same time it will necessary to raise the alarm. If the fire come from an electrical device or system, shut down the electrical source and only use appropriate extinguishers.

a. Small manageable fire outbreak (immediately reported, small surface, etc)

Use the appropriate extinguisher and notify the SDE2014 Organization by indicating the affected area. The SDE2014 Organization will ensure that the fire is completely extinguished and carry out an investigation with the concerned people.

b. Larger fire that cannot be controlled with available resources

Fire within the worksite area

- Immediately notify the SDE2014 Organization.
- The SDE2014 Organization will call emergency services.
- The SDE2014 Organization will remain available to guide the emergency services.

The alert message shall be given as follows :

TEAM NAME
NATURE AND CAUSE OF THE INCIDENT
SPECIFIC LOCATION OF THE INCIDENT
NUMBER OF VICTIMS, IF ANY
CONDITION OF THE VICTIM (S)
SURROUNDING HAZARDS THAT MAY HINDER EMERGENCY OPERATIONS (obstacles, electrical risks, storage of flammable products, etc)

The location of La Cité du Soleil:
Domaine due chateau de Versailles
Allée des Matelots
Versailles

And above all, do not hang up the telephone first.

The SDE2014 Organization will guide the emergency services from entrance n.1 or from the service entrance to the location of the incident.

Fire at site boundary

- Immediately inform the SDE2014 Organization
- The SDE2014 Organization will call emergency services.

The alert message shall be given as follows:

TEAM NAME
NATURE AND CAUSE OF THE INCIDENT
SPECIFIC LOCATION OF THE INCIDENT
NUMBER OF VICTIMS, IF ANY
CONDITION OF THE VICTIM(S)
SURROUNDING HAZARD THAT MAY HINDER EMERGENCY OPERATIONS (obstacles, electrical risks, storage of flammable products, etc)

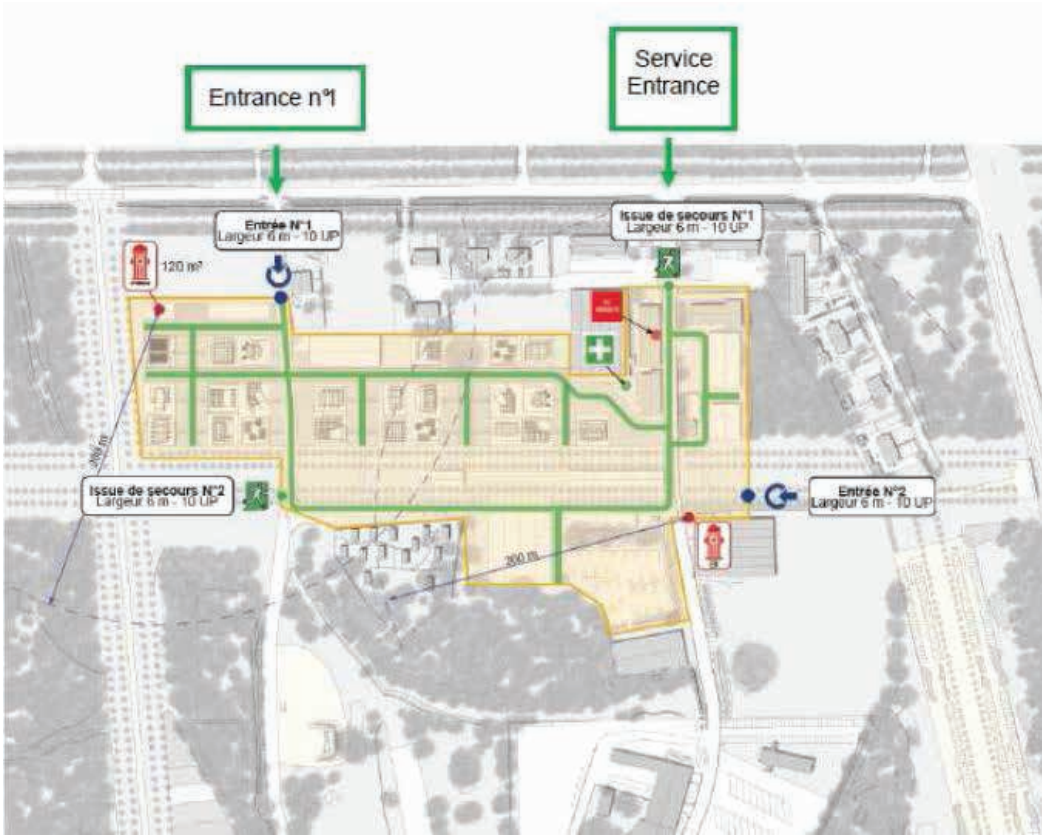
And above all, do not hang up the telephone first.
The SDE2014 Organization will guide the emergency services from entrance n.1 or from the service entrance to the location of the incident.

5. Site Evacuation

- As soon as the alert is given, personnel will calmly evacuate to the emergency areas after quickly making their workstations safe (shut off compressors, close gas cylinders, etc)
- Emergency areas are identified with the following panel:



- Stop all machines without blocking traffic.
  The list of personnel responsible for evacuation is :
  (to be defined by SDE 2014)
- These “Evacuation Officers” will be responsible for checking that all people have evacuated the worksite to the appropriate emergency areas.
- Each “Evacuation Officer” list his / her personnel in order to verify that no one is missing. The Team’s Safety Officers will be asked to check that none of their team members are missing. The competition manager will give the order to resume work.
- During the alert, nobody will be authorised to leave the emergency area without agreement of the SDE2014 Organization.



12.4 First AID kit

First aid bag will be located inside the house and in the warehouse during the construction area. According to France regulation, required items in first aid bags are specifies in the following table.

No	Item
1	2 x elastic bandage 6 x 8 cm
2	4 x bandage nr. 1 K
3	2 x bandage nr. 2 M
4	16 x sterile gauze 1/16
5	10 x sterile gauze 1/ 5x5
6	2 x non-adherent pad
7	4 x bandage clips
8	1 set of tweezers
9	1 bandage scissors
10	1 cambric bandage 6 cm
11	1 cambric bandage 8 cm
12	3 x hydrophilic bandage 6 cm
13	1 box of band aids
14	1 pair of gloves
15	1 role of synthetic cottonwool
16	1 fixation plaster 5 x 2,5 cm
17	1 facepiece respirator
18	1 Triangular cloth
19	25 gram white cottonwool
20	Desinfectant
21	3 safetypins

Before the work construction starts, all workers are required to take medical check up.

12.5 Preventive medicine

No preventive medicine were mentioned after the medical check-ups.

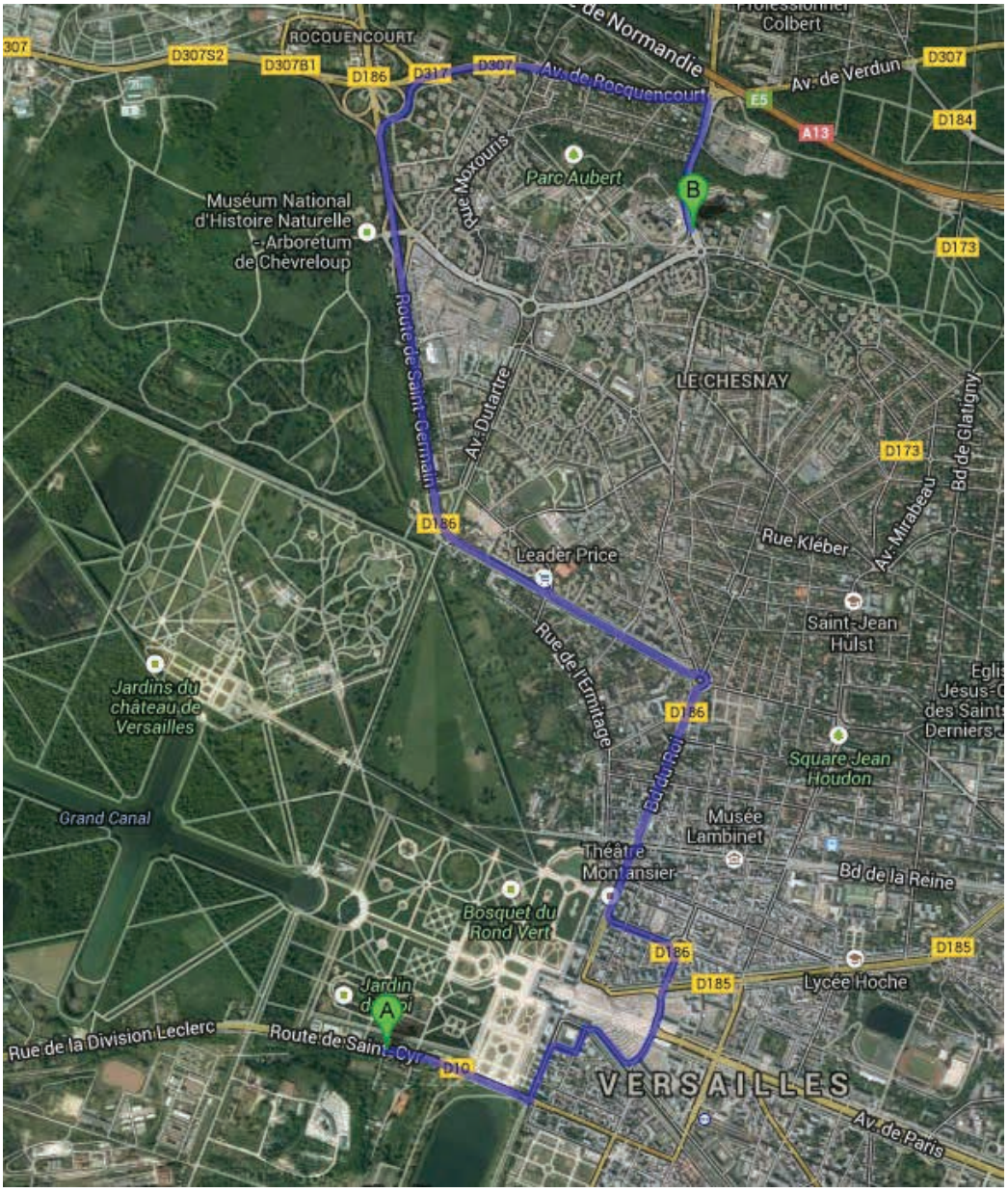
12.6 Accident victims evacuation

To evacuate victims we added the route to the closest hospital and dentist in Versailles and Harbrinkhoek. We also added the route to the closest pharmacy. The location of the medical centre in the Cité du Soleil is not known yet.

France
Departure from SDE14 terrain Versailles (France)

Hospital
Name: **L'Hopital André Mignot**
Address: **177 Rue de Versailles**
Zip code: **78150**
City: **Le Chesnay**
Phone: **(+33) 13 963 91 33**

Route: 7,6 km / 13 minutes

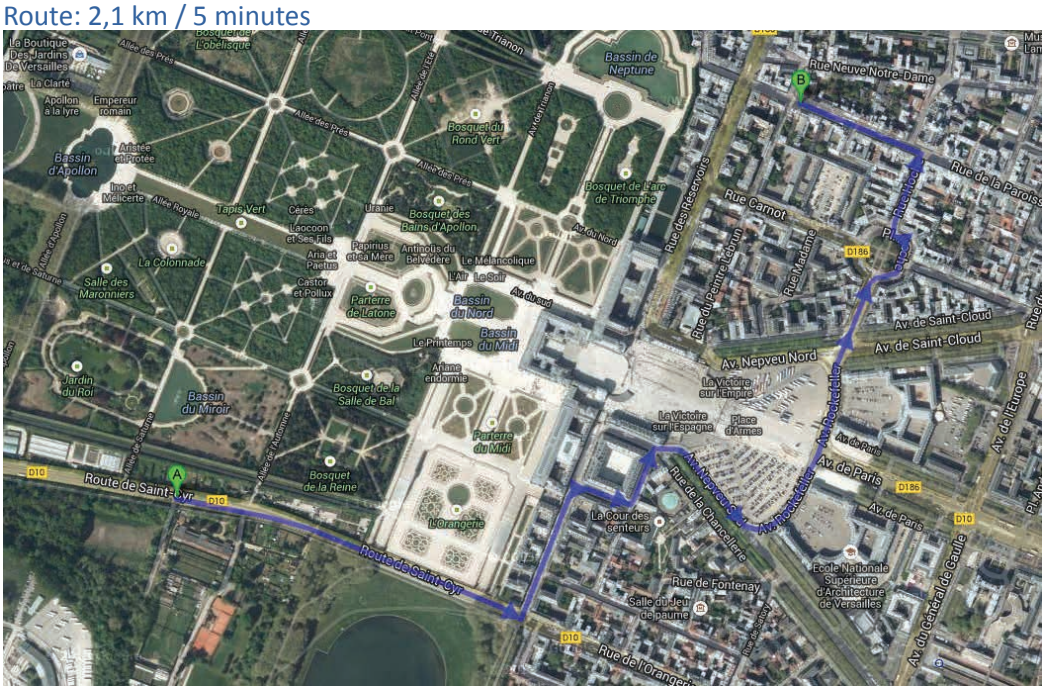


1. Go east on the D10 to Allée de l'Automne
2. After 600 m go left on Rue de l'Indépendance Américaine
3. After 250 m continue on Rue Saint-Julien
4. After 70 m go left on Rue des Récollets
5. After 100 m go right on Avenue Nepveu Sud
6. After 200 m go left on Avenue Rockefeller
7. After 400 m continue on Rue Hoche/D186
8. After 220 m continue on Rue Carnot
9. After 160 m stay right on Rue Carnot
10. After 50 m go right on Rue des Réservoirs
11. After 250 m take the second exit on the roundabout to Bd du Roi/D186
12. After 650 m take the fifth exit on the roundabout to Bd Saint-Antoine/D186
13. After 700 m go right on Bd Saint-Antoine
14. After 25 m go left to stay on Bd Saint-Antoine
15. After 25 m go right on Bd Saint-Antoine/D186, continue on D186
16. After 2,0 km follow the D307, heading La Celle-Saint-Cloud/Rocquencourt-Étang
17. After 1,2 km straight ahead on Route de Mantes/D307
18. After 150 m go right pm Rue de Versailles
19. After 550 m, destination on the right side

Pharmacy

Name:	Pharmacie Ambrose
Address:	5 Rue de la Paroisse
Zip code:	78000
City:	Versailles
Phone:	(+33) 1 39 50 06 20

Route: 2,1 km / 5 minutes

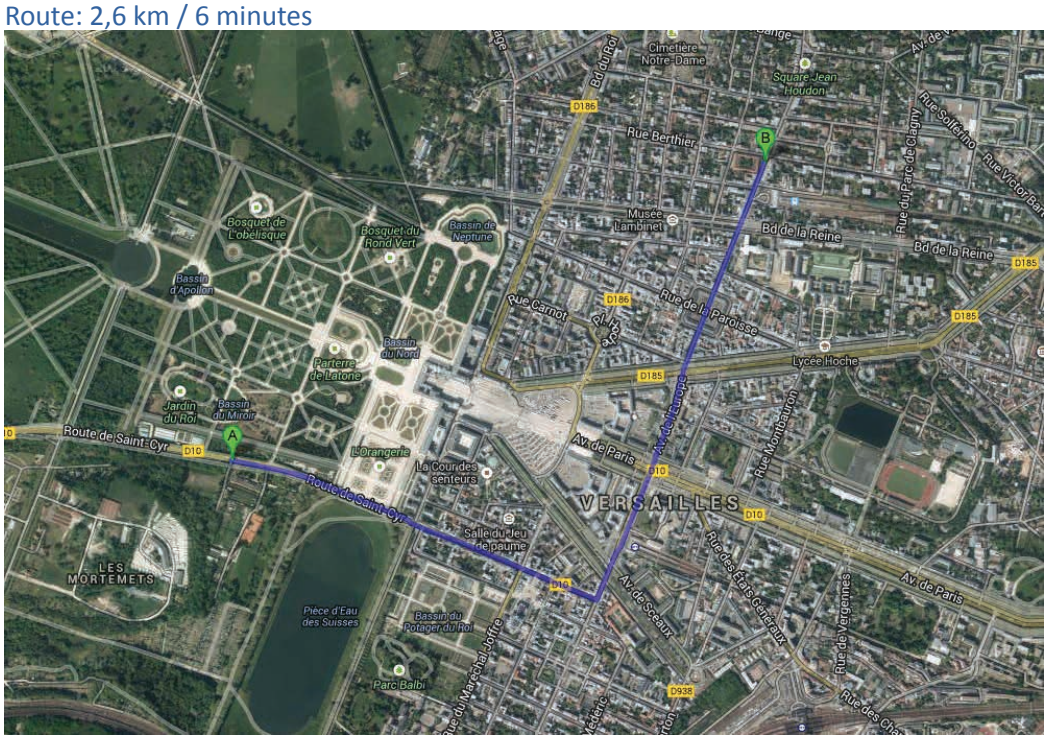


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2. After 600 m go left on Rue de l'Indépendance Américaine
3. After 250 m continue on Rue Saint-Julien
4. After 70 m go left on Rue des Récollets
5. After 100 m go right on Avenue Nepveu Sud
6. After 200 m go left on Avenue Rockefeller
7. After 400 m continue on Rue Hoche/D186
8. After 80 m stay right en continue on Pl. Hoche/D186
9. After 120 m go right on Rue Hoche/D186
10. After 140 m go left on Rue de la Paroisse/D186
11. Destination is on the right side after 200 m

Dentist

Name:	Seluri de Chirugiens Denitstes Beal
Address:	50 Rue de Maréchal Foch
Zip code:	78000
City:	Versailles
Phone:	(+33) 1 39 67 03 88

Route: 2,6 km / 6 minutes



1. Go east on D10 to Allée de l'Automne
2. After 1,2 km go left on Rue Royale/D10, continue on D10
3. After 450 m continue on Avenue de l'Europe
4. After 300 m continue on Rue du Maréchal Foch
5. After 650 m destination is on the right side

Harbrinkhoek (The Netherlands)

Departure from Groothuis Bouwen
Address: Ootmarsumseweg 12
Zip code: 7615 PL
CIty: Harbrinkhoek

Hospital
Name: ZGT Almelo
Address: Zilvermeeuw 1
Zip code: 7609 PP
City: Almelo
Phone: (+31) 546 69 36 93

Route: 9,7 km / 12 minutes



1. Go west on the Ootmarsumseweg/N349 heading to Klösseweg, continue on the N349
2. After 3,5 km go left on the Van Rechteren Limpurgsingel/N349
3. After 2,8 km go right on the Nijreessingel/N349
4. After 2,2 km continue on the Weezebeeksingel
5. After 1,0 km go left on the Zilvermeeuw
6. After 100 meter go right

Pharmacy

Name:	Apotheek Albergen-Geesteren
Address:	Philippus Robbenstraat 8
Zip code:	7665 AA
City:	Albergen
Phone:	(+31) 546 44 22 11
Route:	3,3 km / 4 minutes



1. Go east on Ootmarsumseweg/N349 heading to Hofmaatsweg
2. After 3,3 km go right pm the Philippus Robbenstraat
3. Destination after 70 meter at number 8

Dentist

Name:	Tandenpraktijk GPKB Holthinrichs
Address:	Stins 4
Zip code:	7608 HD
City:	Almelo
Phone:	(+31) 546 86 42 26

Route: 4,3 km / 7 minutes



1. Go east on Ootmarsumseweg/N349 heading to Klösseweg, continue on the N349
2. After 3,0 km go right on Buitenhof
3. After 1,0 km go left on Binnenhof
4. After 220 m go right on Stins
5. Destination after 100 m at number 4

13 Risks identification for possible later works

13.1 Incident report

After every incident an ‘Incident Report’ shall be filled in by the victim and/or other who witnessed the event. The goal of this report is to learn from it and avoid any similar future accidents.

Indicent report

Date	Time
Activity	
Location	
Description of accident	
Factors	
Corrective Actions to Prevent Reaccurance	
Lesson Learned	
H&S Officer	

14 USEFUL PLANS AND INFORMATION FOR POSSIBLE LATER WORKS

14.1 Maintenance

Once the construction is finished and the house is tested, maintenance activities will take place to ensure the functionality and the cleanliness of the house's components. During the exhibition, maintenance operation of the house will consist of cleaning the house and its surrounding, cleaning PV panel, and change the filters of heat pump. Furthermore, problems in electrical installation could appear and therefore repairing the electrical installation might also become part of activity. The risk analysis for the maintenance activities can be found in chapter 8.

14.2 Analyzing construction in Harbrinkhoek

Another important thing that can be useful for possible later works is the risk analysis process. The risk analysis process for assembly and disassembly of the house is done in several steps. The information is based on French Regulation, SDE Rules Book, and SDE General Coordination Plan for Safe and Healthy Protection.

Firstly, the breakdown activities are determined from the site operation. Which agents, machinery, and tools is used. Then, labour risks are classified for each activity. In addition, probability and severity level is also analyzed to determine which activities are the crucial ones.

To handle the risks, we determine the collective protection, PPE, signs, and prevention procedure for each activity. Since each activity contain different characteristic of work and hazard, it will have different safety measures. Another important step to measure the risk is the actual construction. This construction of the house took place at the Groothuis factory in Harbrinkhoek, Netherlands, starting from 14 April 2014.



During the assembly process, we were guided and trained by construction professional from Groothuis. In this way, student who will work in Versailles will have the hands-on experience on constructing the house prior to the competition. Trained employees from Groothuis also taught the students on how to use the hand tools properly and safely.

This analysis of the Harbrinkhoek construction shall be updated weekly until the construction is finished.

We try to learn from mistakes and bad practice during this construction in Harbrinkhoek. On the image below a powertool that is not being used is clearly visable. Power tools which are not being used should be placed in the designated storage. Power tools (and other objects) which lay on the ground can create tripping hazard for people who walk.



Complete PPE was not always worn by all the students and workers. For example, safety glasses are not always used by the students during the construction. Some people also took off their helmet during the breaks on site. According to the regulations, all PPE should be worn all time (hard hat, safety glass, construction uniform, safety boots, reflective jacket).

Working on heights is another risky activity in construction. Although scaffolding and fences were provided, sometimes situations occurred in which they were not used. By not using the right protection all the time additional risk is added. All these moments together in Harbrinkhoek resulted in a great learning process for all the students and other team members.

The use of power tools should also be done in a safe way. The example of an activity that needs to be avoided is the use of power tools while standing on the stairs. In La Cite Du Soleil, we will arrange platform ladders so that people can use it for working with power tools.

Another example is the fact that people are almost standing underneath the load. People close to the load could add more possible consequences to the risk of the load falling or tipping over. In Versailles, the panels should be guided by ropes in order to create distance between the load and the workers. Only after the panel is more stabilized and in its designated place the people can climb the scaffolding to help placing the panels

After the construction in Harbrinkhoek, the construction team evaluated all critical moments during construction. The meeting to discuss these findings were hold on 28 May 2014 on TU Delft and it was attended by students and workers. Together with the professionals from the companies, we tried to find solutions to reduce the risks.

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15 ADOPTED SYSTEM FOR THE LEVEL OF HEALTH AND SAFETY CONTROL DURING WORKS

The level of Health and Safety should be controlled during works, this shall be the responsibility of the HS Team Coordinator and the HS Officers. They shall keep visual on every constructual activity and make sure this happens accoding the SO and HS Plan. If not their it is their responsibility to change or halt the situation. Therefore the HS Plan should be on site at any time.

In case of an accident it should be analyzed with an incident report. The outcome of this report shall be a lesson for the entire team. To communicate this to the team is the responsibility of the HS Team Coordinator and/or the HS Officers.

15.1 Buddy System

During the construction activities, we concluded that some of the workers sometimes forget to use certain parts of their PPE. This behavior can lead to many consequences. Firstly, it causes more risk than necessary. Secondly, it is a violation with the health and safety regulation.

The “Buddy check system” is a procedure which the workers from Prêt-à-Loger follow during the assembly and disassembly in the Solar Decathlon competition. The aim of this procedure is to reduce the probability of not wearing parts of their PPE (personal protection equipment) during construction activities. This will ensure that the workers will comply to the regulations and minimize the risk of accidents.

Before entering the construction site, each worker has the obligation to check his equipment and then to check the equipment of his/her “buddy” partner. During construction activities, the buddy couples are also expected to actively remind his/her partner to always wear the PPE. By this “buddy check system”, it is expected that the risk of workers missing their PPE can be minimized. Checking everybody’s PPE is also one of the responsibilities of the HS Officers.

During the competition in La Cité du Soleil, the hot temperature and the load of work will increase the risk of dehydrating for people. Therefore, it is also necessary to remind each other to drink sufficient amount of water. The buddy couples will ensure that their couples will drink three liters of water during each shift.

Because our team does not work with the same set of people every day, the couples will change day by day. Also during the construction ‘buddies’ could be separated because of certain activities, in that case the HS officer might instruct to form new couples. Because of this dynamic nature of people working on site, the HS officer shall determine on forehand who will form couples and keep of track of any changes.

15.2 Expert System

Construction activities consist of numerous different activities which are highly. Each activity has its own installation requirements and technical complexity. It is almost impossible for one person to understand all of the installation in details. On the other hand, understanding the interdependency between construction activities is crucial. Therefore, to tackle the complexity of the construction activities, we implemented the "expert system".

The expert system involves a number of people who have been assigned specific construction activities. The following students have been highly involved in the installation of specific parts during the construction in Harbrinkhoek. They were trained to install these parts and gained sufficient knowledge on the installation activities. Therefore, they will be assigned as the "construction experts" for construction in Versailles.

Construction Experts	Field
Stefan	Plumbing / Ventilation
Jan	Plumbing / Ventilation
Bob	Solatubes
Matt	Solatubes
Gabrielle	Glasshouse
Jasper Spiegeler	Glasshouse
Jasper Overduin	PV Panels
Carolin	PV Panels
Vasilis	PV Panels
Matt	PV Panels
Arjan	Rainwinner
Rudger	Rainwinner
George	Sliding Doors

As an illustration, one of the students is assigned to be expert on the plumbing installation. Therefore, he is expected to have necessary knowledge this. The installation knowledge consists of the required tools and equipment for installation, the overall plumbing scheme, and critical points. Another important point is to be aware on how the plumbing might affect surrounding activities.

They are also responsible to ensure the transfer of knowledge and to become communicator between the professional workers and other student members. Furthermore, they can provide valuable input to the quality manager and site operator if there is problem during the installation.

The expected outcome is a more safe working environment in which workers know what they are doing. The expert system should avoid students participating in activities they do not have any knowledge of and thereby creating additional risk. The expert system is only applied on specific parts of the house, because every worker is already expert on the general parts.

15.3 HS Checklist system

To help the HS Officers do their tasks we made an HS checklist. This checklist contains only activities in which the HS Officer (and all team members) should pay extra attention. This checklist helps in making sure all required measures have been taken before starting an activity.

Task code	Task Name	H&S Risk	Prevention / Check List
EH01 - EH09	EXISTING HOUSE: Assembly Southwall groundfloor + support	Fall of objects because they come loose	working platform
	EXISTING HOUSE: mount chimneys on East and West wall	Fall of persons from different level	safety harness
	EXISTING HOUSE: coupling the water connection of the panels		
	EXISTING HOUSE: Removing of temporary support		
	EXISTING HOUSE: Placing the stairs		
	EXISTING HOUSE: Assembly interior walls ground-floor		
EH10- EH17	EXISTING HOUSE: Mounting feet for fences on floor panels	Fall of objects because they come loose	working platform
	EXISTING HOUSE: Placing floor panels first floor	Fall of persons from different level	safety harness
	EXISTING HOUSE: Placing fences around the first floor and cover staircase	Knocked by objects or tools	fences
	EXISTING HOUSE: Assembly Southwall firstfloor + support		
	EXISTING HOUSE: Mount chimneys on East and West wall		
EH19- EH35	EXISTING HOUSE: Placing side walls tips	Fall of objects because they come loose	working platform
	EXISTING HOUSE: Removing of temporary support	Fall of persons from different level	safety harness
	EXISTING HOUSE: placing the outside floors	Knocked by objects or tools	fences
	EXISTING HOUSE: Placing the roofbeam		
	EXISTING HOUSE: Placing the roofpanels		
	EXISTING HOUSE: placing the safety fences on the roof		
	EXISTING HOUSE: placing the Chimneys		
	EXISTING HOUSE: Filling of caps between panels		
	EXSITING HOUSE: placing of ceiling mediaroom		
	EXSITING HOUSE: placing of door and framing		
	EXISTING HOUSE: placement of the raingutters		
	EXISTING HOUSE: placement side walls greenhouse		
	EXISTING HOUSE: carpentry panel connections		
	EXISTING HOUSE: placing the plints		
	EXISTING HOUSE: placing of the windowsills		
	EXISITNG HOUSE: placing of the sliding doors		

GR01 - GR03	GREENROOF: placing and burning the Bitumen	Fall of persons from different level	safety harness
	GREENROOF: placing the sedum crates	Fire	fire extinguisher
	GREENROOF: placing the covers of the Solatubes		fences
GS01- GS08	GLASSHOUSE STEEL: setting up scaffolding	Fall of persons from different level	scaffolding
	GLASSHOUSE STEEL: getting the boomlift in place	Fall of objects because they come loose	boomlift
	GLASSHOUSE STEEL: placing and leveling the main coloms		safety harness
	GLASSHOUSE STEEL: placing façade truss		
	GLASSHOUSE STEEL: placing the roofbeam		
	GLASSHOUSE STEEL: placing the 4 connecting beams		
	GLASSHOUSE STEEL: placing the horizontal beams		
	GLASSHOUSE STEEL: complete the frontside		
GA01 - GA04	GLASSHOUSE ALU: placing top support and gutter	Fall of persons from different level	scaffolding
	GLASSHOUSE ALU: placing the front windowframing		boomlift
	GLASSHOUSE ALU: placing the top windowsframing		safet harness
	GLASSHOUSE ALU: placing the side connection and polycarbonaat		
GP01 - GP04	GLASSHOUSE PANELS: placing the power optimizers	Fall of persons from different level	Fences
	GLASSHOUSE PANELS: placing the PV panels	Exposure to electric connections	electrical work done by specialists
	GLASSHOUSE PANELS: connecting the PV panels		boomlift
	GLASSHOUSE PANELS: placing the windows (top- and frontside)		safety harness
EL05	ELECTRIC: connecting the PV panels with the house	Exposure to electric connections	electrical work done by specialists
PL10	PLUMBING: Place the energie panels	Exposure to harmful substances	Respiratory protection
PL11	PLUMBING: connecting energie panels	Fall of persons from different level	Fences

IN01-IN11	INTERIOR: Wall finishing first floor	Knocked by objects or tools	working platform
	INTERIOR: placement of the Sunshading		
	INTERIOR: placement of the Solatubes		
	INTERIOR: Wall finishing groundfloor		
	INTERIOR: Cleaning complete house for floors		
	INTERIOR: Flooring first floor		
	INTERIOR: Flooring ground floor		
	INTERIOR: installing Kitchen		

16 FORMATION AND INFORMATION ABOUT HEALTH AND SAFETY

16.1 Insurance

CERTIFICATE OF INSURANCE

This is to certify that we, Aon Risk Solutions, Insurance Brokers & Risk Consultants at Rotterdam, The Netherlands, have effected the following Liability Insurance.

Policy number	:	V0100036213
Policy holder	:	Technische Universiteit Delft.
Insured	:	Technische Universiteit Delft, and further as described in the policy conditions.
Limit of liability	:	EUR 6,000,000.00 any one claim, and with a maximum of EUR 12,000,000.00 in the aggregate Sublimit: EUR 500,000.00 any one claim for pure financial loss, with a maximum of EUR 1,000,000.00 in the aggregate
Territory	:	world wide, however excluding the USA and/or Canada

The current policy period expires October 1, 2014 with tacit renewal for 12 months, unless notice has been given by either party according to the policy conditions.

This certificate is subject to the terms, conditions, exclusions and limitations of policy number V0100036213 issued in the Dutch language and in the event of claims or disputes the policy wording will be binding.

Rotterdam, April 22, 2014

Aon Risk Solutions

16.2 Overview of students with specific training

Student	BHV	VCA	Boomlift	EHBO
A. Oosterhof	x	x (*)	x	
B. Bogers	x (*)	x	x	
C. Bellstedt			x	
D. IJsselstijn	x (*)			
G. De Leo			x	
G. Arimbi				x (*)
J . Portheine	x	x (*)	x	
J. Overduin	x		x	
J. Spiegeler	x (*)		x	
J. Kruizinga	x (*)			
M. Zarmpis			x	
O. Heinen	x			
P. Zhivkov		x (*)	x	x (*)
R. De Jong	x	x (*)	x	
S. Hoekstra	x (*)		x	
T. Jonathan	x (*)	x (*)		

* the certificate has not been presented to the team yet

BHV
Stands for 'Bedrijfshulpverlener' (in-house emergency response personnel).
This certificate is a First Aid degree that focusses on company settings mainly, construction sites are also part of these settings. The course contains 2 aspects: First Aid, and fire fighting and evacuation. To receive the BHV certificate the students had to successfully participate in both of those aspects.

VCA
Stands for 'Veiligheid, gezondheid en milieu Checklist Aannemers' (Safe, Healthy and Environment Checklist for Contractors)
This certificate contains safe working procedures in the construction area. The students followd the 'VCA Vol for supervisors' course. The site operators, HS officers, a quality controller and another student participated in this course to act more adequate as such in the construction area.

Boomlift
Certificate to operate 1B, 3A and 3B type of boomlifters. The course contained safe working procedures, maintenance, operating, stability and legislation.

EHBO
Stands for 'Eerste Hulp Bij Ongelukken' (First Aid for accidents).
This course was taken in English by two international students. It does not contain the fire fighting and evacuation aspects, but the First Aid aspect itself is much more intensive.

All certificates can be found in the appendix of the HS Plan.

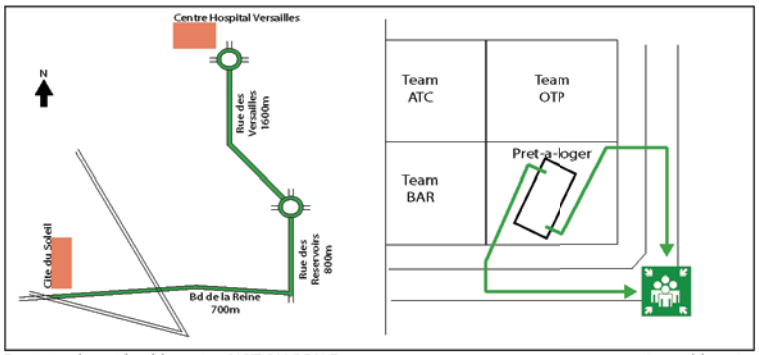
16.3 Overview of professionals with specific training

Company	Name	Position	Activities	Additional Licenses
Van Dorp	S. de Werk	Installer	Installing Demotica system	
Era Contour	R. Vermaire	Project manager	Supervising, construction	
Groothuis	K. Braakhuis	Carpenter	Placing of the panels/ house construction, boomlifting	VCA, Boomlift
	R. van den Noort	Carpenter	Placing of the panels/ house construction, boom and forklifting	VCA, Boomlift
	J. Busscher	Carpenter	Placing of the panels/ house construction, boomlifting	BHV, VCA, Boomlift
	D. Abbink	Carpenter	Placing of the panels/ house construction, boom and forklifting	VCA, Boomlift, Forklift
	H. ter Horst	Eletrical engineer	Installing PV Panels	VCA, electrical engineering degrees
	P. Hinnen	Electrician	Installing electrics	VCA
	G. Schuurink	Electrician	Installing electrics	VCA
	F. Asbroek	Supervisor	Supervising, construction	VCA
NL Green label	R. Frerix	Gardener	Creating the garden	
	M. Hissink	Gardener	Creating the garden	
	L. Grims	Gardener	Creating the garden	
	J. Simmelink	Gardener	Creating the garden	
	T. Krizan	Designer	Creating the garden	
Nobutec	H. Bloem	Construction worker	Constructing the steel and aluminum frame	
Putman	M.S. de Paauw	Installer	Installing installtions	
	S.A. van Schie	Installer	Installing installtions	
	P.G. van Schie	Installer	Installing installtions	
	T.D. de Waal	Installer	Installing installtions	
	T. Roorda	Installer	Installing installtions	

17 Emergency evacuation plan during the assembly and disassembly periods

All BHV certificated workers are trained in evacuation. A evacuation plan shall be made and the BHV team shall, at that time, function as the evacuation team. They shall:

- first of all do not put their own safety at risk
- be responsible for guiding all present people to the emergency assembly point.
- If necessary inform the emergency services
- extinguish starting fires
- wait for the emergency services and provide them with all info
- inform SDE14 organization
- apply first AID



Route to closest health center; NOT ON SCALE

Assembly point

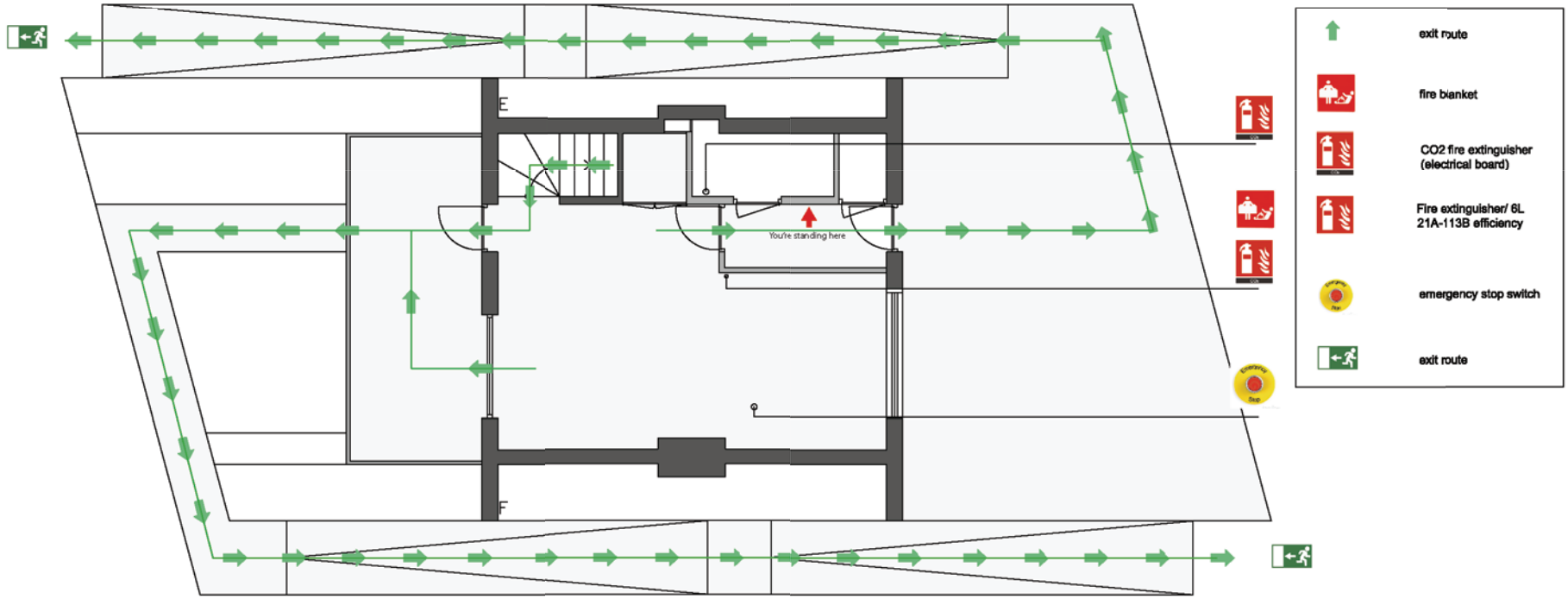
Procedures in case of fire:
ON DISCOVERY OR SUSPICION OF FIRE
- Operate the nearest fire alarm call point
- Dial 112; fire brigade
- Attack fire using available appliance
- Evacuate
- Proceed to the assembly point.

Assembly point:

Emergency numers France:

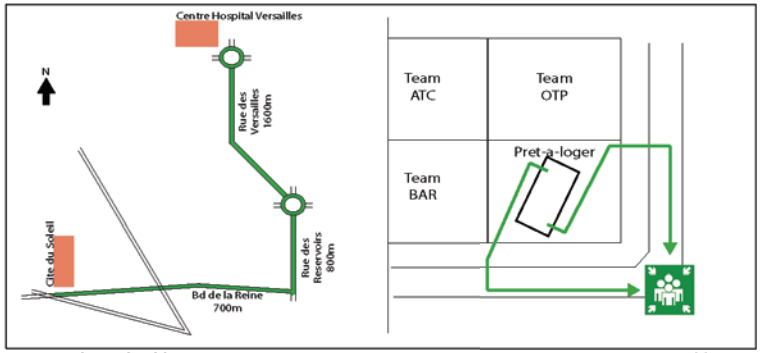
SOS - Fire brigade, police, ambulance	112
SOS - Fire brigade, police, ambulance (hearing assistence)	114
Emergency Shelter	115
Medical help/SAMU	15
Police/Police Nationale (Gendarmerie)	17
Fire & accident/Sapeurs Pompiers	18

Procedures & Emergency numbers



EVACUATION PLAN BG

A3



Route to closest health center; NOT ON SCALE

Assembly point

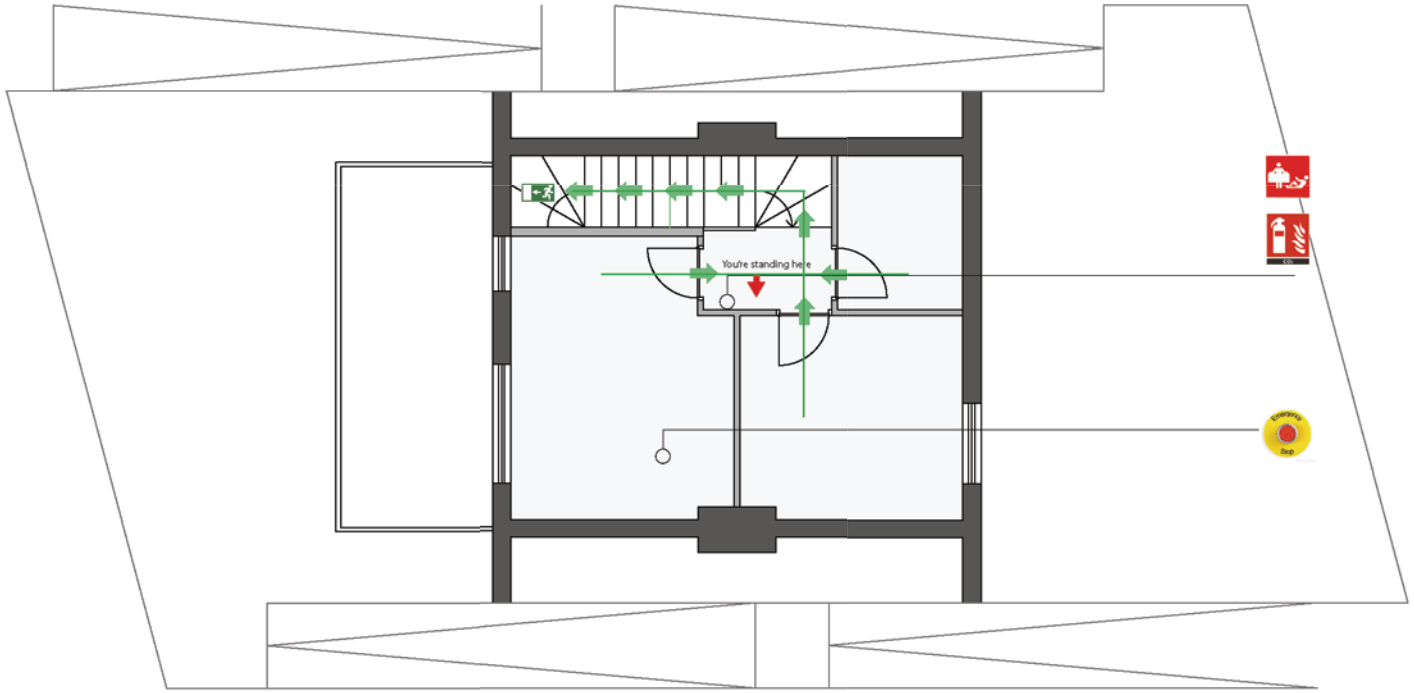
Procedures in case of fire:
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- Operate the nearest fire alarm call point
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- Attack fire using available appliance
- Evacuate
- Proceed to the assembly point.

Assembly point:

Emergency numers France:

SOS - Fire brigade, police, ambulance	112
SOS - Fire brigade, police, ambulance (hearing assistence)	114
Emergency Shelter	115
Medical help/SAMU	15
Police/Police Nationale (Gendarmerie)	17
Fire & accident/Sapeurs Pompiers	18

Procedures & Emergency numbers





EVACUATION PLAN +1

A3

18 Appendix HS: Specific Terms and Conditions

Table of content

1. Team statement: risk & Team statement: HS demands
2. Technical specifications: collective protection
3. Technical specifications: individual protection
4. Faculty advisor statement: medical checks
5. Faculty advisor statement: training
6. Contracted staff statement
    - Van Dorp
    - TBI Era Contour
    - Groothuis
    - NL Greenlabel
    - Nobutec
    - Putman Installaties

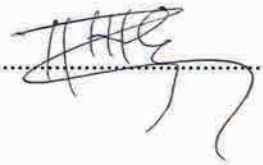
1. Statement to avoid or minimize risks

- Statement in which the Team commits itself to avoid or minimize the risks derived from work process.

1. The entire team has read the Health and Safety Plan: HS Drawings, HS Report and HS Specific Terms and Conditions
2. The entire team is briefed on the HS Plan
3.

Date: 24.04.2014 Name: Petar Zhivkov

HS Team Coordinator

Signature: 

Statement to envisage the HS demands

- Statement in which the Team commits itself to envisage the health and safety demands from all the people taking part in the project (decathletes, sub-contracted workers, etc.), and in which the Team declares to have considered those demands in the HS Plan.

Date: 24.04.2014 Name: Petar Zhivkov

HS Team Coordinator

Signature: 

18.2 Appendix HS: collective protection

CERTIFICAT DE CONFORMITÉ RELATIF AUX ÉQUIPEMENTS DE TRAVAIL ET MOYEN DE PROTECTION D'OCCASION

Le responsable de la location, soussigné :

Société Kiloutou - Services Techniques
Rue du Chemin Vert - CRT n°3 - 59818 Lesquin

Déclare que les équipements de travail d'occasion désignés ci-après sous la référence interne de la Société :

ESCPRO et ESC430

et désignés sous l'appellation constructeur :

Plate-forme individuelle roulante

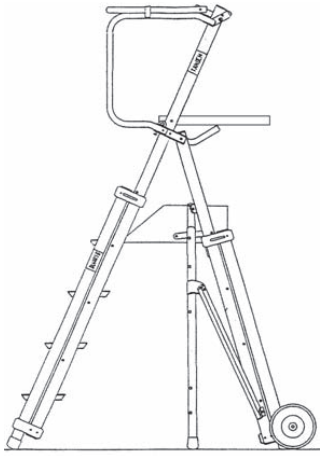
sont conformes à la norme NF P 93-352
Novembre1997 dite PIR

Fait à Lesquin, le 01 Janvier 2005.
P. Lescouffe
Responsable Service Etudes Techniques

Janvier 2007

FICHE CONSEILS

Escabeau alu
télescopique - 4 hauteurs



Kiloutou vous propose une gamme complète d'échafaudages roulants et d'échelles adaptée aux besoins de vos différents chantiers. Pour travailler en toute sécurité, des harnais anti-chute et des équipements de protection sont disponibles. Rendez-vous dans votre magasin Kiloutou le plus proche ou sur www.kiloutou.fr.

Les photos et indications ne sont pas contractuelles. Les données techniques peuvent être sujettes à de légères variations, en fonction des modèles d'appareils.

www.kiloutou.fr

www.kiloutou.fr

DONNÉES TECHNIQUES

	ESCPRO	ESC430
Hauteur Travail :	2,93 à 3,62 m	3,62 à 4,31 m
Poids :	24 kg	29 kg
Charge utile :	150 kg maxi.	
Dimensions Plate-forme :	0,40 x 0,50 m	
Dimensions Transport :	216 x 60 x 40 cm	292 x 60 x 40 cm

ACCESSOIRES FOURNIS

- Machine livrée sans accessoire séparé.

RÈGLES DE SÉCURITÉ

ATTENTION : Toujours s'assurer de la stabilité de l'escabeau avant d'accéder à la plate-forme.

ATTENTION : Les gardes corps doivent toujours être en place pendant le travail sur la plate-forme.

ATTENTION : Vérifiez le bon verrouillage des différents éléments de sécurité.

- Assurez-vous toujours du bon état de l'escabeau (plans, barreaux, verrouillages, garde-corps...). Remisez-le à plat dans un endroit sûr, à l'abri de tous risques de déteriorations, manipulez-le avec douceur.
- Veillez à ce que la zone d'installation de l'escabeau soit dégagée. Le sol doit être de niveau, suffisamment porteur pour éviter l'enfoncement des pieds et non glissant. Ne vous approchez pas de conducteurs électriques nus sous tension.
- L'escabeau doit reposer au sol sur ses quatre patins. Sur un terrain de mauvaise tenue, disposez impérativement une plaque d'appui en dessous de chaque patin.
- Ne jamais installer l'escabeau sur une voie de passage sans balisage adéquat, ou derrière une porte non condamnée.
- Mettez toujours en place les stabilisateurs avant d'accéder à la plate-forme.
- Les garde-corps doivent toujours être en place : 2 garde-corps latéraux, une lisse supérieure et une chainette de sécurité.
- Assurez-vous que toutes les sécurités et verrouillages sont correctement en place (4 verrous des éléments coulissants, billes des stabilisateurs, 2 verrous de garde-corps et crochet de la plate-forme).
- Les personnes fatiguées ou sujettes au vertige ne doivent pas monter sur l'escabeau.
- Portez une tenue vestimentaire adéquate, notamment des chaussures en bon état offrant un appui sûr, avec des semelles propres (pas de graisse, boue, ou autres matériaux glissants).
- Toujours monter et descendre face à l'échelle de l'escabeau.
- Ne jamais monter à plus d'une personne sur l'escabeau. De manière générale, ne pas surcharger l'échelle, respectez les charges maximales indiquées.
- Les pieds télescopiques avant et arrière doivent toujours être verrouillés au même niveau (4 hauteurs indexées sont possibles), et les stabilisateurs déployés au plus près du sol. La plate-forme doit toujours être horizontale.
- Lors des déplacements, la plate-forme doit être vidée de tout matériel et occupant.

NOTICE D'UTILISATION SIMPLIFIÉE

DÉPLOIEMENT DE L'ESCABEAU

1 Positionnez l'escabeau verticalement, puis ouvrez-le en vous positionnant devant ou sur le côté, en basculant la plate-forme jusqu'à son verrouillage (crochet sous la plate-forme).

2 Dépliez les stabilisateurs : appuyez sur la bille d'indexage (**rep.1**), puis faites coulisser le stabilisateur jusqu'à la position suivante.

3 Mise en place des garde-corps : relevez la lisse supérieure, dépliez les garde-corps puis verrouillez-les à l'aide des goupilles (**rep.2**). La lisse supérieure se cale sur les garde-corps grâce aux ergots (**rep.3**).

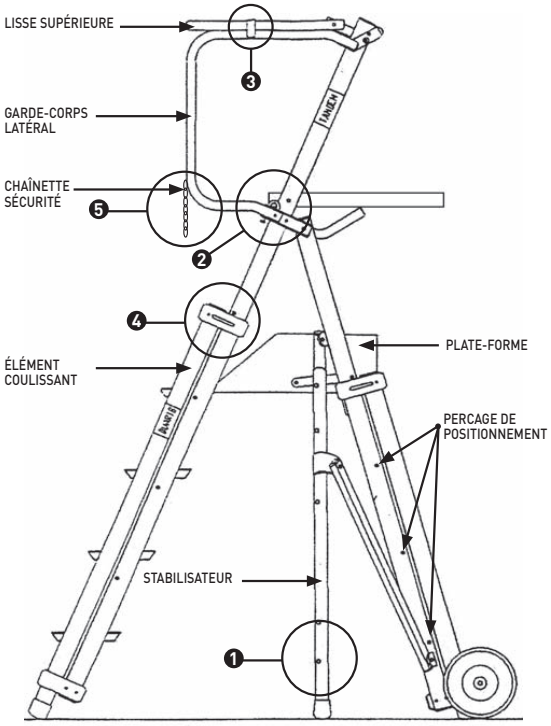
4 Ajustez la hauteur de l'escabeau :

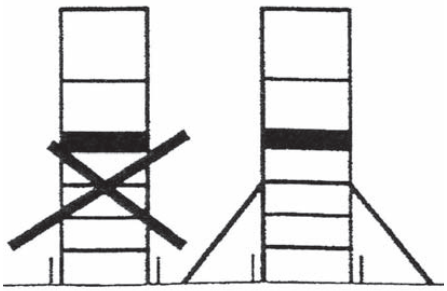
→ Déverrouillez l'élément coulissant de la face échelle en tirant sur les tiges des verrous situés sur chaque montant (**rep.4**).
→ Ajustez la hauteur (4 positions possibles), puis replacez les tiges des verrous (elles doivent bien se remettre dans les perçages de positionnement).
→ Reprenez les points précédents pour l'élément coulissant de l'autre face ; il doit être réglé à la même hauteur que précédemment.
→ Ajustez la hauteur des stabilisateurs et vérifiez leur bon verrouillage.

5 Accédez à la plate-forme puis fermez la chaînette de sécurité avec le crochet (**rep.5**). La lisse supérieure doit être également en position.

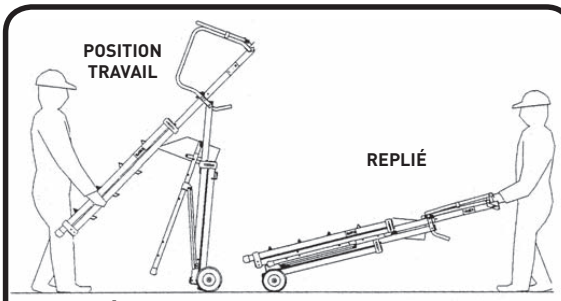
CONSEILS

- Pour le transport de l'escabeau, prévoyez suffisamment de place, le modèle ESCPRO fait 2,16 m de long et le modèle ESC430 fait 2,92 m.
- Si vous envisagez des travaux salissants avec l'escabeau (peinturee, plâtre, enduit...), veillez à le protéger, afin de ne pas avoir à régler les frais correspondant au nettoyage.
- Pour vos travaux de peinture, vous trouverez dans votre magasin Kiloutou les fournitures nécessaires à la protection de vos sols, mobiliers...





LES STABILISATEURS DOIVENT IMPÉRATIVEMENT ÊTRE DÉPLIÉS LORS DE L'UTILISATION



DÉPLACEMENTS DE L'ESCABEAU

CERTIFICAT DE CONFORMITÉ RELATIF AUX ÉQUIPEMENTS DE TRAVAIL ET MOYEN DE PROTECTION D'OCCASION

Le responsable de la location, soussigné :

Société Kiloutou - Services Techniques
Rue du Chemin Vert - CRT n°3 - 59818 Lesquin

Déclare que les équipements de travail d'occasion désignés ci-après sous la référence interne de la Société :

de ALU3EH à ALU7EH et de ALU03H à ALU12H

et désignés sous l'appellation constructeur :

Échafaudage aluminium roulant

sont conformes aux règles techniques applicables
de la norme NF EN 1004.

Fait à Lesquin, le 01 Mars 2007.
P. Lescouffe
Responsable Service Etudes Techniques

kiloutou
LOCATION DE MATERIEL

Avril 2007

FICHE CONSEILS

Échafaudage large ou étroit

tour aluminium 3 à 11 m



Kiloutou vous propose une gamme complète d'échafaudages roulants, adaptée aux besoins de vos différents chantiers. Pour travailler en toute sécurité, des harnais anti-chute et des équipements de protection sont disponibles. Rendez-vous dans votre magasin Kiloutou le plus proche ou sur www.kiloutou.fr.

Les photos et indications ne sont pas contractuelles. Les données techniques peuvent être sujettes à de légères variations, en fonction des modèles d'appareils.

www.kiloutou.fr

www.kiloutou.fr

kiloutou
LOCATION DE MATERIEL

DONNÉES TECHNIQUES

Hauteur de travail max : 6.80 m
Hauteur de plancher : 5.00 m
Matériau : Aluminium
Poids : 209.0 kg
Nombre de paliers : 2
Dimensions plateau : 2,4 X 0,6 m
Hauteur : 6.00 m
Longueur : 2.50 m
Largeur : 4.20 m

ACCESSOIRES FOURNIS

- Machine livrée sans accessoire séparé

CONSOMMABLES

- Filet vert 3 x 20 m, code 89200
- Gant manutention docker, code 20008
- Kit travail en hauteur avec LO, code 10032

RÈGLES DE SÉCURITÉ

ATTENTION : Le personnel chargé du montage et du démontage de l'échafaudage doit être formé à cette tâche. Ne jamais monter ou démonter l'appareil seul.

ATTENTION : Ne pas travailler sur l'échafaudage par vent supérieur à 25 km/h. Arrimez l'échafaudage à une structure fixe à partir de 37,5 km/h de vent.

ATTENTION : En cas de prévision de vent supérieur à 60 km/h, l'échafaudage doit être démonté.

- L'échafaudage doit être assemblé avec la totalité des éléments fournis pour la configuration requise. Ne pas utiliser d'autres éléments que ceux fournis. Ne pas modifier les éléments.
- Lors du montage et du démontage de l'échafaudage, si la protection collective des personnels n'est plus assurée, les dispositifs de protection individuelle deviennent obligatoires. L'accès à la zone de travail doit être interdit aux personnes non habilitées.
- L'échafaudage doit toujours être parfaitement horizontal.
- Les conditions climatiques ne doivent pas compromettre la sécurité des travailleurs.
- Les charges admissibles par l'échafaudage ne doivent pas être dépassées (charge répartie sur la structure et charge par paliers).
- Les garde-corps doivent toujours être en place, même si l'on travaille contre un mur. Ne jamais utiliser de rehaussement pour le travail sur le plateau (chaise, escabeau, échelle...).
- Lors de l'utilisation de l'échafaudage, les supports de roues doivent être verrouillés et les roues bloquées.
- Toujours accéder aux paliers par l'intérieur de l'échafaudage, jamais par l'extérieur. Les trappes d'accès doivent être systématiquement refermées après chaque passage. Rien ne doit entraver leur ouverture ou fermeture.
- L'échafaudage ne doit pas servir de support à des appareils de levage tels que palans, treuils, goulottes à matériaux...
- Ne pas s'approcher de conducteurs électriques volants ou non isolés.
- Ne pas utiliser de planches ou madriers pour l'accès aux paliers, ne pas faire de pont avec le bâtiment ou un autre échafaudage.
- Les stabilisateurs doivent toujours être en place, disposés en diagonale par rapport au rectangle de l'embase.
- Déplacez l'échafaudage manuellement à deux personnes, sur sol solide et de niveau (pente 3% maxi.), avec stabilisateurs déployés. L'échafaudage doit être vidé de son matériel et de ses occupants. Le trajet doit être exempt de tout obstacle au sol ou aérien.

noncontractual picture

The safety fences are made out of 3 types of elements:

1. Steel footings
2. Steel poles
3. Steel fences

The footings are screwed into the wooden panels, the poles are lowered into the footings. The fences themself are places upon the hooks attached to the poles. Fences are strapped together with tie rips.



Safety fence in use



Wearing a safety harness while installing the fencing





Footing connected to the floor

18.3 Appendix HS: individual protection

Noble S3 C

Certification and Information

CE

Oil / Gas	★★★★☆
Heat	★★★☆☆
Chemical	★★★☆☆
Abrasion	★★★★☆
Traction	★★★★★
Comfort	★★★☆☆
Non-marking	✔

Sizes

EU	35 to 48
UK	2 to 13
USA	3½ to 14
Width	EE

Leather Color

Black

Lace Color

Black / Grey







VIEW IN 3D

- Certified according to the CE EN ISO 20345 : 2011 S1 SRC standards
- Water resistant buffalo split leather
- PU/PU sole for comfort and light weight
- Heat resistant sole up to 200 degrees Celsius
- Oil resistant sole
- Antistatic inner and outer sole
- Energy absorption in the heel
- Slip resistance as per SRC standard
- Steel toe cap
- PU scuff nose
- EVA insole

Peltor veiligheidshelm G3000 met uv-indicator

De helm is voorzien van een unieke uv-indicator.

- Norm: EN 397 (-30°C MM)
- Materiaal: ABS
- Gewicht: 340 gram
- Binnenwerk: 4-punts met textiele draagbanden met of zonder draaiknop leverbaar
- Maat binnenwerk: van 54 t/m 62 cm
- Binnenwerk is omkeerbaar, hierdoor mag deze helm achterstevoren gedragen worden
- 6 ventilatie-openingen bovenin de helm
- Voorzien van kunstlederen absorptieband
- Voorzien van 30 mm slot voor het aanbrengen van oorkappen



PELTOR™

151949 Peltor veiligheidshelm G3000 Solaris met draaiknop

Leverbaar in de volgende kleuren: 200, 300, 400, 600, 700

My-T-Gear Spec 700-serie

- Materiaal lens: polycarbonaat
- Gewicht: 22 gram
- Kleur lens: transparant of grijs
- Kleur montuur: zilver
- Coatings: anti-kras en anti-fog
- Zachte neuspads
- Zachte veren
- Doos à 10 stuks



My-T-Gear® PERSONAL SAFETY

155441 Bril Spec 710, 2C-1,2 1 FT KN CE, anti-kras, anti-fog

4131

My-T-Gear Glovmech 560

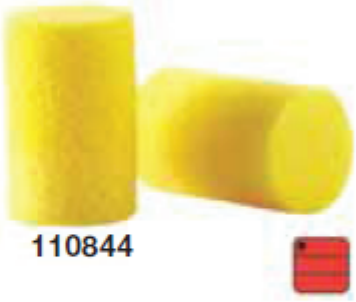
- Materiaal: naadloos gebreid synthetisch/PU
- Kleur: zwart
- Maten: 6 t/m 11
- Palmgecoat
- Met manchet
- Verpakt per 12 paar, 144 paar per overdoos



155076 Handschoen My-T-Gear Glovmech 560

3M EAR Classic

- Materiaal: geschuimd polymeer
- Past in vrijwel elk oorkanaal
- Vochtbestendig
- Geschikt om te dragen in combinatie met gehoorkappen
- Per paar verpakt in een plooidoosje
- Verpakking: dispenserbox à 250 paar/ met koord dispenserbox à 200 paar
- Demping: H=30, M=24, L=22, SNR=28



110844 Oorpluggen 3M Ear Classic



TRIFIC SOLID
POLOSWEATER

model	TRI4322631
kwaliteit	80/20% katoen/polyester
kenmerken	contrasterende knopenlijst en kraag • jeansknopen • verlengd rugpand • gewicht: 320 gr./m2



T'RIFFIC SOLID WORKER

model TRI2011651

kwaliteit 65/35% polyester/katoen

kenmerken 2 steekzakken met coinpocket
- multifunctionele zak op linkerdijbeen met klep
- achterzakken
- riemlussen
- hamerlus
- duimstokzak
- Cordura® kniezakken t.b.v. kniebeschermers
- gewicht: 245 gr./m2



T'RIFFIC SOLID POLOSHIRT K.M.

model TRI5102621

kwaliteit 70/30% katoen/polyester, washed, pique

kenmerken jeansknopen
- contrasterend knoopsgat
- verlengd rugpand
- gewicht: 220 gr./m2



IKAR HWPS Streel Rope Fall Arrest Block

IKAR HWPS Fall Arrest Block with a steelrope lifeline in a **plastic housing** to EN360:2002

This plastic housed fall arrest block is a sturdy, low maintenance device fitted with a steelrope, terminated with an aluminium double action hook. The attachment anchorage point on the fall arrest block is a cast aluminium swivel eye ø16mm, suitable for connection via a Standard Karabiner type connector, or a Standard Karabiner type connector with an Anchorage Sling.

The lifeline in this fall arrest block has been tested in a simulated fall over an edge and passed the German draft amendment EN360. However, not all "edges" will react in the same way as the tested steel edge, so when using this fall arrest block, every effort must be made to ensure that in the event of an arrested fall, the lifeline does not pass over an edge.

Description	Length	Price
HWPS3	3.0 Mtr	£125.55 each
HWPS4.5	4.5 Mtr	£151.00 each
HWPS6	6.0 Mtr	£184.95 each
HWPS9	9.0 Mtr	£257.10 each
HWPS12	12.0 Mtr	£291.00 each

PRODUCT CODE: HWPS6



Fall Arrest Block with a 6.0m steelrope lifeline in a plastic housing to EN360:2002.

This plastic housed fall arrest block is a sturdy, low maintenance device fitted with a steelrope, terminated with an aluminium double action hook. The attachment anchorage point on the fall arrest block is a cast aluminium swivel eye ø16mm, suitable for connection via a Standard Karabiner type connector, or a Standard Karabiner type connector with an Anchorage Sling.

The lifeline in this fall arrest block has been tested in a simulated fall over an edge and passed the German draft amendment EN360. However, not all "edges" will react in the same way as the tested steel edge, so when using this fall arrest block, every effort must be made to ensure that in the event of an arrested fall, the lifeline does not pass over an edge.

The dimensions of this block are: 420 x 145 x 80 mm.

The weight of the block is: 2.5 Kg.

Other lengths of this fall arrest block are available to special order, delivery lead time approximately 4 weeks.

It should be noted that this IKAR Fall Arrest Block is CE marked against EN360 under the PPE Directive and should be treated as such and NOT as lifting equipment.

Service and inspection requirements for this fall arrest block is that it should be inspected and function checked by a trained competent person on a regular basis as deemed by a risk assessment for the environment in which it is used and frequency of use, but at least every 6 months. Additionally, every 12 months it should be returned to IKAR GB, the UK's ONLY approved UK in-house facility, for a Full Service, when it will be tested under workshop conditions and re-certificated as laid down by the manufacturer IKAR GmbH.

IKAR GB can offer Training in both use and inspection of the fall arrest block. Please contact the IKAR GB Training TEAM.

Fall arrest blocks are also known as: IKAR blocks, fall arrest devices, fall arresters, inertia blocks, inertia reels, retractable type fall arresters, retractables, retractable lanyards, Sala blocks

PANOPLY JANUS06 FALL ARREST SAFETY HARNESS WITH HI VIZ VEST

Image	Description



Click to view larger Image.

PANOPLY JANUS06.High Visibility Vest and Fall Arrest Safety Harness. 2 Attachment PTS. Materials:polyester Straps. Jacket: Polyester cotton. Sizes: M,L. Colours: Fluorescent Yellow. 89/686/CEE EN471 2.2 EN361 VEST.

FALL ARREST SAFETY HARNESS

- 2 attachment points (rear - chest)
- 1 karabiner
- 4 Adjustment buckles
- Integrated high visibility vest in cotton polyester:
- 4 pockets in vest
- adjustable multi zip Hi Viz vest size (3 in 1)

18.4 Appendix HS: Team statements: medical checks

6 Medical Certificates

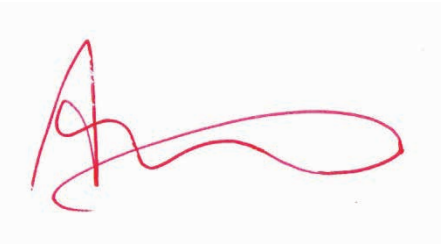
Hereby, the Prêt-à-Loger team of the Solar Decathlon states that all team members who will involve in the construction activities in La Cité du Soleil are in good health and medical conditions. All students are of legal age. Therefore, the following people will be able to do their jobs in accordance with French regulation. The medical certificates can be found in the Appendix.

No	First Name	Last Name
1	Angela	Greco
2	Arjan	Oosterhof
3	Bob	Bogers
4	Carolin	Bellstedt
5	Daniel	Radai
6	David	Jacome Polit
7	Dennis	IJsselstijn
8	Derek	van den Berg*
9	Eftichia	Zoidi*
10	Futura	Falco*
11	Gabriele	De Leo
12	George	Xexakis
13	Gini	Arimbi
14	Hardik	Joshi*
15	Jan	Portheine
16	Jasper	Overduin
17	Jasper	Spiegeler
18	Josien	Kruizinga
19	Jules	Gallisian
20	Laurence	Gibbons
21	Maarten	Bruinsma
22	Marina	Fragkopoulou
23	Matthaios	Zarmpis
24	Nick	Kerckhaert
25	Osama	Naji
26	Oswaldo	Heinen
27	Petar	Zhivkov
28	Rianne	Den Ouden
29	Rudger	De Jong*
30	Sergiu	Troian*
31	Stefan	Hoekstra*
32	Stelios	Stavroulakis
33	Tim	Jonathan
34	Todor	Kesarovski
35	Vasilis	Tzimitras

* certificates have not been presented to the team yet

Date: 30 May 2014 Name: Prof. Andy van den Dobbelsteen, PhD MSc
Faculty Advisor

Signature:



Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify

Mrs/Miss : Gini Arimbi
date of birth : 28-11-1989

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify,

Mr: J.O. Portheine
date of birth : 20-03-1992

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : G. Xexakis
date of birth : 12-08-1987

is not suffering from any contagious disease and
is in good physical and mental health.

R. Swarts, MD.

R. Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify,

Mr : V. Tzimitras
date of birth : 21-11-1987

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify,

Mr: S. Stavroulakis
date of birth : 12-10-1985

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify

Mr: T. Kesarovski
date of birth : 11-11-1987

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify,

Mrs: Carolin Bellstedt
date of birth : 11-06-1987

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : J. Kruizinga
date of birth : 18-02-1991

is not suffering from any contagious disease and
is in good physical and mental health.

R. Swarts, MD.

R.Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify

Mr/Mrs/Miss : Bob Bogers
date of birth : 07-09-1989

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : N. Kerckhaert
date of birth : 03-08-1989

is not suffering from any contagious disease and
is in good physical and mental health.

R. Swarts, MD.

R Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : A.J. Oosterhof
date of birth : 07-10-1989

is not suffering from any contagious disease and
is in good physical and mental health.

R. Swarts, MD.

R.Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify

Mr: M.C. Bruinsma
date of birth : 08-09-1989

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : Laurence Gibbons
date of birth : 19-02-1993

is not suffering from any contagious disease and
is in good physical and mental health.

R. Swarts, MD.

R.Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify,

Mr/Mrs/Miss : J.P. Overduin
date of birth : 07-07-1990

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify,

Mrs/Miss : A. Greco
date of birth : 28-12-1988

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : Osama Naji
date of birth : 03-03-1986

is not suffering from any contagious disease and
is in good physical and mental health.

R.Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

R. Swarts, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : Tim Jonathan
date of birth : 22-06-1989

is not suffering from any contagious disease and
is in good physical and mental health.

R. Swarts, MD.

R.Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify,

Mr/Mrs/Miss : D. IJsselstijn
date of birth : 25-05-1989

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : D. Radai
date of birth : 30-04-1989

is not suffering from any contagious disease and
is in good physical and mental health.

R. Swarts, MD.

R.Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : R.M. den Ouden
date of birth : 17-11-1989

is not suffering from any contagious disease and
is in good physical and mental health.

R. Swarts, MD.

R.Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

sgz
Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify,

Mr : Oswaldo Heinen
date of birth : 13-09-1983

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : J. Spiegeler
date of birth : 24-08-1991

is not suffering from any contagious disease and
is in good physical and mental health.

R. Swarts, MD.

R.Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : J.G.P. Gallissian
date of birth : 17-04-1993

is not suffering from any contagious disease and
is in good physical and mental health.

R. Swarts, MD.

R.Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 20 mei 2014

MEDICAL CERTIFICATE

This is to certify,

Mrs/Miss : M. Fragkopoulou
date of birth : 29-01-1988

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : Petar Zhivkov
date of birth : 27-02-1990

is not suffering from any contagious disease and
is in good physical and mental health.

R. Swarts, MD.
R.Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify,

Mr: David Jacome Polit
date of birth : 11-11-1978

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify,

Mr : Matthaios Zarmpis
date of birth : 31-01-1987

is not suffering from any contagious disease and
is in good physical and mental health.

W. van Donselaar, MD.

Studentengezondheidszorg
Beukenlaan 4G
2612 VC Delft tel.: 015-2121507

Delft, 19 mei 2014

MEDICAL CERTIFICATE

This is to certify, that

Mr/Mrs/Miss : Gabriele De Leo
date of birth : 01-11-1990

is not suffering from any contagious disease and
is in good physical and mental health.

R.Swarts, arts
Beukenlaan 4-G
2612 VC Delft
015-2121507

R. Swarts, MD.

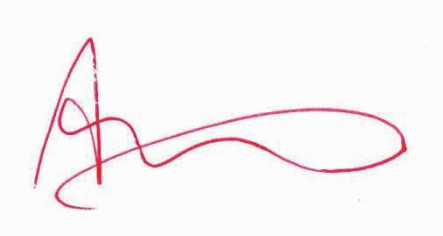
7 Specific Training

Hereby, the Prêt-à-Loger team of the Solar Decathlon states that all team members who will involve in the construction activities in La Cité du Soleil have been trained specifically for their task in constructing the designed house. The students were trained at the site of Groothuis Wonen B.V. by personnel of Groothuis Wonen B.V. The training contained usage of tools, usage of collective and personal protection equipment. Therefore, the following people will be able to do their jobs in accordance with French regulation.

No	First Name	Last Name
1	Angela	Greco
2	Arjan	Oosterhof
3	Bob	Bogers
4	Carolin	Bellstedt
5	Daniel	Radai
6	David	Jacome Polit
7	Dennis	IJsselstijn
8	Derek	van den Berg
9	Eftichia	Zoidi
10	Futura	Falco
11	Gabriele	De Leo
12	George	Xexakis
13	Gini	Arimbi
14	Hardik	Joshi
15	Jan	Portheine
16	Jasper	Overduin
17	Jasper	Spiegeler
18	Josien	Kruizinga
19	Jules	Gallisian
20	Laurence	Gibbons
21	Maarten	Bruinsma
22	Marina	Fragkopoulou
23	Matthaios	Zarmpis
24	Nick	Kerckhaert
25	Osama	Naji
26	Oswaldo	Heinen
27	Petar	Zhivkov
28	Rianne	Den Ouden
29	Rudger	De Jong
30	Sergiu	Troian
31	Stefan	Hoekstra
32	Stelios	Stavroulakis
33	Tim	Jonathan
34	Todor	Kesarovski
35	Vasilis	Tzimitras

Date: 30 May 2014 Name: Prof. Andy van den Dobbelsteen, PhD MSc
Faculty Advisor

Signature:



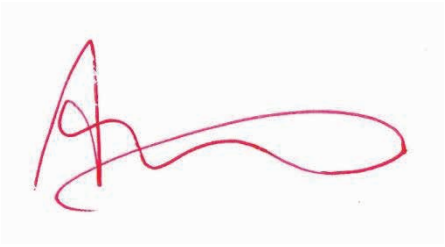
The following students attended special training and received certificates for the BHV, VCA, Boomlift and EHBO courses. These students attended these trainings in order to execute their work safe and correct. All the certificates can be found in the Appendix.

Student	BHV	VCA	Boomlift	EHBO
A. Oosterhof	x	x	x	
B. Bogers	x (*)	x	x	
C. Bellstedt			x	
D. IJsselstijn	x (*)			
G. De Leo			x	
G. Arimbi				x (*)
J . Portheine	x	x (*)	x	
J. Overduin	x		x	
J. Spiegeler	x (*)		x	
J. Kruizinga	x (*)			
M. Zarmpis			x	
O. Heinen	x			
P. Zhivkov		x	x	x (*)
R. De Jong	x	x	x	
S. Hoekstra	x (*)		x	
T. Jonathan	x (*)	x		

* certificates have not been presented to the team yet

BHV (BedrijfsHulpVerlener) = First AID (in-house emergency response personnel)
VCA (Veiligheid, gezondheid en milieu Checklist Aannemers) = Safe working procedures in construction (Safety, health and environment Checklist for Contractors)
EHBO (Eerste Hulp Bij Ongelukken) = First AID (First Aid for accidents)

Date: 30 May 2014 Name: Prof. Andy van den Dobbelsteen, PhD MSc
Faculty Advisor

Signature: 

Diploma
Basisopleiding Bedrijfshulpverlener

Het Nederlands Instituut voor Bedrijfshulpverlening verklaart dat

O. Heinen

met kandidaatnummer:	830913060
geboren op:	13 september 1983

heeft voldaan aan de eisen van het examenreglement Brandbestrijding en Ontruiming en Eerste Hulp van de Basisopleiding Bedrijfshulpverlener.

Afgiftedatum: 7 maart 2014

De diplomahouder

- voor geldigheidsduur z.o.z.

De directeur van het NIBHV

NIBHV
Nederlands Instituut voor Bedrijfshulpverlening

Diploma
Basisopleiding Bedrijfshulpverlener

Het Nederlands Instituut voor Bedrijfshulpverlening verklaart dat

R.A. de Jong

met kandidaatnummer: 900214022

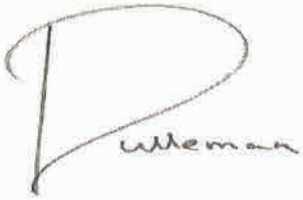
geboren op: 14 februari 1990

heeft voldaan aan de eisen van het examenreglement Brandbestrijding en Ontruiming en Eerste Hulp van de Basisopleiding Bedrijfshulpverlener.

Afgiftedatum: 7 maart 2014

De diplomahouder

De directeur van het NIBHV



NIBHV
Nederlands Instituut voor Bedrijfshulpverlening

- voor geldigheidsduur z.o.z.

Diploma
Basisopleiding Bedrijfshulpverlener

Het Nederlands Instituut voor Bedrijfshulpverlening verklaart dat

A.J. Oosterhof

met kandidaatnummer: 891007024

geboren op: 7 oktober 1989

heeft voldaan aan de eisen van het examenreglement Brandbestrijding en Ontruiming en Eerste Hulp van de Basisopleiding Bedrijfshulpverlener.

Afgiftedatum: 4 februari 2014

De diplomahouder

De directeur van het NIBHV

- voor geldigheidsduur z.o.z.

NIBHV
Nederlands Instituut voor Bedrijfshulpverlening

Diploma
Basisopleiding Bedrijfshulpverlener

Het Nederlands Instituut voor Bedrijfshulpverlening verklaart dat

J.P. Overduin

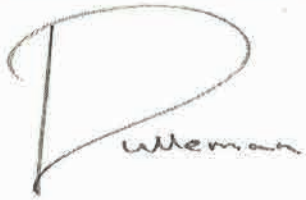
met kandidaatnummer: 900707029
geboren op: 7 juli 1990

heeft voldaan aan de eisen van het examenreglement Brandbestrijding en Ontruiming en Eerste Hulp van de Basisopleiding Bedrijfshulpverlener.

Afgiftedatum: 7 maart 2014

De diplomahouder

De directeur van het NIBHV



NIBHV
Nederlands Instituut voor Bedrijfshulpverlening

- voor geldigheidsduur z.o.z.

Diploma
Basisopleiding Bedrijfshulpverlener

Het Nederlands Instituut voor Bedrijfshulpverlening verklaart dat

J.O. Portheine

met kandidaatnummer: 920320021

geboren op: 20 maart 1992

heeft voldaan aan de eisen van het examenreglement Brandbestrijding en Ontruiming en Eerste Hulp van de Basisopleiding Bedrijfshulpverlener.

Afgiftedatum: 7 maart 2014

De diplomahouder

De directeur van het NIBHV

- voor geldigheidsduur z.o.z.

NIBHV
Nederlands Instituut voor Bedrijfshulpverlening


VOL VCA
Naam
B.A. Bogers
Geboortedatum
07-09-1989
Diplomanummer
9765302/2/NL/008692
www.saio.nl
If found return to Instituut CEC, Postbus 12, 3740 AA, Baarn
www.instituutcec.nl
Geldig tot 01-09-2021

VGM
CHECKLIST
AANNEMERS

Diploma

Safety for Operational Supervisors VCA
Veiligheid voor Operationeel Leidinggevenden VCA

Name/naam:	T.T. Jonathan
Date of birth/geboortedatum:	22-06-1989
Place of birth/geboorteplaats:	Arnhem
Date of issuance/datum uitgifte:	07-05-2014
Place of issuance/plaats van uitgifte:	Utrecht

On behalf of the examination center
Namens het Examencentrum VCA

Mevr. N.J. Heslinga

Graduate Holder
Gediplomeerde

T.T. Jonathan

The diploma is valid up to 10 years after date of issuance.
Het diploma is geldig tot 10 jaar na de datum van uitgifte.

351481.00069210

IBEX

This diploma is registered in the Dutch Central Diploma Register VCA.
Dit diploma is geregistreerd in het Nederlands Centraal Diploma Register VCA.

The examination was conducted in the following language:
Het examen is afgenomen in de volgende taal: Nederlands

The holder of this diploma has passed the examination which was composed by the VCA Examenbank on the basis of the attainment targets and testing targets as specified by the CCVD-VCA.
De houder van dit diploma heeft met goed gevolg het examen afgelegd dat is samengesteld door de VCA Examenbank aan de hand van de eind- en toetstermen die zijn vastgesteld door het CCVD-VCA.

The Stichting Examenkamer (Dutch Foundation) supervises the VCA exams and examinations.
De VCA examens zijn afgenomen onder toezicht van de Stichting Examenkamer.

Printed by Joh. Enschedé Amsterdam. In case of irregularities - at SSVV's sole judgement - SSVV has the right to declare this diploma null and void, to delete its registration from the Dutch Central Diploma Register VCA and to confiscate this document.

Volgnummer:0001084908

VGM
CHECKLIST
AANNEMERS

Diploma

Safety for Operational Supervisors VCA
Veiligheid voor Operationeel Leidinggevenden VCA

Name/naam:	R.A. de Jong
Date of birth/geboortedatum:	14-02-1990
Place of birth/geboorteplaats:	Heerenveen
Date of issuance/datum uitgifte:	07-05-2014
Place of issuance/plaats van uitgifte:	Utrecht

On behalf of the examination center
Namens het Examencentrum VCA

Mevr. N.J. Heslinga

Graduate Holder
Gediplomeerde

R.A. de Jong

The diploma is valid up to 10 years after date of issuance.
Het diploma is geldig tot 10 jaar na de datum van uitgifte.

351481.00069211

IBEX

This diploma is registered in the Dutch Central Diploma Register VCA.
Dit diploma is geregistreerd in het Nederlands Centraal Diploma Register VCA.

The examination was conducted in the following language:
Het examen is afgenomen in de volgende taal: Nederlands

The holder of this diploma has passed the examination which was composed by the VCA Examenbank on the basis of the attainment targets and testing targets as specified by the CCVD-VCA.
De houder van dit diploma heeft met goed gevolg het examen afgelegd dat is samengesteld door de VCA Examenbank aan de hand van de eind- en toetstermen die zijn vastgesteld door het CCVD-VCA.

The Stichting Examenkamer (Dutch Foundation) supervises the VCA exams and examinations.
De VCA examens zijn afgenomen onder toezicht van de Stichting Examenkamer.

Printed by Joh. Enschedé Amsterdam. In case of irregularities - at SSVV's sole judgement - SSVV has the right to declare this diploma null and void, to delete its registration from the Dutch Central Diploma Register VCA and to confiscate this document.

Volgnummer:0001084907

VGM
CHECKLIST
AANNEMERS

Diploma

Safety for Operational Supervisors VCA
Veiligheid voor Operationeel Leidinggevenden VCA

Name/naam:	A.J. Oosterhof
Date of birth/geboortedatum:	07-10-1989
Place of birth/geboorteplaats:	Leidschendam
Date of issuance/datum uitgifte:	07-05-2014
Place of issuance/plaats van uitgifte:	Utrecht

On behalf of the examination center
Namens het Examencentrum VCA

Mevr. N.J. Heslinga

Graduate Holder
Gediplomeerde

A.J. Oosterhof

The diploma is valid up to 10 years after date of issuance.
Het diploma is geldig tot 10 jaar na de datum van uitgifte.

351481.00069212

IBEX

This diploma is registered in the Dutch Central Diploma Register VCA.
Dit diploma is geregistreerd in het Nederlands Centraal Diploma Register VCA.

The examination was conducted in the following language:
Het examen is afgenomen in de volgende taal: Nederlands

The holder of this diploma has passed the examination which was composed by the VCA Examenbank on the basis of the attainment targets and testing targets as specified by the CCVD-VCA.
De houder van dit diploma heeft met goed gevolg het examen afgelegd dat is samengesteld door de VCA Examenbank aan de hand van de eind- en toetstermen die zijn vastgesteld door het CCVD-VCA.

The Stichting Examenkamer (Dutch Foundation) supervises the VCA exams and examinations.
De VCA examens zijn afgenomen onder toezicht van de Stichting Examenkamer.

Printed by Joh. Enschedé Amsterdam. In case of irregularities - at SSVV's sole judgement - SSVV has the right to declare this diploma null and void, to delete its registration from the Dutch Central Diploma Register VCA and to confiscate this document.

Volgnummer:0001084906

VGM
CHECKLIST
AANNEMERS

Diploma

Safety for Operational Supervisors VCA
Veiligheid voor Operationeel Leidinggevenden VCA

Name/naam:	P. Zhivkov
Date of birth/geboortedatum:	27-02-1990
Place of birth/geboorteplaats:	Sofia
Date of issuance/datum uitgifte:	07-05-2014
Place of issuance/plaats van uitgifte:	Utrecht

On behalf of the examination center
Namens het Examencentrum VCA

Mevr. N.J. Heslinga

Graduate Holder
Gediplomeerde

P. Zhivkov

The diploma is valid up to 10 years after date of issuance.
Het diploma is geldig tot 10 jaar na de datum van uitgifte.

351484.00069214

IBEX

This diploma is registered in the Dutch Central Diploma Register VCA.
Dit diploma is geregistreerd in het Nederlands Centraal Diploma Register VCA.

The examination was conducted in the following language:
Het examen is afgenomen in de volgende taal: Engels

The holder of this diploma has passed the examination which was composed by the VCA Examenbank on the basis of the attainment targets and testing targets as specified by the CCVD-VCA.
De houder van dit diploma heeft met goed gevolg het examen afgelegd dat is samengesteld door de VCA Examenbank aan de hand van de eind- en toetstermen die zijn vastgesteld door het CCVD-VCA.

The Stichting Examenkamer (Dutch Foundation) supervises the VCA exams and examinations.
De VCA examens zijn afgenomen onder toezicht van de Stichting Examenkamer.

Printed by Joh. Enschedé Amsterdam. In case of irregularities - at SSVV's sole judgement - SSVV has the right to declare this diploma null and void, to delete its registration from the Dutch Central Diploma Register VCA and to confiscate this document.

Volgnummer:0001084913

Certificaat



Name: C.H. Bellstedt

Date of Birth: 11-06-1987

Certificatenumber: 14.05.HW.031

Has attended the following course succesfully:

WORKING SAFE WITH A BOOMLIFT

This course took place on 26-05-2014

This certificate is valid for five years.

As proof that he/she attended abovementioned course.

The course contains the following subjects:

- Legislation
- The boomlift category 1B, 3A en 3B
- Stability with boomlifts
- Maintenance of boomlifts
- Safety

Albergen,

On behalf of BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Director

BRAND advies & veiligheidsopleidingen

BAVO opleidingen

Zenderseweg 36* | 7665 TM Albergen | info@bavo.nu | www.bavo.nu
Mob.: +31 (0)6 - 55390576 | Tel.: +31 (0)546 - 763408 | Fax: +31 (0)546 - 763407
Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat

Name: B.A. Bogers

Date of Birth: 07-09-1989

Certificatenumber: 14.05.HW.032

Has attended the following course succesfully:

WORKING SAFE WITH A BOOMLIFT

This course took place on 26-05-2014

This certificate is valid for five years.

As proof that he/she attended abovementioned course.

The course contains the following subjects:

- Legislation
- The boomlift category 1B, 3A en 3B
- Stability with boomlifts
- Maintenance of boomlifts
- Safety

Albergen,

On behalf of BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Director

BRAND advies & veiligheidsopleidingen

BAVO opleidingen

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Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat



Name: W.S. Hoekstra

Date of Birth: 04-05-1991

Certificatenumber: 14.05.HW.033

Has attended the following course succesfully:

WORKING SAFE WITH A BOOMLIFT

This course took place on 26-05-2014

This certificate is valid for five years.

As proof that he/she attended abovementioned course.

The course contains the following subjects:

- Legislation
- The boomlift category 1B, 3A en 3B
- Stability with boomlifts
- Maintenance of boomlifts
- Safety

Albergen,

On behalf of BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Director

BRAND advies & veiligheidsopleidingen

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Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat



Name: R.A. de Jong

Date of Birth: 14-04-1990

Certificatenumber: 14.05.HW.035

Has attended the following course succesfully:

WORKING SAFE WITH A BOOMLIFT

This course took place on 26-05-2014

This certificate is valid for five years.

As proof that he/she attended abovementioned course.

The course contains the following subjects:

- Legislation
- The boomlift category 1B, 3A en 3B
- Stability with boomlifts
- Maintenance of boomlifts
- Safety

Albergen,

On behalf of BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Director



BRAND advies & veiligheidsopleidingen

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Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat



Name: A.J. Oosterhof

Date of Birth: 07-10-1989

Certificatenumber: 14.05.HW.026

Has attended the following course succesfully:

WORKING SAFE WITH A BOOMLIFT

This course took place on 26-05-2014

This certificate is valid for five years.

As proof that he/she attended abovementioned course.

The course contains the following subjects:

- Legislation
- The boomlift category 1B, 3A en 3B
- Stability with boomlifts
- Maintenance of boomlifts
- Safety

Albergen,

On behalf of BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Director

BRAND advies & veiligheidsopleidingen

BAVO Opleidingen

Zenderseweg 36a | 7665 TM Albergen | info@bavo.nu | www.bavo.nu

Mob.: +31 (0)6 - 55390576 | Tel.: +31 (0)546 - 763408 | Fax: +31 (0)546 - 763407

Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat



Name: G. De Leo

Date of Birth: 01-11-1990

Certificatenumber: 14.05.HW.027

Has attended the following course succesfully:

WORKING SAFE WITH A BOOMLIFT

This course took place on 26-05-2014

This certificate is valid for five years.

As proof that he/she attended abovementioned course.

The course contains the following subjects:

- Legislation
- The boomlift category 1B, 3A en 3B
- Stability with boomlifts
- Maintenance of boomlifts
- Safety

Albergen,

On behalf of BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Director

BRAND advies & veiligheidsopleidingen

BAVO opleidingen

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Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat



Name: J.P. Overduin

Date of Birth: 07-07-1990

Certificatenumber: 14.05.HW.034

Has attended the following course succesfully:

WORKING SAFE WITH A BOOMLIFT

This course took place on 26-05-2014

This certificate is valid for five years.

As proof that he/she attended abovementioned course.

The course contains the following subjects:

- Legislation
- The boomlift category 1B, 3A en 3B
- Stability with boomlifts
- Maintenance of boomlifts
- Safety

Albergen,

On behalf of BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Director

BRAND advies & veiligheidsopleidingen

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Mob.: +31 (0)6 - 55390576 | Tel.: +31 (0)546 - 763408 | Fax: +31 (0)546 - 763407
Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat



Name: J. Spiegeler

Date of Birth: 24-08-1991

Certificatenumber: 14.05.HW.029

Has attended the following course succesfully:

WORKING SAFE WITH A BOOMLIFT

This course took place on 26-05-2014

This certificate is valid for five years.

As proof that he/she attended abovementioned course.

The course contains the following subjects:

- Legislation
- The boomlift category 1B, 3A en 3B
- Stability with boomlifts
- Maintenance of boomlifts
- Safety

Albergen,

On behalf of BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Director

BRAND advies & veiligheidsopleidingen

BAVO opleidingen

Zenderseweg 36a | 7665 TM Albergen | info@bavo.nu | www.bavo.nu
Mob.: +31 (0)6 - 55390576 | Tel.: +31 (0)546 - 763408 | Fax: +31 (0)546 - 763407
Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat



Name: J.O. Portheine

Date of Birth: 20-03-1992

Certificatenumber: 14.05.HW.030

Has attended the following course succesfully:

WORKING SAFE WITH A BOOMLIFT

This course took place on 26-05-2014

This certificate is valid for five years.

As proof that he/she attended abovementioned course.

The course contains the following subjects:

- Legislation
- The boomlift category 1B, 3A en 3B
- Stability with boomlifts
- Maintenance of boomlifts
- Safety

Albergen,

On behalf of BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Director

BRAND advies & veiligheidsopleidingen

BAVO opleidingen

Zenderseweg 36a | 7665 TM Albergen | info@bavo.nu | www.bavo.nu
Mob.: +31 (0)6 - 55390576 | Tel.: +31 (0)546 - 763408 | Fax: +31 (0)546 - 763407
Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat



Name: M. Zarmpis

Date of Birth: 31-01-1987

Certificatenumber: 14.05.HW.028

Has attended the following course succesfully:

WORKING SAFE WITH A BOOMLIFT

This course took place on 26-05-2014

This certificate is valid for five years.

As proof that he/she attended abovementioned course.

The course contains the following subjects:

- Legislation
- The boomlift category 1B, 3A en 3B
- Stability with boomlifts
- Maintenance of boomlifts
- Safety

Albergen,

On behalf of BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Director

BRAND advies & veiligheidsopleidingen

BAVO opleidingen

Zenderseweg 36ª | 7665 TM Albergen | info@bavo.nu | www.bavo.nu
Mob.: +31 (0)6 - 55390576 | Tel.: +31 (0)546 - 763408 | Fax: +31 (0)546 - 763407
Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat



Name: P.R. Zhivkov

Date of Birth: 27-02-1990

Certificatenumber: 14.05.HW.025

Has attended the following course succesfully:

WORKING SAFE WITH A BOOMLIFT

This course took place on 26-05-2014

This certificate is valid for five years.

As proof that he/she attended abovementioned course.

The course contains the following subjects:

- Legislation
- The boomlift category 1B, 3A en 3B
- Stability with boomlifts
- Maintenance of boomlifts
- Safety

Albergen,

On behalf of BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Director

BRAND advies & veiligheidsopleidingen

BAVO opleidingen

Zenderseweg 36ª | 7665 TM Albergen | info@bavo.nu | www.bavo.nu
Mob.: +31 (0)6 - 55390576 | Tel.: +31 (0)546 - 763408 | Fax: +31 (0)546 - 763407
Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

18.6 Appendix HS: Contracted staff

Contracted Staff TBI

Health and Safety
Hereby TBI promises its compliance to the Health & Safety Plan of Prêt-à-Loger. All employees of TBI that will be present at La Cité du Soleil shall follow the rules and procedures in this Health & Safety Plan and shall not deviate from it.

Medical condition
Hereby TBI states that all employees of TBI that will be present at La Cité du Soleil are in good health and medical conditions and will be able to do their jobs in accordance with the French regulations.

Licenses / certificates
Hereby TBI states that all employees of TBI that will be present at La Cité du Soleil are licensed for the work they will do on the building site.

Training
Hereby TBI states that all employees of TBI that will be present at La Cité du Soleil have fulfilled the proper trainings to do their work.

Personal Data employees
Employees of TBI that will be present at La Cité du Soleil are the following:

Full name	Signature	date
Reman Vermaire		12/05/14

Date: 12-05-2014 Name: Reman Vermaire

Function: project manager

Signature:

Contracted Staff Groothuis Wonen

Health and Safety
Hereby Groothuis Wonen promises its compliance to the Health & Safety Plan of Prêt-à-Loger. All employees of Groothuis Wonen that will be present at La Cité du Soleil shall follow the rules and procedures in this Health & Safety Plan and shall not deviate from it.

Medical condition
Hereby Groothuis Wonen promises all employees of Groothuis Wonen that will be present at La Cité du Soleil are in good health and medical conditions according to the France regulations.

licensees
Hereby Groothuis Wonen promises all employees of Groothuis Wonen that will be present at La Cité du Soleil are licensed for the work they will do on the building site.

Training
Hereby Groothuis Wonen promises all employees of Groothuis Wonen that will be present at La Cité du Soleil have fulfilled the proper trainings to do their work.

Personal Data employees
Employees of Groothuis Wonen that will be present at La Cité du Soleil and fullfill the necessities written above.

Full name	Signature	date
Franc. Asbroek		28.05
Jeroen Busscher		28-05.
Rik ter Horst		28.05
Peter Hinnen		28.05
Cedric Schuurink		28-05
Danny Abbink		28.05
Rony vd. Noord		28-05
Kjell Braakhuis		28-05

Hereby **Groothuis Wonen promises** its compliance to organisation of the Solar Decathlon Europe 2014 and of Prêt-à-Loger. All employees of Groothuis Wonen that will be present at La Cité du Soleil shall follow the rules, have been trained, are in good medical condition and shall not deviate from it.

Date: 28-Mai 2014 Name: Frans Asbroek

Function: Supervisor

Signature:

SONON

www.sonon.nl

Bedrijfshulpverlener incl. bediener AED

Naam: J.G.J. Busscher

Geboortedatum: 20-3-1974

Uitgiftedatum: 10-10-2013 **Pasnr.:** 011146

Werkgever: Groothuis Wonen

Deze pas is geldig tot 1 jaar na uitgiftedatum



Basis BHV
Coördinator BHV
BHV EHBO Reanimatie
Bedrijfsnoodplannen
Ploegleider BHV
Crisisman
RI&E Opleidingen BHV
BHV Ademluchtmaskerdrager

Basisveiligheid VCA

Naam : J.H.D. Abbink
Geboortedatum ; 21 maart 1985
Geboorteplaats: Almelo
Diplomanummer : 9644270/1/NL/639726
Examendatum : 13 maart 2006
Geldigheid 10 jaar

Koninklijke PBNA

VGM
CHECKLIST
AANNEMERS

Diploma

Basic Elements of Safety SCC
Basisveiligheid VCA

Name/naam:	J.H.D. Abbink
Date of birth/geboortedatum:	21 maart 1985
Place of birth/geboorteplaats:	Almelo
Date of issuance/datum uitgifte:	13 maart 2006
Place of issuance/plaats van uitgifte:	Zwijndrecht

On behalf of the examination centre
Namens het Examencentrum VCA
F.P. Hiddink

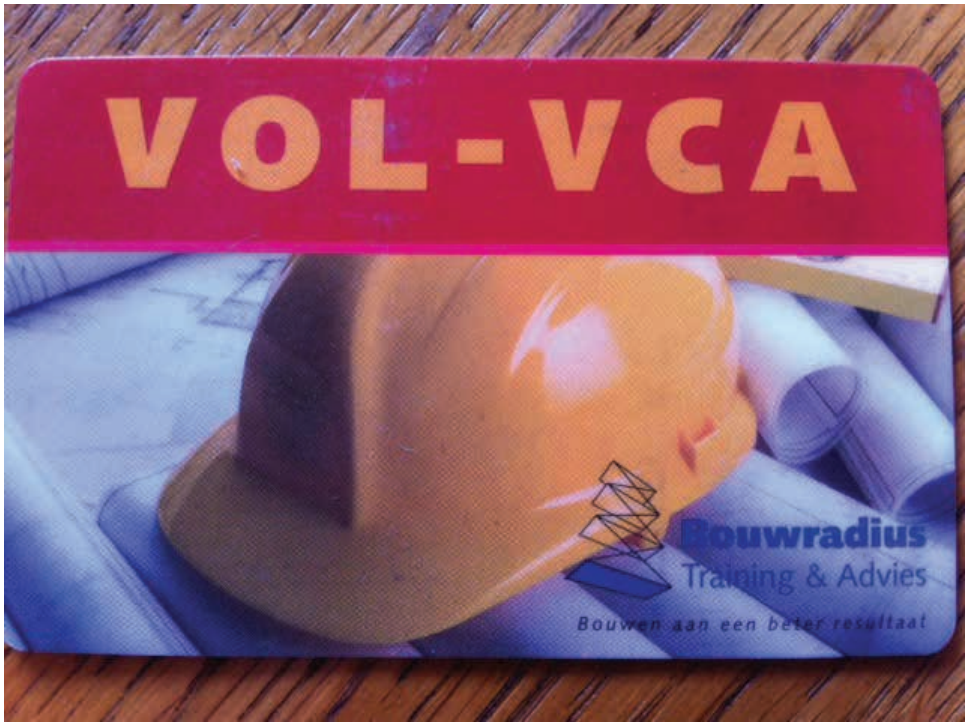
Graduate Holder
Gediplomeerde

The diploma is valid up to 10 years after date of issuance.
Het diploma is geldig tot 10 jaar na uitgifte.
9644270/1/NL/639726

Koninklijke PBNA
Postbus 68 3330 AB Zwijndrecht T (078) 62 53 889

The holder of this diploma has passed the examination which was composed by the SCC Examination Bank on the basis of the attainment targets and testing targets as specified by the CCE-SCC.
De houder van het diploma heeft met goed gevolg het examen afgelegd dat is samengesteld door de VCA Examenbank aan de hand van de eind- en toetstermen die zijn vastgesteld door het CCvd-VCA.

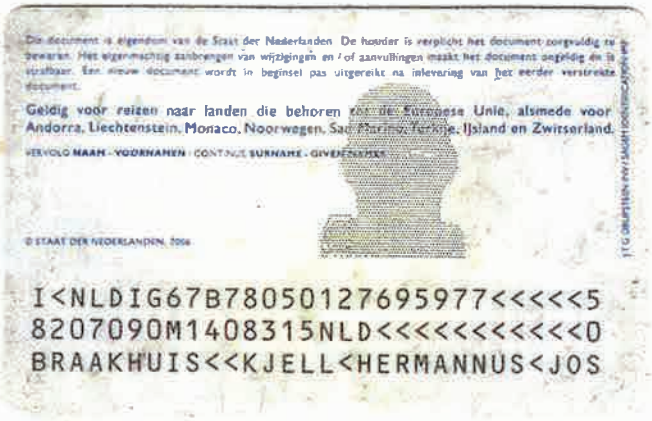
The Examination Chamber (Dutch Foundation) supervises the SCC/SCT exams and examination.
De VCA examens zijn afgenomen onder toezicht van de Stichting Examenkamer.


VOL-VCA
Bouwradius
Training & Advies
Bouwen aan een beter resultaat


Deze pas verwijst naar een door de SSVV erkend diploma
Certificaatnr.
338244.70015504
Voorletter(s) en naam
F.B.R Asbroek
Geboortedatum
04-06-1964
Geboorteplaats
Hengelo
Examendatum
20-11-2013
Geldig tot
20-11-2023
De eerlijke vinder wordt verzocht dit pasje te sturen naar
Bouwradius Training & Advies, Antwoordnummer 10185, 2700 VB Zoetermeer.


IDENTITEITSKAART
KONINKRIJK DER NEDERLANDEN
Nederlandse
IG6787805
Braakhuis
Kjell Hermannus Josephus
09 JUL/JUL 1982
Almelo
1,78 m
M
Burgemeester van Almelo
31 AUG/AUG 2009
31 AUG/AUG 2014


CERTIFICAAT
PLUS PORT
All you need to know.
Veiligheid voor operationeel leidinggevenden VCA
Naam: K.H.J. Braakhuis
Geboortedatum: 09-07-1982
Diplomanummer: 336899.00370717
Geboorteplaats: Almelo
Examendatum: 18-11-2013
Geldigheid 10 jaar zie www.vca.ssvv.nl
De vinder van deze pas wordt verzocht deze te sturen naar PlusPort B.V.
Gevers Deynootweg 61, 2586 BJ 's Gravenhage, Nederland


Geldig voor reizen naar landen die behoren tot de Europese Unie, alsmede voor Andorra, Liechtenstein, Monaco, Noorwegen, San Marino, Turkije, IJsland en Zwitserland.
I<NLDIG67B78050127695977<<<<<5
8207090M1408315NLD<<<<<<<<<<<0
BRAAKHUIS<<KJELL<HERMANNUS<JOS


Bekijk al onze trainingen op | www.plusport.com/trainingen

VGM
CHECKLIST
AANNEMERS

Diploma

Safety for Operational Supervisors VCA
Veiligheid voor Operationeel Leidinggevenden VCA

Name/naam:	J.G.J. Busscher
Date of birth/geboortedatum::	20-03-1974
Place of birth/geboorteplaats:	Tubbergen
Date of issuance/datum uitgifte:	20-09-2011
Place of issuance/plaats van uitgifte	Uden

On behalf of the examination center
Namens het Examencentrum VCA

F.M.J.A. van Heeswijk

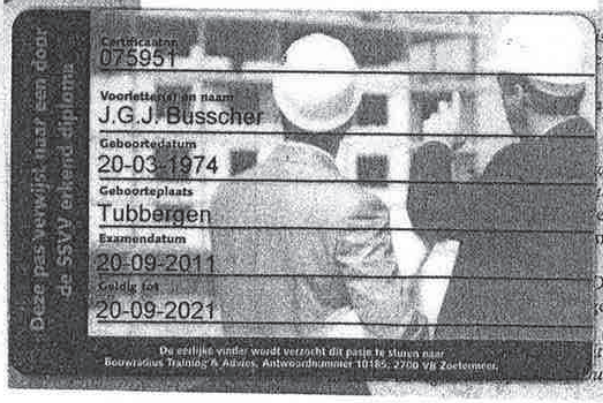
Graduate Holder
Gediplomeerde

J.G.J. Busscher

The diploma is valid up to 10 years after date of issuance.
Het diploma is geldig tot 10 jaar na de datum van uitgifte.

CHECK base

9644551/2/NL/075951



istered in the Dutch Central Diploma Register VCA.
erd in het Nederlands Centraal Diploma Register VCA.

anguage: Dutch/Nederlands

which was composed by the VCA Examenbank on the basis of the attainment targets and targets as specified by the CCVD-VCA.
examen afgelegd dat is samengesteld door de VCA Examenbank aan de hand van de men die zijn vastgesteld door het CCVD-VCA.

Dutch Foundation) supervises the VCA exams and examinations.
genomen onder toezicht van de Stichting Examenkamer.

ties - at SSVV's sole judgement - SSVV has the right to declare this diploma null and void, Dutch Central Diploma Register VCA and to confiscate this document.

technicum

V GM
C HECKLIST
A ANNEMERS

Diploma

Basic Elements of Safety SCC
Basisveiligheid VCA

Name/naam:	P. Hinnen
Date of birth/geboortedatum:	28-06-1971
Place of birth/geboorteplaats:	Almelo
Date of issuance/datum uitgifte:	16-08-2007
Place of issuance/plaats van uitgifte:	Zevenbergschen Hoek

On behalf of the examination centre
Namens het Examencentrum VCA
D.A. Havelaar

Graduate Holder
Gediplomeerde
P. Hinnen

The diploma is valid up to 10 years after date of issuance.
Het diploma is geldig tot 10 jaar na uitgifte.

9649325/1/NL/006377

NIKTA
Nederlands Instituut voor Kwaliteitszorg Training & Advies
Postbus 31, 4765 ZG Zevenbergschen Hoek
Tel. 0168 - 336990 Fax 0168 - 336006
Url: http://www.nikta.nl E-mail: advies@nikta.nl

The holder of this diploma has passed the examination which was composed by the SCC Examination Bank on the basis of the attainment targets and testing targets as specified by the CCE-SCC.
De houder van het diploma heeft met goed gevolg het examen afgelegd dat is samengesteld door de VCA Examenbank aan de hand van de eind- en toetstermen die zijn vastgesteld door het CCvD-VCA.

The Examination Chamber (Dutch Foundation) supervises the SCC/SCT exams and examinations.
De VCA examens zijn afgenomen onder toezicht van de Stichting Examenkamer.

VGM
CHECKLIST
AANNEMERS

Diploma

Safety for Operational Supervisors VCA
Veiligheid voor Operationeel Leidinggevenden VCA

Name/naam:	H. ter Horst
Date of birth/geboortedatum:	10-06-1972
Place of birth/geboorteplaats:	Gramsbergen
Date of issuance/datum uitgifte:	11-03-2013
Place of issuance/plaats van uitgifte:	Uden

On behalf of the examination center
Namens het Examencentrum VCA

F.M.J.A. van Heeswijk

Graduate Holder
Gediplomeerde

H. ter Horst

The diploma is valid up to 10 years after date of issuance.
Het diploma is geldig tot 10 jaar na de datum van uitgifte.

CHECK base

319602.70011657

This diploma is registered in the Dutch Central Diploma Register VCA.
Dit diploma is geregistreerd in het Nederlands Centraal Diploma Register VCA.

The examination was conducted in the following language:
Het examen is afgenomen in de volgende taal: Dutch/Nederlands

The holder of this diploma has passed the examination which was composed by the VCA Examenbank on the basis of the attainment targets and testing targets as specified by the CCVD-VCA.
De houder van dit diploma heeft met goed gevolg het examen afgelegd dat is samengesteld door de VCA Examenbank aan de hand van de eind- en toetstermen die zijn vastgesteld door het CCVD-VCA.

The Stichting Examenkamer (Dutch Foundation) supervises the VCA exams and examinations.
De VCA examens zijn afgenomen onder toezicht van de Stichting Examenkamer.

Volgnummer:0000883153

Corporate Express
731 38 13

Printed by Joh. Enschedé Amsterdam. In case of irregularities - at SSVV's sole judgement - SSVV has the right to declare this diploma null and void,

V GM
C HECKLIST
A ANNEMERS

Diploma

Basic Elements of Safety VCA
Basisveiligheid VCA

Name/naam:	R. van den Noort
Date of birth/geboortedatum:	03-07-1991
Place of birth/geboorteplaats:	Rijssen
Date of issuance/datum uitgifte:	06-04-2011
Place of issuance/plaats van uitgifte:	Maarn

On behalf of the examination center
Namens het Examencentrum VCA

Mevr. M.C.J.L. Versteegt-Siebes

Graduate Holder
Gediplomeerde

R. van den Noort

The diploma is valid up to 10 years after date of issuance.
Het diploma is geldig tot 10 jaar na de datum van uitgifte.

9649328/1/NL/013380

IBEX

This diploma is registered in the Dutch Central Diploma Register VCA.
Dit diploma is geregistreerd in het Nederlands Centraal Diploma Register VCA.

The examination was conducted in the following language: Dutch/Nederlands
Het examen is afgenomen in de volgende taal:

The holder of this diploma has passed the examination which was composed by the VCA Examenbank on the basis of the attainment targets and testing targets as specified by the CCVD-VCA.
De houder van dit diploma heeft met goed gevolg het examen afgelegd dat is samengesteld door de VCA Examenbank aan de hand van de eind- en toetstermen die zijn vastgesteld door het CCVD-VCA.

The Stichting Examenkamer (Dutch Foundation) supervises the VCA exams and examinations.
De VCA examens zijn afgenomen onder toezicht van de Stichting Examenkamer.

Printed by Joh. Enschedé Amsterdam. In case of irregularities - at SSVV's sole judgement - SSVV has the right to declare this diploma null and void, to delete its registration from the Dutch Central Diploma Register VCA and to confiscate this document.

technicum

VGM
CHECKLIST
AANNEMERS

Diploma

Safety for Operational Supervisors VCA
Veiligheid voor Operationeel Leidinggevenden VCA

Name/naam:	G.H. Schuurink
Date of birth/geboortedatum:	09/10/1966
Place of birth/geboorteplaats:	Enschede
Date of issuance/datum van uitgifte:	26/04/2011
Place of issuance/plaats van uitgifte:	Rotterdam

On behalf of the examination center
Namens het Examencentrum VCA
J.W.J.G. Ouwehand

Graduate Holder
Gediplomeerde
G.H. Schuurink

The diploma is valid up to 10 years after date of issuance.
Het diploma is geldig tot 10 jaar na de datum van uitgifte.

9644566/2/NL/034044

NIBHV
Nederlands Instituut voor Bedrijfshulpverlening

This diploma is registered in the Dutch Central Diploma Register VCA.
Dit diploma is geregistreerd in het Nederlands Centraal Diploma Register VCA.

The examination was conducted in the following language:
Het examen is afgenomen in de volgende taal: Dutch/Nederlands

The holder of this diploma has passed the examination which was composed by the VCA Examenbank on the basis of the attainment targets and testing targets as specified by the CCVD-VCA.
De houder van dit diploma heeft met goed gevolg het examen afgelegd dat is samengesteld door de VCA Examenbank aan de hand van de eind- en toetstermen die zijn vastgesteld door het CCVD-VCA.

The Stichting Examenkamer (Dutch Foundation) supervises the VCA exams and examinations.
De VCA examens zijn afgenomen onder toezicht van de Stichting Examenkamer.

Certificaat

Naam: D.J.H. Abbink

Geboren: 21-03-1985

Certificaatnummer: 14.05.HW.024

Heeft met goed gevolg deelgenomen aan de cursus:

VEILIG WERKEN MET DE HOOGWERKER

Deze opleiding heeft plaatsgevonden op 26-05-2014

Dit certificaat is geldig voor een periode van 5 jaar.

Als bewijs dat hij/zij heeft deelgenomen aan bovengenoemde cursus.

De cursus omvat de volgende onderdelen:

- Wetgeving
- De hoogwerker categorie 1B, 3A en 3B
- Stabiliteit en de hoogwerker
- Onderhoud en de hoogwerker
- Veiligheid

Albergen,

Namens BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Directeur

BRAND advies & veiligheidsopleidingen

BAVO opleidingen

Zenderseweg 36* | 7665 TM Albergen | info@bavo.nu | www.bavo.nu
Mob.: +31 (0)6 - 55390576 | Tel.: +31 (0)546 - 763408 | Fax: +31 (0)546 - 763407
Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat

Naam: K.H.J. Braakhuis

Geboren: 09-07-1982

Certificaatnummer: 14.05.HW.021

Heeft met goed gevolg deelgenomen aan de cursus:

VEILIG WERKEN MET DE HOOGWERKER

Deze opleiding heeft plaatsgevonden op 26-05-2014

Dit certificaat is geldig voor een periode van 5 jaar.

Als bewijs dat hij/zij heeft deelgenomen aan bovengenoemde cursus.

De cursus omvat de volgende onderdelen:

- Wetgeving
- De hoogwerker categorie 1B, 3A en 3B
- Stabiliteit en de hoogwerker
- Onderhoud en de hoogwerker
- Veiligheid

Albergen,

Namens BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Directeur

BAVO opleidingen

Zenderseweg 36* | 7665 TM Albergen | info@bavo.nu | www.bavo.nu
Mob.: +31 (0)6 - 55390576 | Tel.: +31 (0)546 - 763408 | Fax: +31 (0)546 - 763407
Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat

Naam: J.G.J. Busscher

Geboren: 20-03-1974

Certificaatnummer: 14.05.HW.023

Heeft met goed gevolg deelgenomen aan de cursus:

VEILIG WERKEN MET DE HOOGWERKER

Deze opleiding heeft plaatsgevonden op 26-05-2014

Dit certificaat is geldig voor een periode van 5 jaar.

Als bewijs dat hij/zij heeft deelgenomen aan bovengenoemde cursus.

De cursus omvat de volgende onderdelen:

- Wetgeving
- De hoogwerker categorie 1B, 3A en 3B
- Stabiliteit en de hoogwerker
- Onderhoud en de hoogwerker
- Veiligheid

Albergen,

Namens BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Directeur

BAVO Opleidingen

Zenderseweg 36* | 7665 TM Albergen | info@bavo.nu | www.bavo.nu

Mob.: +31 (0)6 - 55390576 | Tel.: +31 (0)546 - 763408 | Fax: +31 (0)546 - 763407

Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

Certificaat

Naam: R. van den Noort

Geboren: 03-07-1991

Certificaatnummer: 14.05.HW.022

Heeft met goed gevolg deelgenomen aan de cursus:

VEILIG WERKEN MET DE HOOGWERKER

Deze opleiding heeft plaatsgevonden op 26-05-2014

Dit certificaat is geldig voor een periode van 5 jaar.

Als bewijs dat hij/zij heeft deelgenomen aan bovengenoemde cursus.

De cursus omvat de volgende onderdelen:

- Wetgeving
- De hoogwerker categorie 1B, 3A en 3B
- Stabiliteit en de hoogwerker
- Onderhoud en de hoogwerker
- Veiligheid

Albergen,

Namens BAVO Opleidingen Albergen

Dhr. H.F.M. Brand
Directeur

BAVO opleidingen

Zenderseweg 36° | 7665 TM Albergen | info@bavo.nu | www.bavo.nu
Mob.: +31 (0)6 - 55390576 | Tel.: +31 (0)546 - 763408 | Fax: +31 (0)546 - 763407
Op uw verzoek sturen wij u een exemplaar van onze algemene voorwaarden toe.

LEUS OPLEIDINGEN

Certificaat

Heftruck-Reachtruck

Leus Opleidingen verklaart dat Dhr. J.H.D. Abbink

Geboren 21-03-1985

Met goed gevolg heeft deelgenomen aan de Veiligheidstraining Heftruck-Reachtruck conform de richtlijnen van de Arbeidsomstandigheden wet Heftruck-Reachtruck

Gehouden d.d. maandag 13 februari 2012

ten bewijze daarvan zij de deelnemer uitgereikt dit **CERTIFICAAT**

Almelo

Theorie

Praktijk

Advies: appplicatie

voor

Certificaatnummer 00.007.878

Namens de directie van Leus Opleidingen

Leus Opleidingen

Baniersweg 41
7603 NA ALMELO
tel: 0546-861238

website www.leus.nl
email info@leus.nl

ARBO & VEILIGHEID



CERTIFICAAT

ARBO & VEILIGHEID

Heftruck – Reachtruck bestuurder

Naam: J.H.D. Abbink
Geb. datum: 21-3-1985
BSN: 190366357
Advies applicatie voor: 13-02-2017_

LEUS OPLEIDINGEN

Baniersweg 41
7603 NA Almelo
The Netherlands
www.leus.nl

NEDERLANDSE IDENTITEITSKAART

KONINKRIJK DER NEDERLANDEN

Nederlandse
IV22PC8R9
Abbink
Johan Herman Danny
21 MAA/MAR 1985
Almelo
1,86 m M 190366357
Burgemeester van Twenterand
20 AUG/AUG 2009 20 AUG/AUG 2014
D Abbink



CERTIFICAAT

ARBO & VEILIGHEID

Heftruck – Reachtruck bestuurder

Naam: J.H.D. Abbink
Geb. datum: 21-3-1985
BSN: 190366357
Advies applicatie voor: 13-02-2017_

LEUS OPLEIDINGEN

Baniersweg 41
7603 NA Almelo
The Netherlands
www.leus.nl

NEDERLANDSE IDENTITEITSKAART

KONINKRIJK DER NEDERLANDEN

Nederlandse
IV22PC8R9
Abbink
Johan Herman Danny
21 MAA/MAR 1985
Almelo
1,86 m M 190366357
Burgemeester van Twenterand
20 AUG/AUG 2009 20 AUG/AUG 2014
D Abbink

MORGENLAND COLLEGE
CHRISTELIJK BEROEPSONDERWIJS

HOOGEVEEN
HARDENBERG

MIDDELBAAR
TECHNISCH ONDERWIJS

DIPLOMA

DE EXAMENCOMMISSIE VAN DE M.B.O.-SECTOR TECHNIEK
BELAST MET HET AFNEMEN VAN HET EINDEXAMEN VAN DE AFDELING

ELEKTROTECHNIEK
STUDIERICHTING ENERGIETECHNIEK

VERKLAART DAT ~ Henderikus ter Horst ~

GEBOREN 10 juni 1972 TE Ermsbergen

IN HET JAAR 1994 DIT EINDEXAMEN, AFGENOMEN VOLGENS DE VOORSCHRIFTEN KRACHTENS ARTIKEL 29 VAN DE WET OP HET VOORTGEZET ONDERWIJS, MET GUNSTIG GEVOLG HEEFT AFGELEGD.

HOOGEVEEN, 14 JULI 1994

DE GECOMMITTEERDEN:

, VOORZITTER

DE EXAMENCOMMISSIE:

, VOORZITTER

, SECRETARIS

Diploma

BEROEPSONDERWIJS

Kwalificatie **Technicus Sterkstroominstallaties (TSI)**

code centraal register **10238** niveau **4S** leerweg **BBL**

Landelijk orgaan **Kenteq**

De ondergetekenden verklaren dat

ROC Oost-Nederland

Henderikus ter Horst

geboren **10 juni 1972** te **De Krim**

aan **ROC Oost-Nederland, school voor Technologie** te **Hengelo**

het examen, afgenomen volgens de voorschriften gegeven bij en krachtens artikel 7.4.6 van de Wet Educatie Beroepsonderwijs, met goed gevolg heeft afgelegd en dat de kandidaat examen heeft afgelegd in de **drie** aan ommezijde vermelde examenonderdelen.

Plaats: **Hengelo** Datum: **6 juni 2003**

De secretaris van het examen: Namens het College van Bestuur:

Handtekening van de kandidaat:

Doorhalingen en/of wijzigingen maken dit diploma ongeldig.

Certificaat

De heer H. ter Horst

geboren: 10-06-1972 te: Gramsbergen

heeft de cursus

NEN 1010:2007 + C1:2008

met positief resultaat afgesloten,
ten bewijze waarvan dit certificaat is uitgereikt.

Hengelo, d.d. 18 juni 2011



H.J.L.M. de Haas
Directeur
STODT Bedrijfsopleidingen

STODT
TOEKOMSTTECHNIEK

Certificaat

De heer H. ter Horst

geboren: 10-06-1972 te: Gramsbergen

heeft de cursus

NEN 3140:2011

met positief resultaat afgesloten,
ten bewijze waarvan dit certificaat is uitgereikt.

Hengelo, d.d. 18 juni 2011

H.J.L.M. de Haas
Directeur
STODT Bedrijfsopleidingen

STODT
TOEKOMSTTECHNIEK

Contracted Staff NL Greenlabel

Health and Safety
Hereby NL Greenlabel promises its compliance to the Health & Safety Plan of Prêt-à-Loger. All employees of NL Greenlabel that will be present at La Cité du Soleil shall follow the rules and procedures in this Health & Safety Plan and shall not deviate from it.

Medical condition
Hereby NL Greenlabel states that all employees of NL Greenlabel that will be present at La Cité du Soleil are in good health and medical conditions and will be able to do their jobs in accordance with the French regulations.

Licenses / certificates
Hereby NL Greenlabel states that all employees of NL Greenlabel that will be present at La Cité du Soleil are licensed for the work they will do on the building site.

Training
Hereby NL Greenlabel states that all employees of NL Greenlabel that will be present at La Cité du Soleil have fulfilled the proper trainings to do their work.

Personal Data employees
Employees of NL Greenlabel that will be present at La Cité du Soleil are the following:

Full name	Signature	date
Rutger Frerix		14-5-14
Michiel Hissink		14-5-14
Lars Grims		14-5-14
Tomáš Křižan		15-5-14
Jurgen Sinnelink		28-5-14

Date: 15 mei 2014 Name: M.W.M. Wissink

Function: DCM

Signature:

Contracted Staff Nobutec B.V.

Health and Safety
Hereby Nobutec B.V. promises its compliance to the Health & Safety Plan of Prêt-à-Loger. All employees of Nobutec B.V. that will be present at La Cité du Soleil shall follow the rules and procedures in this Health & Safety Plan and shall not deviate from it.

Medical condition
Hereby Nobutec B.V. states that all employees of Nobutec B.V. that will be present at La Cité du Soleil are in good health and medical conditions and will be able to do their jobs in accordance with the French regulations.

Licenses / certificates
Hereby Nobutec B.V. states that all employees of Nobutec B.V. that will be present at La Cité du Soleil are licensed for the work they will do on the building site.

Training
Hereby Nobutec B.V. states that all employees of Nobutec B.V. that will be present at La Cité du Soleil have fulfilled the proper trainings to do their work.

Personal Data employees
Employees of Nobutec B.V. that will be present at La Cité du Soleil are the following:

Full name	Signature	date
HENRI W. BLOEM		25/4/14

Date: 25/4/14 Name: A.R. NOORDAD

Function: DIRECTOR

Signature:

putman | INSTALLATIES BV
ONDERHOUDSDIENSTEN BV

LUCHT
WARMTE
KOELING
SANITAIR
ZWEMBADTECHNIEK
WARMTEKRACHTINSTALLATIES

Contracted Staff Putman Installaties B.V.

Health and Safety
Hereby Putman Installaties B.V. promises its compliance to the Health & Safety Plan of Prêt-à-Loger. All employees of Putman Installaties B.V. that will be present at La Cité du Soleil shall follow the rules and procedures in this Health & Safety Plan and shall not deviate from it.

Medical condition
Hereby Putman Installaties B.V. states that all employees of Putman Installaties B.V. that will be present at La Cité du Soleil are in good health and medical conditions and will be able to do their jobs in accordance with the French regulations.

Licenses / certificates
Hereby Putman Installaties B.V. states that all employees of Putman Installaties B.V. that will be present at La Cité du Soleil are licensed for the work they will do on the building site.

Training
Hereby Putman Installaties B.V. states that all employees of Putman Installaties B.V. that will be present at La Cité du Soleil have fulfilled the proper trainings to do their work.

Personal Data employees
Employees of Putman Installaties B.V. that will be present at La Cité du Soleil are the following:

Full name	Signature	date
M.S. de Paauw		14-5-14
S.A. van Schie		14-5-14
P.G. van Schie		14-5-14
T.D. de Waal		14-5-14
T. Raarda	Tjaarda	14-5-14

Date: 14-5-2014 Name: P.G. van Schie
Function: Director
Signature:

Keyserswey 52 • 2201 CX Noordwijk • Postbus 148 • 2200 AC Noordwijk • Telefoon (071) 3619210 • Fax (071) 3610316

Installaties B.V. • K.v.K. Leiden 28031026 • B.T.W. nr. NL007231179B04
Onderhoudsdiensten B.V. • K.v.K. Leiden 28037792 • B.T.W. nr. NL007231179B02
Internet page: http://www.Putman-Installaties.nl
E-mail: info@putmanbv.nl

DETAILED WATER BUDGET

For the Detailed Water Budget please refer to the Contest Support Documents, chapter 3.3 Plumbing Design, included in the file DEL_PM#6_2014-06-02 on page 195.

Water delivery and water removal					
	1st water delivery 23th June	2nd water delivery 25th June	3rd water delivery 7th July	1st water removal 7th July	2nd water removal 15th July
	Quantity of water to deliver (L)	Quantity of water to deliver (L)	Quantity of water to deliver (L)	Quantity of water to remove (L)	Quantity of water to remove (L)
DEL	1700	500	1200	1700	1700

PROJECT SPECIFICATIONS

Block of Specs	**Required Specs**	**Referenced Documents**
Structure	Foundations	ST-001
	Structural Floors and Sections	ST-011/012/021/101/111
Architecture	Enclosure	AR-002/011/014/031/101/102/111/112/113
	Openings	AR-301/311/351
	Partitions	AR-017/021/022/041/051/201/211/351
	Finishes	AR101/102
	Furnishings	IN001/002/101/102/301/302/401/501/502/511/512/601/602/603
System Installations	Fire Suppression	FP-001/002
	Plumbing	PL001/002/003/004/005/006/011/012/013/021/022/023/101/102/103/104/201/202/211/221
	HVAC	ME001/002/003/004/005/011/201/202/203/204
	Electrical	EL-001/301(f)/301(g)/401(f)/401(g)/501/601/602
	Solar Systems - Photovoltaic and thermal	PV-001/011/021/031/041/042
	Telecommunication and BAS	BAS-001/002/003/201
Safety Information	Fire Safety Table	DEL_Fire_Safety_Table_2014-06-01
	Safety in Use Table	DEL_Safety_in_Use_2014-06-01
Appliances and Home Electronic Equipment Specifications and User Manuals		Appliances and Home Electronic Equipment Table and Appendix PM#6 pp.1253

Prêt-à-Loger
Home with a Skin

TU Delft

Solar Decathlon Europe

Structural design approval

According to rule 6.1 b, the structural provisions of the Solar Decathlon Europe Building Code have been met by the design and the structure is safe to be used and visited by the general public, if it is constructed the way it is designed.

The documents revised and certified are the following:

Drawings certified

Structural
ST-001 Foundation Plan and Details
ST-002 Load Bearing Pressure Plan
ST-011 Structural Ground Floor Plan
ST-012 Structural First Floor Plan
ST-021 Structural Roof Plan
ST-101 Structural Longitudinal Section
ST-111 Structural Transversal Section
ST-201 Structural Blow up
ST-301 Structural Details
ST-302 Structural Details

Project manual pages certified

Structural
Project Manual #5 pp. .....

Date: 29/04/2014

Certified by:

prof. ir. R. Nijsse

Structural calculations - House

1. General principles

1.1 Building Type

Definition	Family house		*EC 1990-B3.1*
Consequence Class	CC1	(consequence class)	*EC 1990-B3.1*
Reliability Class	RC1	(reliability class)	*EC 1990-B3.2*
Reliability Index 1 year	β	4.2	*EC 1990-B3.2*
Reliability index 50 years	β	3.3	*EC 1990-B3.2*
Differentiation Factor	KFI	0.9	*EC 1990-B3.3*
	γ_G =	1.35	*SD Building Code*
	γ_Q =	1.5	*SD Building Code*
Design Life Class	3		
Design life	t	50 years	

1.2 Applicable standards and regulations

The applicable standards of Netherlands, France and Solar Decathlon building code are taken into account jointly,using the most unfavourable design rules on each occasion.

EN 1990	Basis of structural design
EN 1991	Load definitions
EN 1995	Timber Structures

Dutch and French National Annexes to the above standards (NEN & NF)

Bouwbesluit 2012 (*Building regulation of Netherlands*)
Compendium Constructive Approach to Security
Solar Decathlon 2014 - Building code

1.3 ψ-factors for buildings (by class)

		ψo	ψ1	ψ2	
A	Residential areas	0.7	0.5	0.3	*SD & EC 1990-A1.2.2*
H	Roofs	0	0	0	*SD & EC 1990-A1.2.2*
-	Snow loads	0	0.6	0	*SD Building Code*
-	Wind load	0.6	0.2	0	*SD &EC 1990-A1.2.2*

1.4 Accidental loads

As mentioned in rule 51.6.6 in SD BC, the exterior and interior impact resistance should be taken into account.

This is mainly affecting the ground floor facades where an accidental load might pose a problem for their structural integrity.

Since the French standard NF P 08-302 was not available, the load specification from the German practice is used instead, which is about 0.5kN/m.

This load magnitude is not considered influential in comparison with the much higher wind loads on the walls. Therefore the accidental loads will not be explicitly calculated. Another reason to support this is that the main load bearing system is timber frame walls where numerous timber studs are tied in a single panel. Thus, they can provide many alternative load roads, even if a small number of studs fails during a heavy impact.

1.4 Timber frame panels (abbreviated as HSB-Houtskeletbouw in Dutch)

HSB panels	Timber strength class	Structural role	b (mm)		h (mm)		(mm)
north façade	C18	stud	38	x	170	c.t.c. =	400
south façade	C18	stud	38	x	105	c.t.c. =	400
side walls	C18	stud	38	x	244	c.t.c. =	600
main interior wall	C18	stud	38	x	114	c.t.c. =	600
secondary interior wall	C18	stud	38	x	74	c.t.c. =	600
ground floor panels	C18	joist	71	x	245	c.t.c. =	600
1st floor panels	C18	joist	70	x	196	c.t.c. =	600
roof - north side	C24	joist	38	x	285	c.t.c. =	600
roof - south side	C24	joist	38	x	215	c.t.c. =	600

I) Timber Frame panel - Wall

HSB wall with half brick cladding - South wall

material	number per m^2	b in mm	h in mm	density	weight (kg)
half brick cladding	15	26	50	1800	35.10
Eter Backer HD	1	1000	8	1925	15.40
battens	2.5	30	25	550	1.03
Ethernit Duripanel	1	1000	18	1250	22.50
Timber Studs	2.5	38	105	550	5.49
Glasswool (Ins)	1.00	1000	105	25	2.63
PIR Xtra Therm	1	1000	90	22.5	2.03
OSB	1	1000	11	650	7.15
fermacell	1	1000	12.5	1200	15.00
additional finish	no				
				total	**106.32**

HSB wall without outer leaf - Side walls

material	number per m^2	b in mm	h in mm	density	weight (kg)
outer leaf					0
Ethernit Duripanel	1	1000	18	1250	22.50
Timber Studs	1.67	38	244	550	8.50
Glasswool (Ins)	1.00	1000	244	25	6.10
fermacell	1	1000	18	1200	21.60
additional finish	no				
				total	**58.70**

HSB wall with STO extra insulation - North wall

material	number per m^2	b in mm	h in mm	density	weight (kg)
brick slips	15	10	50	1800	13.50
STO EPS	1	1000	80	22.5	1.80
Ethernit Duripanel	1	1000	18	1250	22.50
Timber Studs	2.5	38	170	550	8.88
Glasswool (Ins)	1.00	1000	170	25	4.25
PIR Xtra Therm	1	1000	90	22.5	2.03
OSB	1	1000	11	650	7.15
fermacel	1	1000	12.5	1200	15.00
additional finish	no				
				total	**75.11**

HSB wall - Main interior wall

material	number per m^2	b in mm	h in mm	density	weight (kg)
fermacell	1	1000	18	1200	21.60
Timber Studs	1.67	38	114	550	3.97
Sound insulation	1.00	1000	114	25	2.85
fermacell	1	1000	18	1200	21.60
				total	**50.02**

HSB wall - Secondary interior wall

material	number per m^2	b in mm	h in mm	density	weight (kg)
fermacell	1	1000	18	1200	21.60
Timber Studs	1.67	38	74	550	2.58
Sound insulation	1.00	1000	74	25	1.85
fermacell	1	1000	18	1200	21.60
				total	**47.63**

II) Timber Frame panel - Floor

HSB Ground floor

material	number per m^2	b in mm	h in mm	density	weight (kg)
Plywood	1	1000	36	650	23.4
Timber Joists	1.67	71	245	550	15.95
Glasswool (Ins)	1.00	1000	245	25	6.13
OSB	1	1000	18	650	11.7
				total	**57.17**

HSB 1st floor

material	number per m^2	b in mm	h in mm	density	weight (kg)
Plywood	1	1000	18	650	11.7
Timber Joists	1.67	70	196	550	12.58
				total	**24.28**

III) Timber Frame panel - Roof

HSB North roof

material	number per m^2	b in mm	h in mm	density	weight (kg)
green roof	1	1000	75	1267	95.00
waterproofing	-	-	-	-	0.00
OSB	1	1000	18	650	11.7
Timber Joists	1.67	38	285	550	9.93
Glasswool (ins)	1	1000	285	25	7.125
OSB	1	1000	18	650	11.7
				total	**135.45**

HSB South roof

material	number per m^2	b in mm	h in mm	density	weight (kg)
roof tiles	21	-	-	-	48
battens	1.67	18	29	550	0.4785
OSB	1	1000	21	650	13.65
Timber Joists	1.67	38	215	550	7.49
Glasswool (ins)	1	1000	215	25	5.375
OSB	1	1000	18	650	11.7
				total	**86.69**

1.5 Assumptions about live loads

Class A:	residential areas			*SD Building Code*
	q_k (kN/m^2)	Q_k (kN)		
floors	1.5	2	(on area 50x50mm)	
stairs	2.5	2		

Class H and I:	flat roofs - unaccessible			*EC 1991-1-1 art 6.3.4.2*
slope	α	21^o		
	q_k (kN/m^2)	Q_k (kN)		
H	0	1.5	(on area 100x100mm)	

(Roofs only accessible for maintenance - take water accumulation into account)

stairs:

	q_k (kN/m^2)	Q_k (kN)		*SD Building Code*
floors	2.5	3	(on area 50x50mm)	*EC 1991-1-1 art 6.3.1.2*

* In addition, a line load must be considered of 2 kN / m on a working length of 1 m and a width of 0, 1 m
This last line works on the entire roof deck and on each individual roof element (eg, roof deck or roof).
* In case of areas of roof deck or roof elements above purlins, rafters and beams,
concentrated loads are applied equal to: Q_k = 2kN
The roof structure is considered as ribbed panel, reducing the load of 2.0 kN by a factor of
(500/600 + 1) = 1.83 where 600 is the center to center distance of the tracks.
F = 2 / 1.83 = 1.09 kN

		g_k (kN/m^2)	
Additionally the partition dead load is considered:		**1.5**	*SD Building Code*

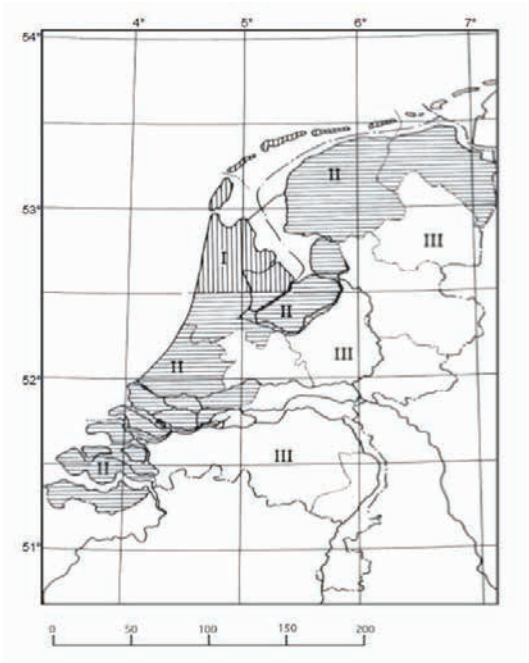
1.6 Variable snow load

General *EC 1991-1-3*

characteristic snow load	sk	0.7	kN/m2	*EC 1991-1-3 art.4.1*
warmtecoefficient	Ct	1,0		*EC 1991-1-3 art.5.2*
blootstellingscoefficient	Ce	1,0		*EC 1991-1-3 art.5.2*

1.7 Variable wind load *EC 1991-1-4*

Wind Area Area II built



building height	z	7	m
building height	h	7	m
building width	b	6	m
building depth	d	8	m
wind factor	C_{dir}	1	
seasonal factor	C_{season}	1	
probability factor	C_{prob}	1	
characteristic avg. wind	$V_{b,O}$	27	m/s
basic wind speed	V_b	27	m/s
average wind speed	V_m (Z)	17.6	m/s
air density	ρ	1.25	kg/m^3
Peak veloc. Pressure *(Zone II - rural)*	q_p (z)	0.75	kN/m^2

General factors for detailed calculations

correlation factor		0.85
structure factor perpendicular to b	$c_s c_d$	1
structure factor perpendicular to d	$c_s c_d$	1

Wind Pressure Factors

external wind pressure	C_{pe}		accordance with EC 1991-1-1 Chapter 7
internal negative pressure	C_{pi}	-0.3	(Uniformly distributed openings)
internal positive pressure	C_{pi}	0.2	(Uniformly distributed openings)

Wind Friction

surface		very rough (wrinkles, ribs, convolutions)
coefficient of friction	c_{fr}	0.04

1.8 Requirements regarding serviceability criteria

-Deflection requirement:	maximum	0.004 L
	under live loads	0.004 L

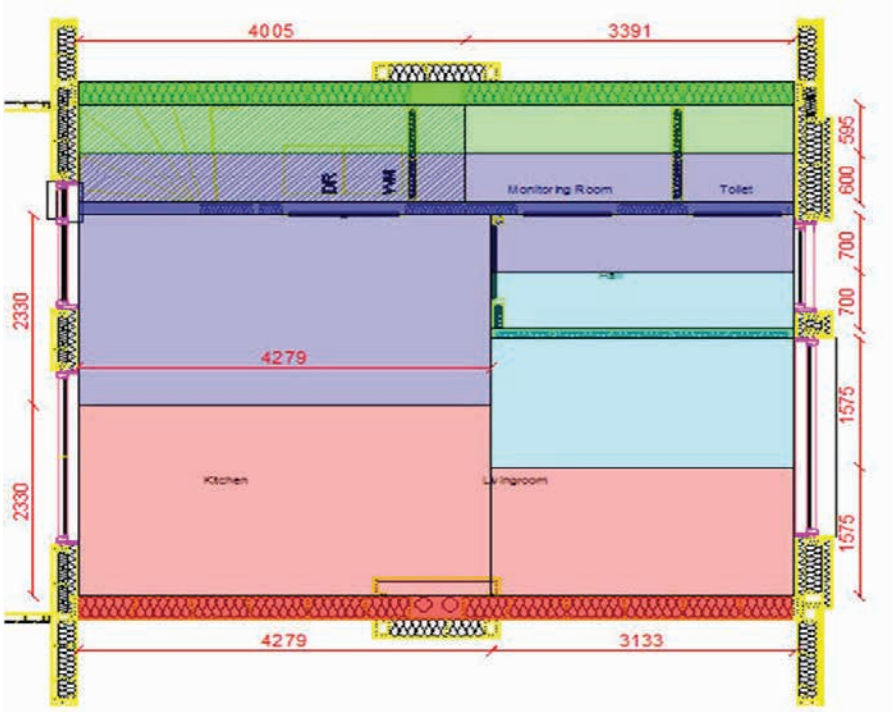
Structural analysis - Load transfer sequence

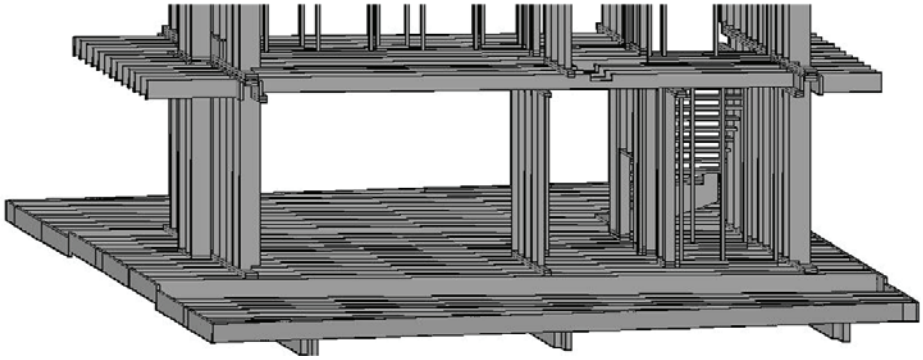
Since the house structure is panel based, the analysis model and load transfer order that is assumed is rather simple:

1) all the load from the 1st floor panels is transferred to the side walls and the main structural interior wall
2) half of the load from the roof panels goes to the facades and the rest to the ridge beam and the side walls
3) all the load of the staircase goes to its nearest side wall
4) all the loads of the ground floor and the walls are transferred directly to the foundations beams
5) the loads of the foundation beams are transferred to the center of each foundation plate

1st Floor panels

Specifically the loads are transferred as shown below, with the respective colour of each of the 4 ground floor walls





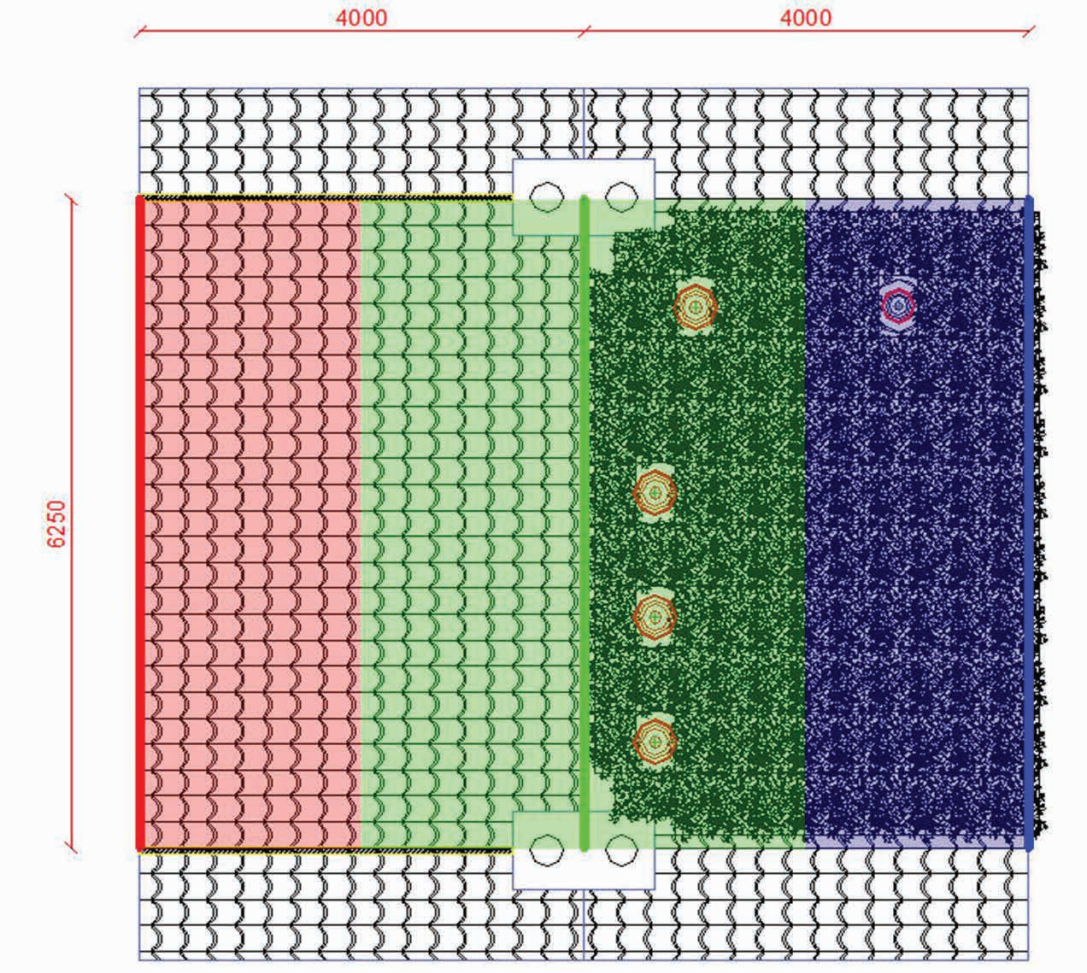
The order of line loads in the following table is given from left to the right and from top to bottom..
The width distancewill be multiplied with the area loads to create the line loads per wall.

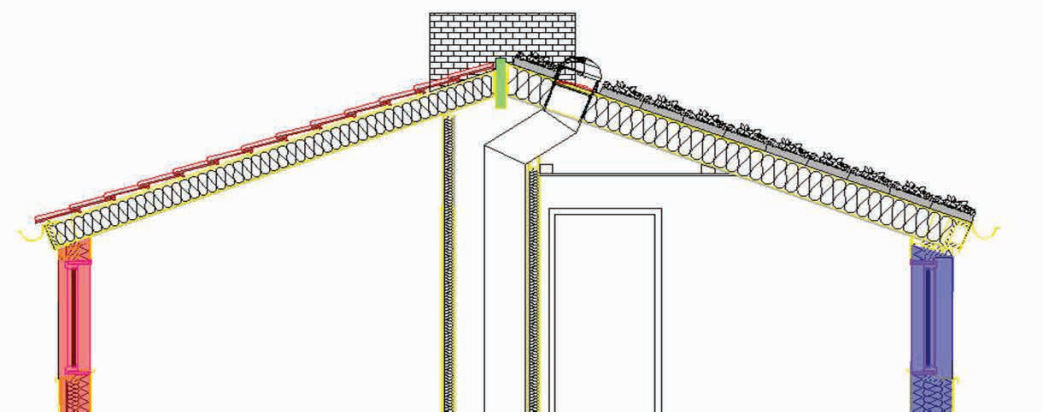
					Self-weight	Partit. Load	Live load
				area loads (kN/m^2):	0.24	1.5	1.5
	Colour	Length (m)	Width (m)	Area (m^2)	Line load per type (kN/m)		
East side wall	red	4.279	2.330	9.97	0.57	3.50	3.50
		3.133	1.575	4.93	0.38	2.36	2.36
West side wall	green	3.391	0.595	2.02	0.14	0.89	0.89
Main interior wall	blue	4.279	2.330	9.97	0.57	3.50	3.50
		3.391	0.600	2.03	0.15	0.90	0.90
		3.133	0.700	2.19	0.17	1.05	1.05
Sec. interior wall	cyan	3.133	0.700	2.19	0.17	1.05	1.05
		3.133	1.575	4.93	0.38	2.36	2.36
				Total floor loads (kN):	9.29	57.37	57.37

Staicase

The self-weight of the staircase is about the same as the one of the 1st floor.

					Self-weight	Live load
				area loads (kN/m^2):	0.24	2.5
	Colour	Length (m)	Width (m)	Area (m^2)	Line load per type (kN/m)	
West side wall	green	4.005	0.595	2.38	0.14	1.49
Main interior wall	blue	4.005	0.600	2.40	0.15	1.50
				Total floor loads (kN):	1.16	11.96


4000
4000
6250



North roof panels (diagonal width = 4/cos21)

					Self-weight	(max-press) Wind load
				area loads (kN/m^2):	1.35	0.41
	Colour	Length (m)	Width (m)	Area (m^2)	Line load per type (kN/m)	
North façade	blue	6.250	2.142	13.39	2.90	0.88
Ridge beam	green	6.250	2.142	13.39	2.90	0.88

Total roof loads (kN):	36.27	10.98
Total ridge loads (kN):	18.14	5.49

The load on the ridge beam is distributed to the side walls equally (kN): 9.07 2.74

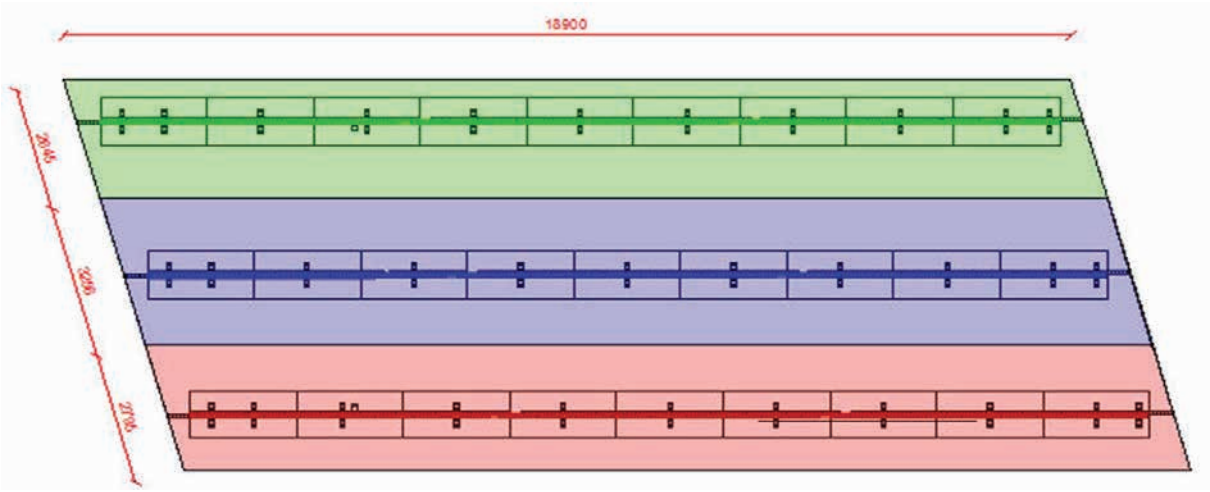
South roof panels (diagonal width = 4/cos21)

					Self-weight	(max-press) Wind load
				area loads (kN/m^2):	0.87	0.41
	Colour	Length (m)	Width (m)	Area (m^2)	Line load per type (kN/m)	
South façade	red	6.250	2.142	13.39	1.86	0.88
Ridge beam	green	6.250	2.142	13.39	1.86	0.88

Total roof loads (kN):	23.22	10.98
Total ridge loads (kN):	11.61	5.49

The load on the ridge beam is distributed to the side walls equally (kN): 5.80 2.74

Ground floor

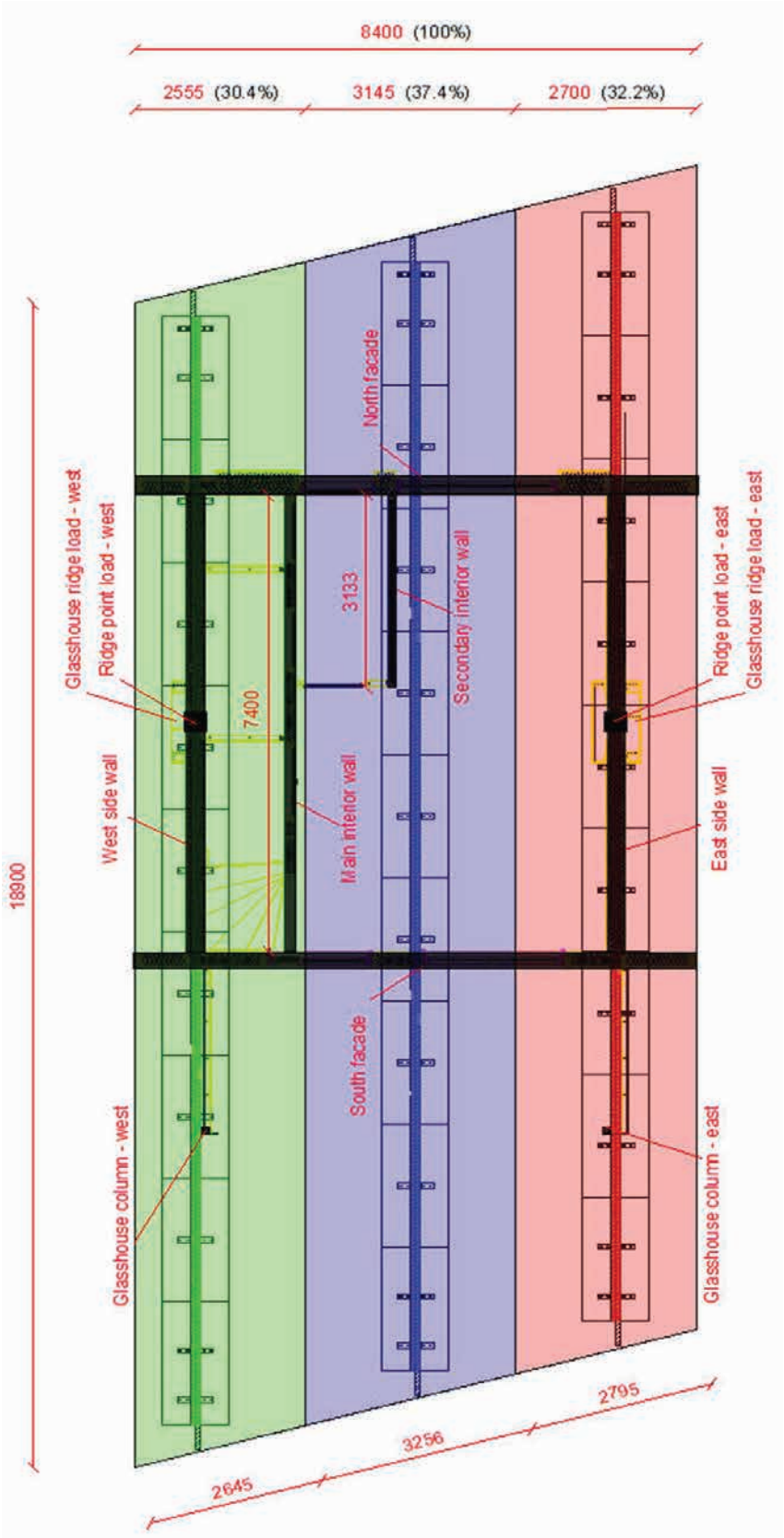


					Self-weight	Partit. Load	Live load
				area loads (kN/m^2):	0.57	1.5	1.5
	Colour	Length (m)	Width (m)	Area (m^2)	Line load per type (kN/m)		
West side beam	green	18.900	2.645	49.99	1.51	3.97	3.97
Middle beams	blue	18.900	3.256	61.54	1.86	4.88	4.88
East side beam	red	18.900	2.795	52.83	1.60	4.19	4.19

Total floor loads (kN):	93.96	246.53	246.53

Calculation and distribution of loads in foundation beams

The elements that are transferring their loads in each foundation beam are shown in the following:



The verification of the foundation beams and plates will be performed with the imposed live loads of the floors as the determinant live load. This assumption is based on the magnitude of the imposed load in comparison with the wind load (1.5 kN/m^2 vs ~0.7 kN/m^2) and the larger area of effect of the first in comparison with the second (2x floor plates -> about 100m^2 vs roof area -> about 54m^2). Nevertheless, the wind load will be taken into account due to the Solar Decathlon Building code, with a combination factor of 0.6.

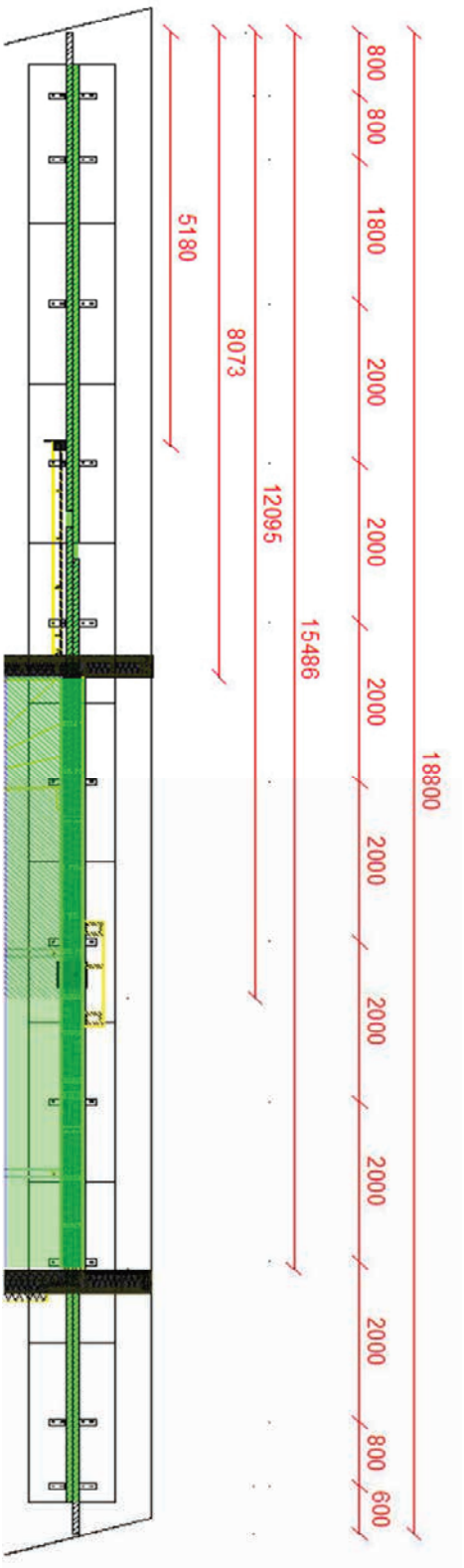
ULS -> 1.35 G + 1.5 Q + 1.50 * 0.6 * W

SLS -> G + Q + 0.6 * W

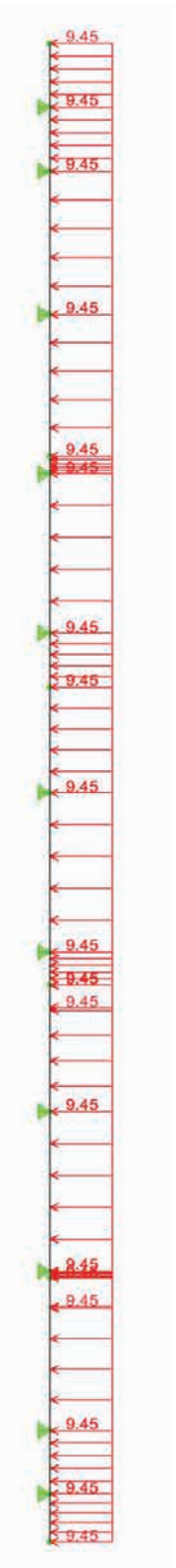
Transferred to	Element	Self-weight	Partition load	Imposed live load	Wind load	ULS	**SLS**
West side foundation beam (green)	**Ground floor - west** (kN/m)	1.51	3.97	3.97	0.00	13.35	**9.45**
	West side wall (kN/m)	*3.16*	0.00	0.00	0.00	4.27	**3.16**
		0.14	0.89	0.89	0.00	2.74	**1.93**
		0.14	0.00	1.49	0.00	2.43	**1.63**
	1/2 main interior (kN/m)	0.65	0.00	0.00	0.00	0.88	**0.65**
		0.28	1.75	1.75	0.00	5.36	**3.78**
		0.16	0.98	0.98	0.00	2.99	**2.11**
		0.07	0.00	0.75	0.00	1.22	**0.82**
	Glass. west (kN)	-	-	-	-	*25.26*	***19.81***
	column/ridge	-	-	-	-	*16.20*	***12.71***
	Ridge roof load - west (kN)	14.87	0.00	0.00	5.49	25.02	**18.17**
	30.4% of south façade total load (kN)	12.69	0.00	0.00	0.00	17.13	**12.69**
		4.74	0.00	0.00	2.24	8.42	**6.09**
	30.4% of north façade total load (kN)	8.97	0.00	0.00	0.00	12.10	**8.97**
		7.41	0.00	0.00	2.24	12.02	**8.76**
Central foundation beam (blue)	**Ground floor - central** (kN/m)	1.86	4.88	4.88	0.00	16.43	**11.63**
	1/2 main interior (kN/m)	0.65	0.00	0.00	0.00	0.88	**0.65**
		0.28	1.75	1.75	0.00	5.36	**3.78**
		0.16	0.98	0.98	0.00	2.99	**2.11**
		0.07	0.00	0.75	0.00	1.22	**0.82**
	Secondary interior (kN/m)	1.24	0.00	0.00	0.00	1.67	**1.24**
		0.55	3.41	3.41	0.00	10.47	**7.38**
	37.4% of south façade total load (kN)	15.61	0.00	0.00	0.00	21.08	**15.61**
		5.83	0.00	0.00	2.76	10.36	**7.49**
	37.4% of north façade total load (kN)	11.03	0.00	0.00	0.00	14.89	**11.03**
		9.12	0.00	0.00	2.76	14.79	**10.77**
East side foundation beam (red)	**Ground floor - east** (kN/m)	1.60	4.19	4.19	0.00	14.11	**9.98**
	East side wall (kN/m)	3.16	0.00	0.00	0.00	4.27	**3.16**
		0.57	3.50	3.50	0.00	10.72	**7.56**
		0.38	2.36	2.36	0.00	7.25	**5.11**
	Ridge roof load - east (kN)	14.87	0.00	0.00	5.49	25.02	**18.17**
	Glass. east (kN)	-	-	-	-	*25.26*	***19.81***
	column/ridge	-	-	-	-	*16.20*	***12.71***
	32.2% of south façade total load (kN)	13.44	0.00	0.00	0.00	18.15	**13.44**
		5.02	0.00	0.00	2.38	8.92	**6.45**
	32.2% of north façade total load (kN)	9.50	0.00	0.00	0.00	12.82	**9.50**
		7.85	0.00	0.00	2.38	12.73	**9.27**

Using the above load combinations, a structural model is calculated using the analysis program ETABS v.9.7.
The models for each foundation beam are based on its dimensions, its supports on the foundation plates every 2m, the application lengths of the line loads and the position of the point loads.
Note: In the diagrams below, if a load has the same position as another is automatically added to it (e.g. ridge loads)

West side foundation beam (green)



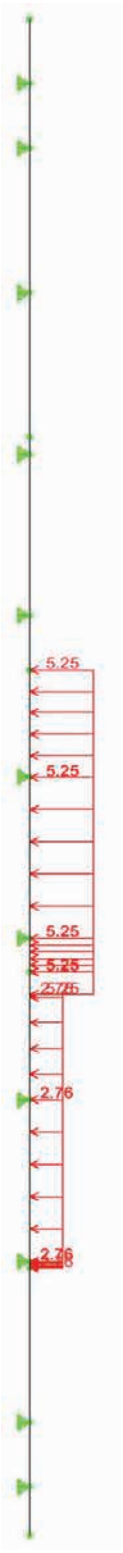
Ground floor - west (kN/m)



West side wall (kN/m)



1/2 main interior (kN/m)

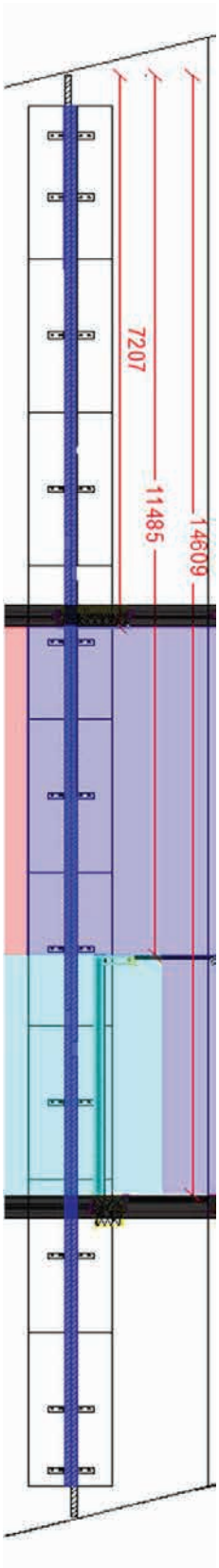


Point loads (kN)

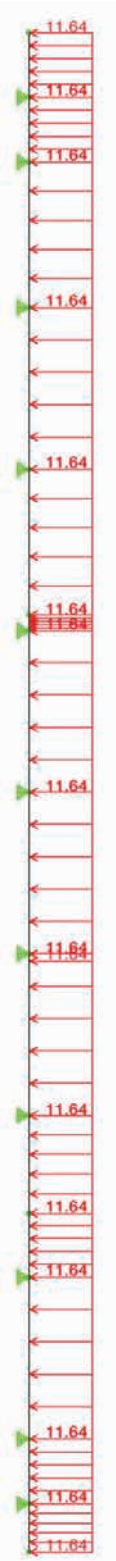


Note 2. : The loads here are corresponding to the SLS

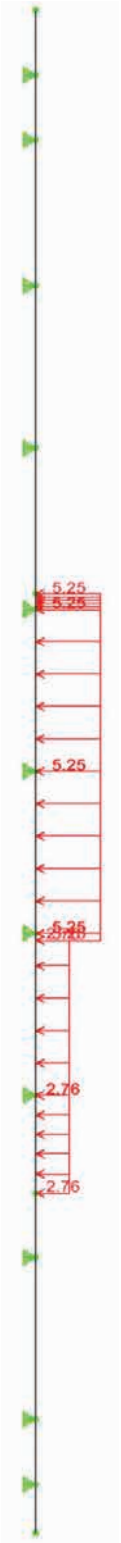
Central foundation beam (blue)



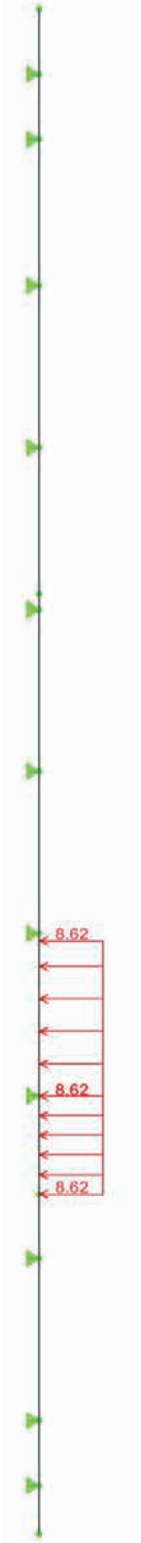
Ground floor - central (kN/m)



1/2 main interior (kN/m)



Secondary interior (kN/m)



Point loads (kN)

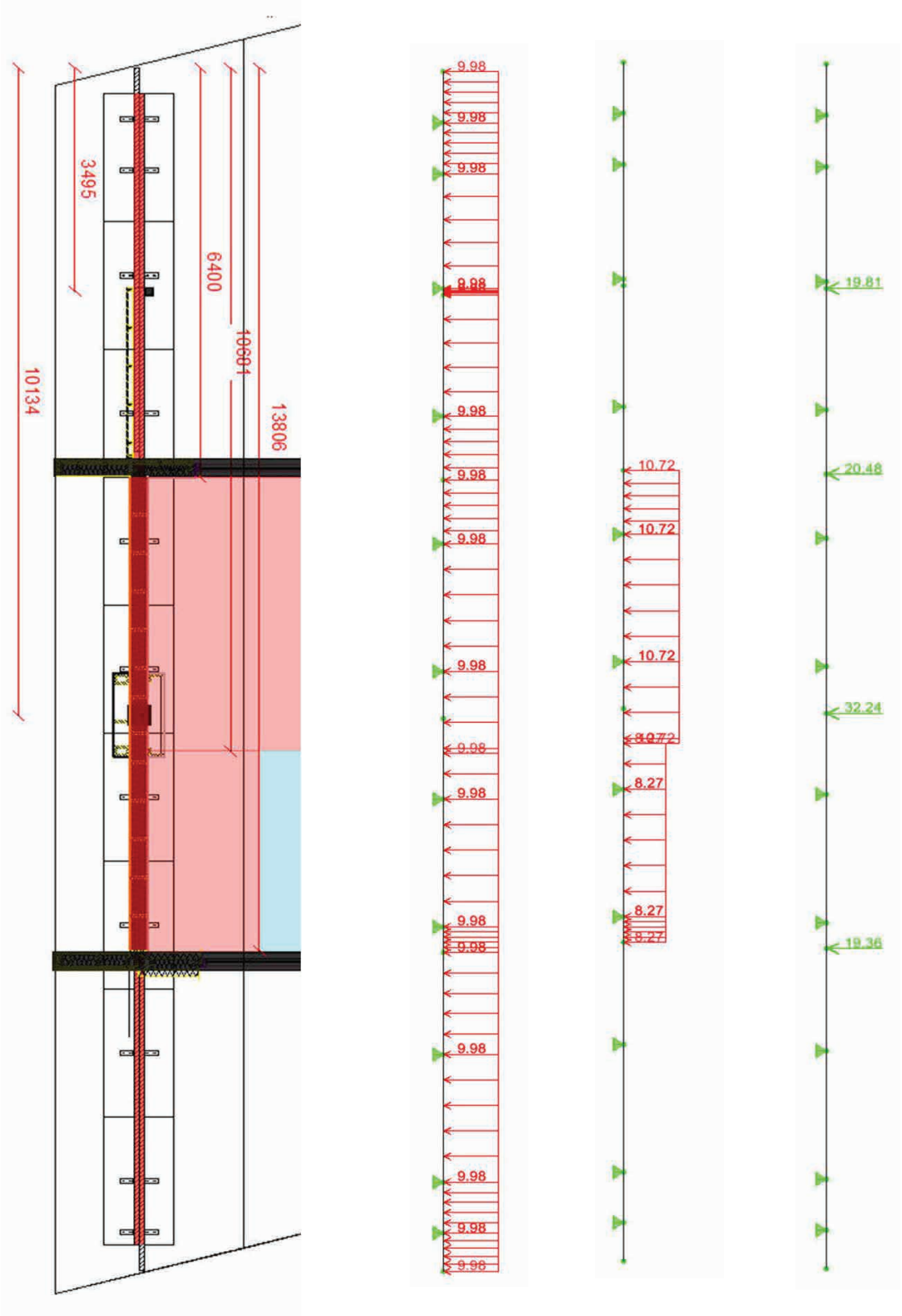


East side foundation beam (red)

Ground floor - east (kN/m)

East side wall (kN/m)

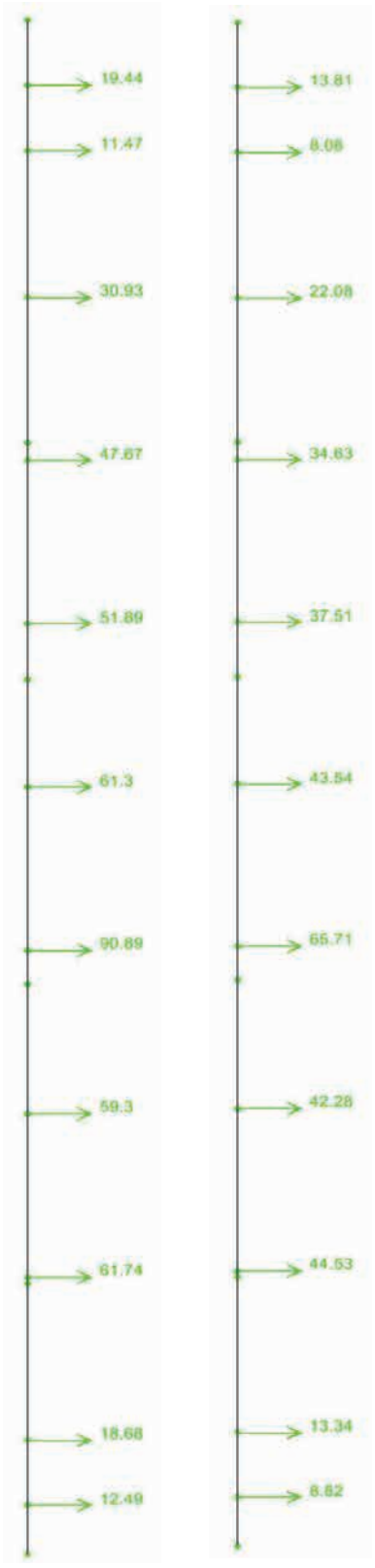
Point loads (kN)



Resulting forces on the foundations

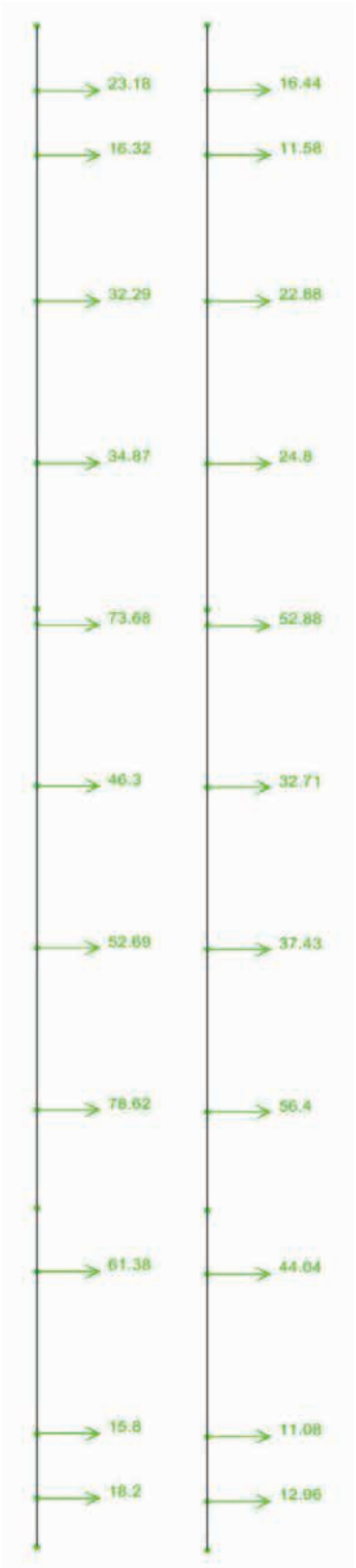
West side foundation beam (green)

ULS SLS



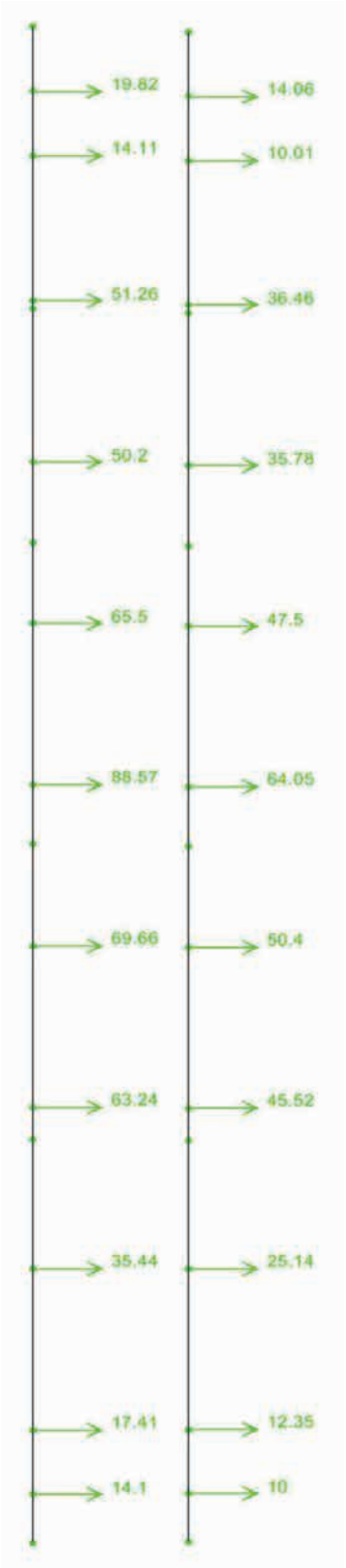
Central foundation beam (blue)

ULS SLS



East side foundation beam (red)

ULS SLS



Verification of Stelcon foundation plates

ULS - Strength verification

The following are true for all the foundation plates:

1) same material and product (Stelcon prefabricated concrete plate)2x1m and 160mm thick)
2) same dimensions (2x1m and 160mm thick)
3) same load application in the center of the plate, with the exception of the end-plates of the foundation beams that receive the load In two locations Nevertheless as their loading is far smaller in comparison with the center foundations plates, this difference in load application will be neglected.

Due to the points below, the verification of only the Stelcon plate with the largest load can be sufficient.

As seen from the results above the largest ULS load on the foundation plate is: **91.89** kN
From the brochure of the Stelcon plate manufacturer the allowed strength is: **95** kN

Therefore the unity check is : **UC = 0.97** sufficient

It has to be also noted that the above load calculation is considered mildly consevative, therefore the allowed strength of foundations will be more than sufficient in the normal use of the building.

SLS - Allowed load bearing pressure

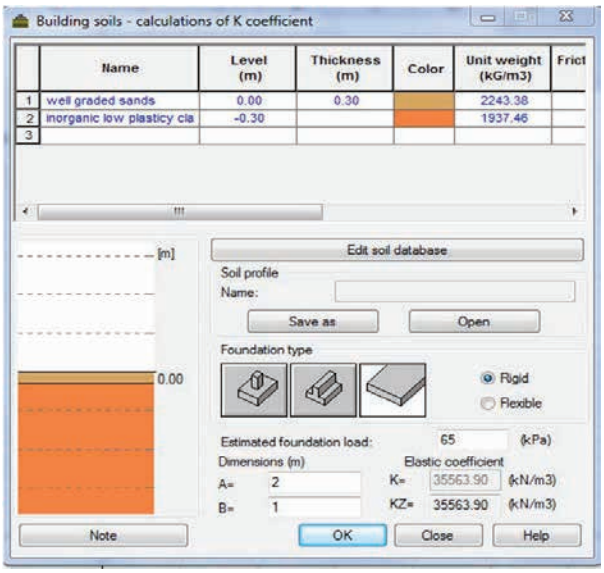
The same assumptions can be used as in the ULS for the calculation of the resulting load bearing pressure in each foundation plate. Since all the plates are equivalent and the pressure calculation is considered almost linear, one base model of the loaded plate can be created in the analysis program Autodesk Robot.

If the model is then loaded by 1 kN, the resulting max load bearing pressure can be multiplied by each reaction load as found before and yied the respective max load bearing pressure for each plate.

Base model in Autodesk Robot

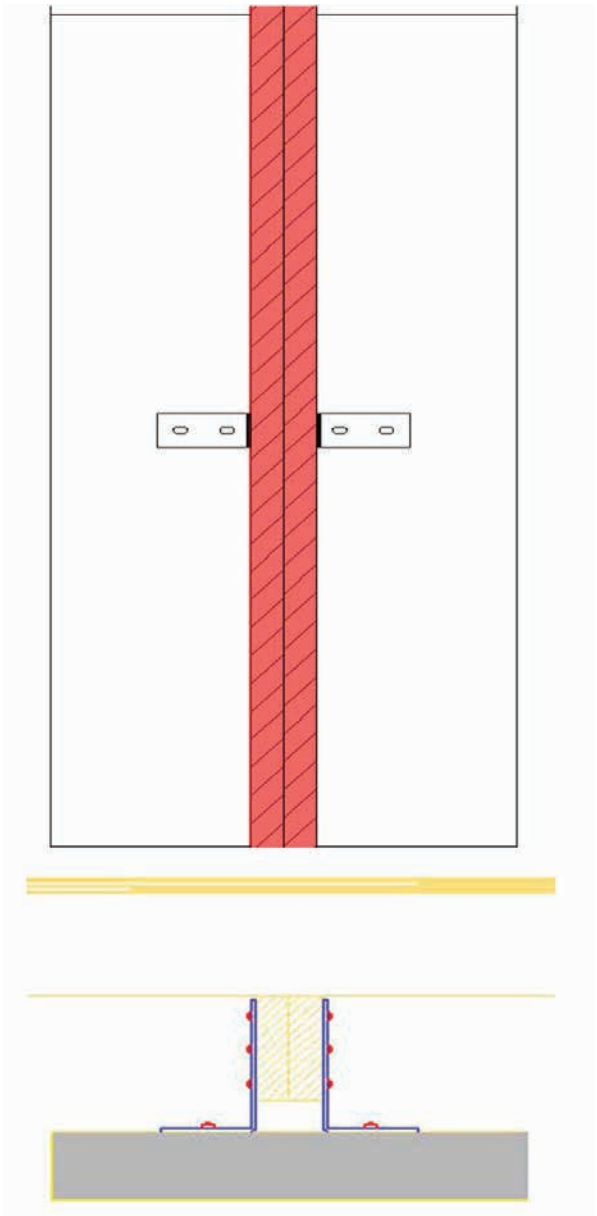
The plate is modelled with its exact dimensions and materials in the program.

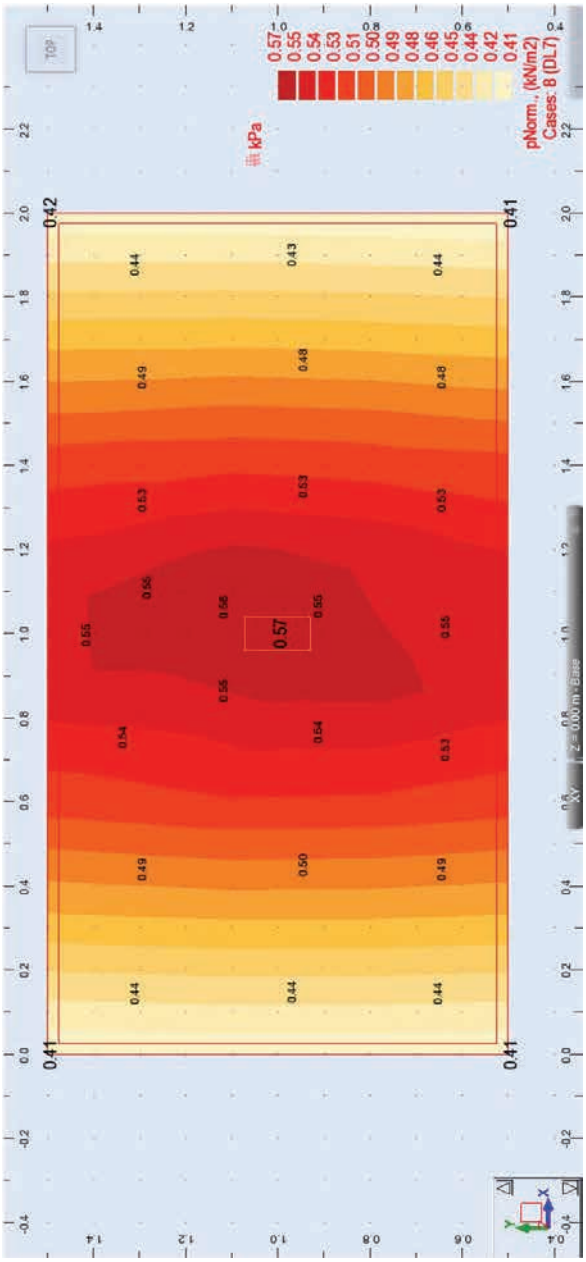
By using the latest soil details from the competition the elastic coefficient KZ is calculated. The existant sub-soil type is not given specifically, but is considered a very low strength clay soil type.



Therefore the max load bearing pressure is calculated for 1kN load: **0.57 kN/m^2**

The distribution can be seen below:





Load bearing pressure calculation

The limit given by the Solar Decathlon Building code is: **50** **kN/m^2**

The self weight of the 2x1m Stelcon plate is given from the brochure as: 770 kg
For a total area of 2m^2 the load bearing pressure from the self weight is: **3.85** **kN/m^2**

It is noted that this pressure will be considered uniform and will be added below to the max resulting load bearing pressures for the different reaction loads.

Foundation plate index	**West side foundation beam** (green)		**Central foundation beam** (blue)		**East side foundation beam** (red)	
from left to right	SLS - reactions	max load bearing	SLS - reactions	max load bearing	SLS - reactions	max load bearing pressure
1	13.81 8.08	16.33	16.44 11.58	19.82	14.06 10.01	17.57
2	22.08	16.44	22.88	16.89	36.46	24.63
3	34.63	23.59	24.8	17.99	35.78	24.24
4	37.51	25.23	52.88	33.99	47.5	30.93
5	43.54	28.67	32.71	22.49	**64.05**	**40.36**
6	**65.71**	**41.30**	37.43	25.19	50.4	32.58
7	42.28	27.95	**56.4**	**36.00**	45.52	29.80
8	44.53	29.23	44.04	28.95	25.14	18.18
9	13.34 8.82	16.48	11.08 12.96	17.55	12.35 10	16.59

Therefore, the maximum resuting load bearing pressure is: **41.30** < 50 **kN/m^2**

The unity check is then: **UC = 0.83**

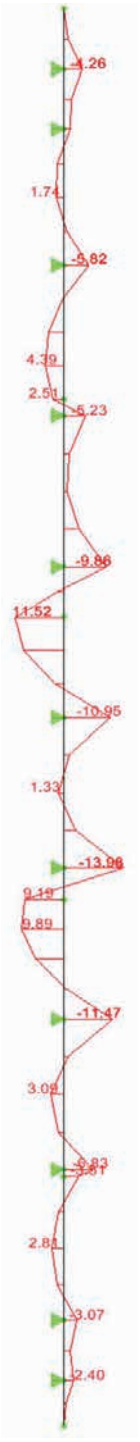
Foundation beam verification

As with the foundation plates, the beams will be also verified against the most unfavourable moments and deflections. These are given below as derived from the analysis model:

Resulting forces on the foundations beams

West side foundation beam (green)

ULS - Bending moment



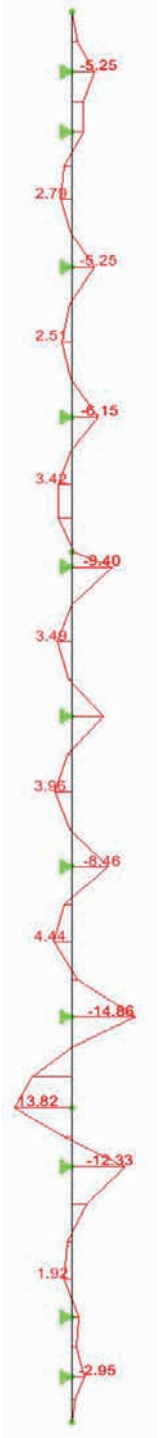
SLS - deflection



	X	Y	Z
Trans	0.000000	0.000000	-0.001623
Rotn	0.000000	0.001402	0.000000

Central foundation beam (blue)

ULS - Bending moment



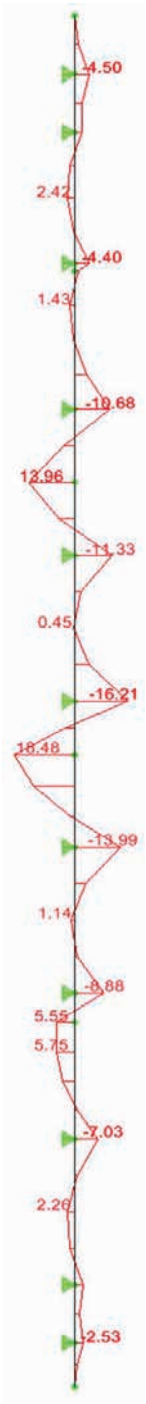
SLS - deflection



	X	Y	Z
Trans	0.000000	0.000000	-0.001813
Rotn	0.000000	-0.000959	0.000000

East side foundation beam (red)

ULS - Bending moment



SLS - deflection



	X	Y	Z
Trans	0.000000	0.000000	-0.002391
Rotn	0.000000	0.001547	0.000000

Model: 2 point support beam (the bending moments, shear forces and deflections are deriving from the above)
Check: for vertical forces

Input data

material:	Sawn timber		load duration class:	Medium
wood quality:	C24		resulting class:	CC1
b =	142	mm	climate class:	1
h =	245	mm		
length =	2000	mm		

Cross-section properties (*the effective width from the plywood plate is not taken into account)*

$f_{m,k}$ =	24	$f_{m,d}$ =	14.77	N/mm^2	A =	34790	mm^2
$f_{t,0,k}$ =	14	$f_{t,0,d}$ =	8.62	N/mm^2	W_y =	1420592	mm^3
$f_{t,90,k}$ =	0.4	$f_{t,90,d}$ =	0.22	N/mm^2	I_y =	1.7E+08	mm^4
$f_{c,0,k}$ =	21	$f_{c,0,d}$ =	12.92	N/mm^2	$\rho_{g,k}$ =	320	kg/m^3
$f_{c,90,k}$ =	2.5	$f_{c,90,d}$ =	1.35	N/mm^2			
$f_{v,k}$ =	4	$f_{v,d}$ =	2.46	N/mm^2	γ_m =	1.3	
$E_{0.05}$ =	7400	N/mm^2			k_{mod} =	0.8	
E =	11000	N/mm^2			$k_{mod,ft,90,k}$ =	0.7	
$G_{0.05}$ =	690	N/mm^2			k_{def} =	0.6	

Loads

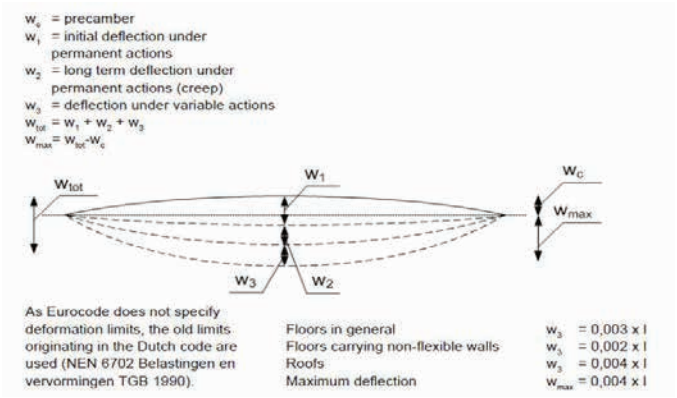
Lineload	permanent	$g_{k,j}$ =	-	kN/m	
	live (imposed)	$q_{k,j}$ =	-	kN/m	
	ULS		-	kN/m	
	SLS		-	kN/m	
Pointload	permanent	$G_{k,j}$ =	-	kN	
	live	$Q_{k,j}$ =	-	kN	
	ULS		-	kN	
	SLS		-	kN	

Load factors

ULS	γ_g =	1.35
	γ_q =	1.5
SLS	γ_g =	1
	γ_q =	1

Deflections (in mm)

	Calculated	*Allowed*
w_0 =	0	-
w_1 =	-	-
w_2 =	-	-
w_3 =	-	8
$w_{ins,max}$ =	*2.39*	6
$w_{fin,max}$ =	4.30	8



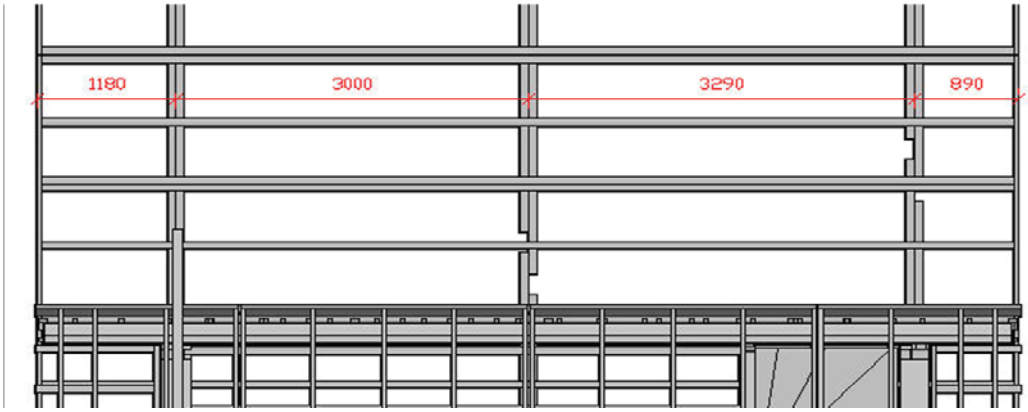
Resulting forces and stresses

	F_d	V_d	$M_{y,d}$	σ_m	τ_d
Calculated	0.00	*53.10*	*18.48*	13.01	2.29
Allowed	-	-	-	14.77	2.46
	kN	kN	kNm	N/mm	N/mm^2

Unity Check

deflection from live	**-**
total deflection	**0.54**
bending stress	**0.88**
shear stress	**0.93**

F.1 - Ground floor verification



Max length = 3290 mm

The joists of the ground floor are doubled every other c.t.c. distance. Nevertheless, the most unfavourable will be the single joist with an effective width of: 600 mm

vertical load on ground floor joists	(mm)		(kN/m2)		(kN/m)
self weight - ground floor panels:	600	X	0.57	=	0.34
partition load:	600	X	1.50	=	0.90
				Σg_k =	**1.24**
uniform live load on floor:	600	X	1.50	=	0.90
				Σq_k =	**0.90**
					(kN)
single live load on floor:					2.00
				ΣQ_k =	**2.00**

Ground floor verification

Model: 2 point support beam
Check: for vertical forces

Input data

material:	Sawn timber		load duration class:	Medium
wood quality:	C18		resulting class:	CC1
			climate class:	1
b =	71	mm		
h =	281	mm	*In the height of the cross section the thickness of plywood*	
length =	3290	mm	*is also added as a minimum T-beam cooperation*	

Cross-section properties (*the effective width from the plywood plate is not taken into account)*

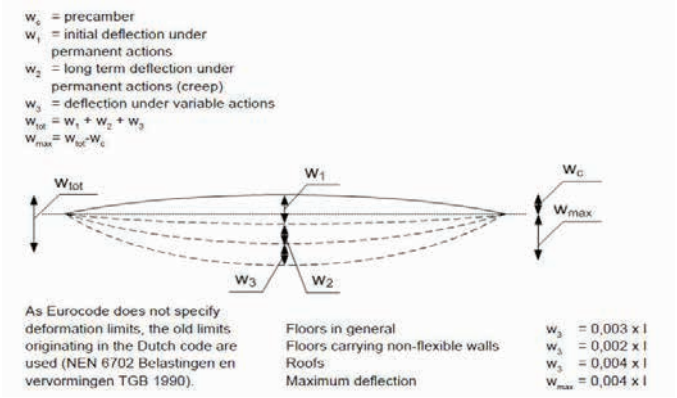
$f_{m,k}$ =	18	$f_{m,d}$ =	11.08	N/mm^2	A =	19951	mm^2
$f_{t,0,k}$ =	11	$f_{t,0,d}$ =	6.77	N/mm^2	W_y =	934372	mm^3
$f_{t,90,k}$ =	0.4	$f_{t,90,d}$ =	0.22	N/mm^2	I_y =	1.3E+08	mm^4
$f_{c,0,k}$ =	18	$f_{c,0,d}$ =	11.08	N/mm^2	$\rho_{g,k}$ =	320	kg/m^3
$f_{c,90,k}$ =	2.2	$f_{c,90,d}$ =	1.18	N/mm^2			
$f_{v,k}$ =	3.4	$f_{v,d}$ =	2.09	N/mm^2	γ_m =	1.3	
$E_{0.05}$ =	6000	N/mm^2			k_{mod} =	0.8	
E =	9000	N/mm^2			$k_{mod,ft,90,k}$ =	0.7	
$G_{0.05}$ =	560	N/mm^2			k_{def} =	0.6	

Loads

					Load factors	
Lineload	permanent	$g_{k,j}$ =	1.24	kN/m	*ULS*	γ_g = 1.35
	live (imposed)	$q_{k,j}$ =	0.90	kN/m		γ_q = 1.5
	ULS		3.03	kN/m		
	SLS		2.14	kN/m	*SLS*	γ_g = 1
						γ_q = 1
Pointload	permanent	$G_{k,j}$ =	0.00	kN		
	live	$Q_{k,j}$ =	2.00	kN		
	ULS		3.00	kN		
	SLS		2.00	kN		

Deflections (in mm)

		Calculated	*Allowed*
	w_0 =	0	-
	w_1 =	1.60	-
	w_2 =	0.96	-
(taken as roof)	w_3 =	1.26	13.16
	$w_{ins,max}$ =	2.86	13.16
	$w_{fin,max}$ =	3.82	13.16



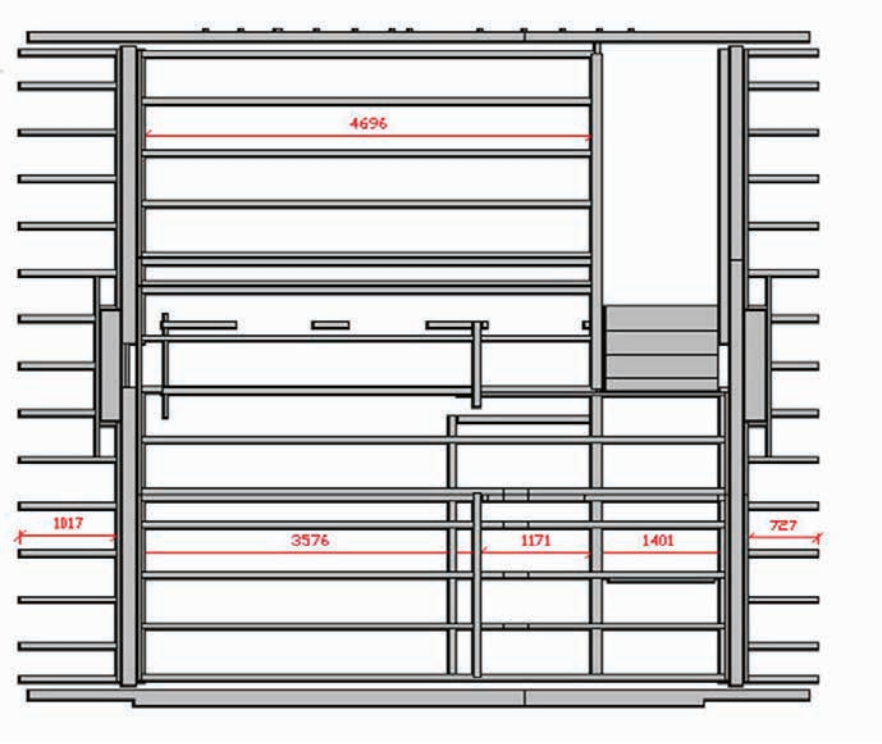
Resulting forces and stresses

	F_d	V_d	$M_{y,d}$	σ_m	τ_d
Calculated	0.00	4.98	4.74	5.07	0.37
Allowed	-	-	-	11.08	2.09
	kN	kN	kNm	N/mm	N/mm^2

Unity Check

deflection from live	**0.10**
total deflection	**0.29**
bending stress	**0.46**
shear stress	**0.18**

F.2 - First floor verification



Max length = 4696 mm

For the verification, the most unfavourable joist will be calculated.
This is a single joist with the above length and an effective width of: 600 mm

vertical load on 1st floor joists	(mm)		(kN/m2)		(kN/m)
self weight - 1st floor panels:	600	X	0.24	=	0.15
partition load:	600	X	1.50	=	0.90
				Σg_k =	**1.05**
uniform live load on floor:	600	X	1.50	=	0.90
				Σq_k =	**0.90**
					(kN)
single live load on floor:					2.00
				ΣQ_k =	**2.00**

1st floor verification

Model: 2 point support beam
Check: for vertical forces

load duration class: Medium
consequence class: CC1
climate class: 1

Input data

material: Sawn timber
wood quality: C18

b =	146	mm
h =	214	mm
length =	4696	mm

In the height of the cross section the thickness of plywood is also added as a minimum T-beam cooperation

Cross-section properties (*the effective width from the plywood plate is not taken into account)*

$f_{m,k}$ =	18	$f_{m,d}$ =	11.08	N/mm^2	A =	31244	mm^2
$f_{t,0,k}$ =	11	$f_{t,0,d}$ =	6.77	N/mm^2	W_y =	1114369	mm^3
$f_{t,90,k}$ =	0.4	$f_{t,90,d}$ =	0.22	N/mm^2	I_y =	1.2E+08	mm^4
$f_{c,0,k}$ =	18	$f_{c,0,d}$ =	11.08	N/mm^2	$\rho_{g,k}$ =	320	kg/m^3
$f_{c,90,k}$ =	2.2	$f_{c,90,d}$ =	1.18	N/mm^2			
$f_{v,k}$ =	3.4	$f_{v,d}$ =	2.09	N/mm^2	γ_m =	1.3	
$E_{0.05}$ =	6000	N/mm^2			k_{mod} =	0.8	
E =	9000	N/mm^2			$k_{mod,ft,90,k}$ =	0.7	
$G_{0.05}$ =	560	N/mm^2			k_{def} =	0.6	

Loads

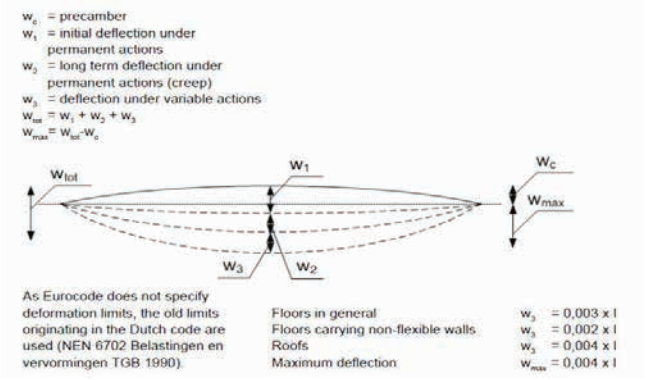
Lineload	permanent	$g_{k,i}$ =	1.05	kN/m	
	live (imposed)	$q_{k,i}$ =	0.90	kN/m	
	ULS		2.76	kN/m	
	SLS		1.95	kN/m	
Pointload	permanent	$G_{k,i}$ =	0.00	kN	
	live	$Q_{k,i}$ =	2.00	kN	
	ULS		3.00	kN	
	SLS		2.00	kN	

Load factors

ULS	γ_g =	1.35
	γ_q =	1.5
SLS	γ_g =	1
	γ_q =	1

Deflections (in mm)

		Calculated	*Allowed*
	w_0 =	0	-
	w_1 =	6.17	-
	w_2 =	3.70	-
(taken as roof)	w_3 =	5.31	18.784
	$w_{ins,max}$ =	11.48	18.784
	$w_{fin,max}$ =	15.18	18.784



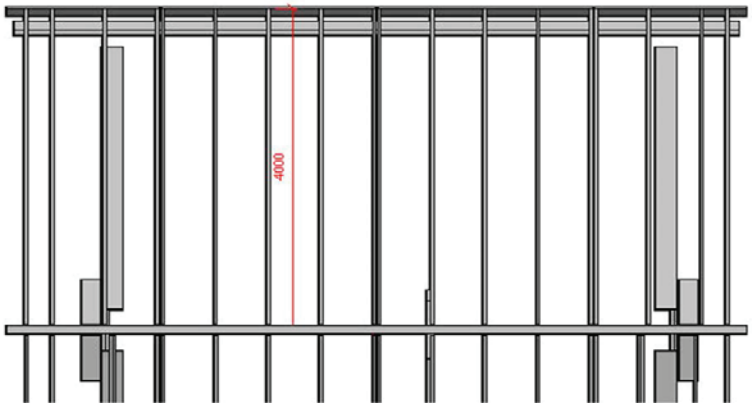
Resulting forces and stresses

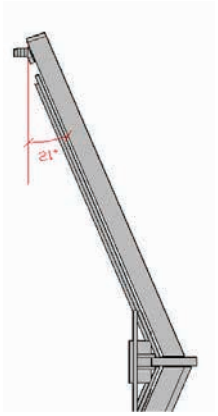
	F_d	V_d	$M_{y,d}$	σ_m	τ_d
Calculated	0.00	6.48	7.61	6.83	0.31
Allowed	-	-	-	11.08	2.09
	kN	kN	kNm	N/mm	N/mm^2

Unity Check

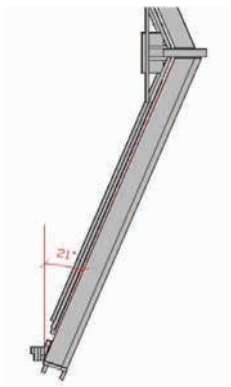
deflection from live	**0.28**
total deflection	**0.81**
bending stress	**0.62**
shear stress	**0.15**

R - Roof verification









Horizontal = 4000 mm
Max length = 4285 mm (*horizontal/cos21)*

For the verification, the most unfavourable joist will be calculated in each side.
This is a single joist with the above max length and an effective width of: 600 mm
As it can be seen above, the form of the roof is the same for both sides, only the cross section of the joists change.

The forces are calculated by a separate structural analysis. The summary of results can be found below:

15. Internal forces on member

Linear calculation, Extreme : Cross-section, System : LCS
Selection : All
Class : All ULS

Member	CSS	dx [m]	Case	N [kN]	Vz [kN]	My [kNm]
B1	left beam (south side) - RECT	0,000	ULS5 snow/1	-1,30	2,49	0,00
B1	left beam (south side) - RECT	4,285	ULS5 snow/1	1,30	-4,27	-3,82
B1	left beam (south side) - RECT	1,714	ULS5 snow/1	-0,26	-0,22	1,95
B3	right beam (north side) - RECT	4,285	ULS5 snow/1	-1,60	-3,28	0,00
B3	right beam (north side) - RECT	0,000	ULS5 snow/1	1,60	5,06	-3,82
B3	right beam (north side) - RECT	2,571	ULS5 snow/1	-0,32	0,06	2,76

19. Deformations on member

Linear calculation, Extreme : Cross-section
Selection : All
Class : All SLS

Member	dx [m]	Case	ux [mm]	uz [mm]	fiy [mrad]	Resultant [mm]
B1	2,142	SLS5 snow/2	0,0	-5,6	-1,2	5,6
B1	0,000	SLS1 wind left1/3	0,0	0,0	1,2	0,0
B1	1,714	SLS5 snow/2	0,0	-5,9	0,4	5,9
B1	3,856	SLS3 wind right 1/4	0,0	0,2	0,2	0,2
B1	2,999	SLS5 snow/2	0,0	-3,4	-3,2	3,4
B1	0,000	SLS5 snow/2	0,0	0,0	5,1	0,0
B3	2,142	SLS5 snow/2	0,0	-4,2	0,5	4,2
B3	2,571	SLS5 snow/2	0,0	-4,2	-0,5	4,2
B3	4,285		0,0	0,0		0,0
B3	0,857	SLS5 snow/2	0,0	-1,8	2,1	1,8

B1 = South roof
B3 = North roof

North roof verification

Model: 2 point support beam
Check: for vertical forces

Input data

material:	Sawn timber		load duration class:	Short
wood quality:	C24		resulting class:	CC1
b =	38	mm	climate class:	1
h =	285	mm		
length =	4285	mm		

Cross-section properties (*the effective width from the plywood plate is not taken into account)*

$f_{m,k}$ =	24	$f_{m,d}$ =	16.62	N/mm^2	A =	10830	mm^2
$f_{t,0,k}$ =	14	$f_{t,0,d}$ =	9.69	N/mm^2	W_y =	514425	mm^3
$f_{t,90,k}$ =	0.4	$f_{t,90,d}$ =	0.25	N/mm^2	I_y =	7.3E+07	mm^4
$f_{c,0,k}$ =	21	$f_{c,0,d}$ =	14.54	N/mm^2	$\rho_{g,k}$ =	350	kg/m^3
$f_{c,90,k}$ =	2.5	$f_{c,90,d}$ =	1.54	N/mm^2			
$f_{v,k}$ =	4	$f_{v,d}$ =	2.77	N/mm^2	γ_m =	1.3	
$E_{0.05}$ =	7400	N/mm^2			k_{mod} =	0.9	
E =	11000	N/mm^2			$k_{mod,ft,90,k}$ =	0.8	
$G_{0.05}$ =	690	N/mm^2			k_{def} =	0.6	

Loads

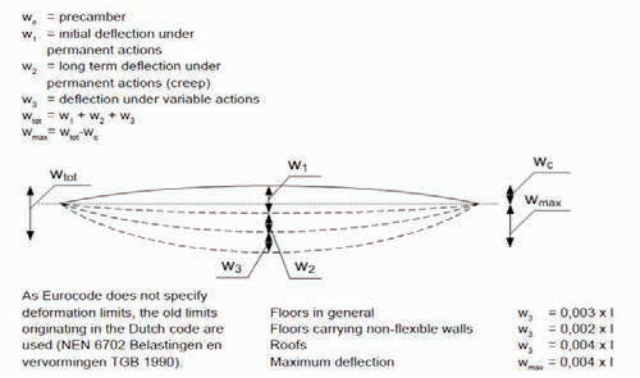
Lineload	permanent	$g_{k,i}$ =	-	kN/m	
	live (imposed)	$q_{k,i}$ =	-	kN/m	
	ULS		-	kN/m	
	SLS		-	kN/m	
Pointload	permanent	$G_{k,i}$ =	-	kN	
	live	$Q_{k,i}$ =	-	kN	
	ULS		-	kN	
	SLS		-	kN	

Load factors

ULS	γ_g =	1.35
	γ_q =	1.5
SLS	γ_g =	1
	γ_q =	1

Deflections (in mm)

		Calculated	*Allowed*
	w_0 =	0	-
	w_1 =	-	-
	w_2 =	-	-
(taken as roof)	w_3 =	-	17.14
	$w_{ins,max}$ =	*4.20*	17.14
	$w_{fin,max}$ =	6.72	17.14



Resulting forces and stresses

	F_d	V_d	$M_{y,d}$	σ_m	τ_d
Calculated	0.00	*5.06*	*3.82*	7.43	0.70
Allowed	-	-	-	16.62	2.77
	kN	kN	kNm	N/mm	N/mm^2

Unity Check

deflection from live	**-**
total deflection	**0.39**
bending stress	**0.45**
shear stress	**0.25**

South roof verification

Model: 2 point support beam
Check: for vertical forces

Input data

material:	Sawn timber		load duration class:	Short
wood quality:	C24		resulting class:	CC1
b =	38	mm	climate class:	1
h =	215	mm		
length =	4285	mm		

Cross-section properties (*the effective width from the plywood plate is not taken into account)*

$f_{m,k}$ =	24	$f_{m,d}$ =	16.62	N/mm^2	A =	8170	mm^2
$f_{t,0,k}$ =	14	$f_{t,0,d}$ =	9.69	N/mm^2	W_y =	292758	mm^3
$f_{t,90,k}$ =	0.4	$f_{t,90,d}$ =	0.25	N/mm^2	I_y =	3.1E+07	mm^4
$f_{c,0,k}$ =	21	$f_{c,0,d}$ =	14.54	N/mm^2	$\rho_{g,k}$ =	350	kg/m^3
$f_{c,90,k}$ =	2.5	$f_{c,90,d}$ =	1.54	N/mm^2			
$f_{v,k}$ =	4	$f_{v,d}$ =	2.77	N/mm^2	γ_m =	1.3	
$E_{0.05}$ =	7400	N/mm^2			k_{mod} =	0.9	
E =	11000	N/mm^2			$k_{mod,ft,90,k}$ =	0.8	
$G_{0.05}$ =	690	N/mm^2			k_{def} =	0.6	

Loads

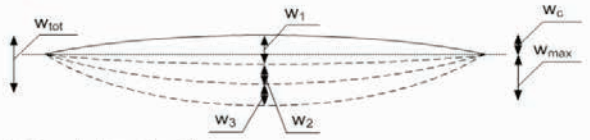
Load factors

Lineload	permanent	$g_{k,j}$ =	-	kN/m	*ULS*	γ_g = 1.35
	live (imposed)	$q_{k,j}$ =	-	kN/m		γ_q = 1.5
	ULS		-	kN/m		
	SLS		-	kN/m	*SLS*	γ_g = 1
						γ_q = 1
Pointload	permanent	$G_{k,j}$ =	-	kN		
	live	$Q_{k,j}$ =	-	kN		
	ULS		-	kN		
	SLS		-	kN		

Deflections (in mm)

		Calculated	*Allowed*
	w_0 =	0	-
	w_1 =	-	-
	w_2 =	-	-
(taken as roof)	w_3 =	-	17.14
	$w_{ins,max}$ =	5.90	17.14
	$w_{fin,max}$ =	9.44	17.14

w_c = precamber
w_1 = initial deflection under permanent actions
w_2 = long term deflection under permanent actions (creep)
w_3 = deflection under variable actions
$w_{tot} = w_1 + w_2 + w_3$
$w_{max} = w_{tot} - w_c$



As Eurocode does not specify deformation limits, the old limits originating in the Dutch code are used (NEN 6702 Belastingen en vervormingen TGB 1990).

Floors in general	w_3 = 0,003 x l
Floors carrying non-flexible walls	w_3 = 0,002 x l
Roofs	w_3 = 0,004 x l
Maximum deflection	w_{max} = 0,004 x l

Resulting forces and stresses

	F_d	V_d	$M_{y,d}$	σ_m	τ_d
Calculated	0.00	4.27	3.82	13.05	0.78
Allowed	-	-	-	16.62	2.77
	kN	kN	kNm	N/mm	N/mm^2

Unity Check

deflection from live	**-**
total deflection	**0.55**
bending stress	**0.79**
shear stress	**0.28**

W. HSB Walls - General data and loads

Design principle of HSB walls

The HSB elements are stacked on the foundation. On each floor the HSB walls are connected horizontally to the floor by means of a steel strip/anchor rail and Fischer FAZ. II 10/10 anchors on the floor.
Because the walls are stacked, these walls are dimensioned by the largest vertical load for each of them, while the wind load remains the same.
On the following pages the walls are dimensioned based on their geometric and material characteristics.
The side walls will not have any outer leaf, simulating the side walls of real middle row-house.
The back façade as well as the "neighbour walls" (the small, non-load bearing extensions of the facades, that simulate the neighbouring walls of the row house) will be cladded in brick system of 1/2 width of the typical size.
The front façade is bearing an extra panel of insulation from the sponsor STO, using light & thin brick slips as cladding.

Openings - detailing

In principle above the window frames a trimmer joist is placed. This joist is made, for construction reasons, from a series of glued timber planks of 38x140mm dimensions. Their number is defined by the structural bending capacity needed for the wall above and for construction reasons, in case that no other studs can fit above them.

At small frame openings the trimmer beams above the openings are connected to the jamb studs through a cross-cut compound of nails ø 3.1-90, whereas the length of the nails is dependent on the size of the studs. When there is a double stud, more length is required to achieve the desired connection. For larger openings the trimmer will transfer the vertical load to a half stud and the rest will be transferred to the jamb stud below. The half-stud will be connected to the jamb stud.

Side walls - Loads

				ground	*2.6*	*m*
max height	hmax	6.1	m	*1st floor*	*3.5*	*m*
min height	hmin	4.675	m	*1st floor*	*2.1*	*m*
building width	b	8	m			
building depth	d	6	m			
Geometric factor	e min(b,2h)	8	m	>d		

Self weight

The self weight of the wall will be different along its length, due to its th

Dead load for HSB without outer leaf		0.59	kN/m2
Average dead load per m on ground level		3.16	kN/m
	(level) Ground	1st floor	
Max dead load (higher stud)	**2.15**	**1.23**	kN
Min dead load (lower stud)	**1.65**	**0.73**	kN

Transferred load

It is first noted that the side walls transfer mainly the floor and staircase load from the 1st storey. The ridge forces of the roof and the glasshouse, although mentioned as part of the side walls loads, they are in fact transferred by the chimney structure which will be verified separately in the future.

The remaining transferred loads will be assigned to the studs according to their location on the side walls.
For the most unfavourable situation, the studs of the east wall are calculated.

	dead		live (imposed)		*These loads will be combined with*
Level : Ground	kN/m	kN	kN/m	kN	*the wind load below with a 0.6 factor*
higher stud	4.06	**2.44**	3.50	**2.10**	**(per stud)**
lower stud	4.06	**2.44**	3.50	**2.10**	**(per stud)**

Wind loads

Peak veloc. Pressure q_p (z) 0.71 kN/m^2 (z = 6.1m)

0.6 kN/m^2 (z = 0)

Side wind

For e>d, the walls are loaded by Zone A suction for length of e/5 =1.6m from its sides and Zone B for the central area.

The C_{pe} factors are: Zone A : -1.2 (combined with min dead load)

Zone B : -0.8 (combined with max dead load)

Wind towards the side walls

			Zone D	Zone E
For a h/d factor of :	*(max h)*	h/d = 1.02	0.8	-0.5
	(min h)	h/d = 0.78	0.77	-0.44

Internal loads

internal pressure -0.3

internal suction 0.2

The internal load factors will be added accordingly to the extrnal wind load factors.

per stud	Max suction			Max pressure		
	factor (max ext. suction + int. pressure)	load (kN/m)		factor (max ext. pressure + int. suction)	load (kN/m)	
		top	ground		top	ground
max h stud	-1.1	-0.47	-0.40	1	0.43	0.36
min h stud	-1.5	-0.64	-0.54	0.97	0.41	0.35

(*the loads are calculated as* $qw = c_s c_d *(C_{pe}^{int} + C_{pe}^{ext})*q_p(z)*l_{c.t.c}$)

W1. Side façade - Studs subjected to bending or bending and compression (no openings)

Model: 2 point support stud

Check: stud subjected to bending or bending and compression (no openings)

Higher stud - 1st floor

stud dimension		b =	38	mm		h =	244	mm	
		c.t.c. =	600	mm					
wood quality		C18		Sawn timber				γ_m =	1.3
	E0.05 =	6000	N/mm²		I_y =	46001483	mm⁴	i_y =	70.44
	$f_{m,k}$ =	18	N/mm²		I_z =	1115730.7	mm⁴	i_z =	10.97
	$f_{c,0,k}$ =	18	N/mm²		A =	9272	mm²	I_t =	4025044.107
	$f_{v,k}$ =	3.4	N/mm²		E =	9000	N/mm²	W_y =	377061.3333
				γG,k	γq,k			G0.05 =	560
Consequence class		CC1		1.35	1.5				
Climate class: 1		Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year							
load duration class		Short		Less than 1 week					
k_{mod} =		0.9		e.g. snow, wind					

buckling length	1886	mm
Gk =	1.23	kN
qk (wind)=	-0.43	kN/m

							UC
M_d (kNm) =	0.29	σ_{md} =	0.76	f_{md} =	12.46	N/mm²	**0.06**
N_d (kN) =	1.66	$\sigma_{c,0,d}$ =	0.18	$f_{c,0,d}$ =	12.46	N/mm²	**0.01**
V_d (kN) =	0.61	τ_d =	0.10	$f_{v,d}$ =	2.35	N/mm²	**0.04**
wtot (mm) =	0.17		max def 1/300xL =		6.29		**0.03**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

λ_y = 26.78 $\lambda_{rel,y}$ = 0.47

λ_z = 171.93 $\lambda_{rel,z}$ = 3.00

k_y = 0.63 $k_{c,y}$ = 0.96

k_z = 5.26 $k_{c,z}$ = 0.10

Buckling y - U.C. = 0.02

Buckling z - U.C. = 0.14

Flexural torsional buckling

$$\sigma_{m,crit} = \frac{\pi}{W_y l_{ef}}\sqrt{E_{0.05} I_z G_{0.05} I_t}, \text{ where } I_t \approx \frac{1}{3} h b^3 (1 - 0.63 \cdot \frac{b}{h})$$

$l_{ef} = m * l$, where l is de span

$$\lambda_{rel} = \sqrt{\frac{f_{m,k}}{\sigma_{m,crit}}}$$

When:

$\lambda_{rel} \le 0.75$ $k_{crit} = 1$

$0.75 < \lambda_{rel} \le 1.4$ $k_{crit} = 1.56 - 0.75\lambda_{rel}$

$1.4 < \lambda_{rel}$ $k_{crit} = \frac{1}{\lambda_{rel}^2}$

Requirement

$\sigma_{m,d} < k_{crit} f_{m,d}$

Stud type: two point support → m = 0.88

Loading type: uniform load

Leff = 1659.68 mm

$\sigma_{m,crit}$ = 19.50 N/mm²

$\lambda_{rel,m}$ = 0.96

k_{crit} = 0.84 (0.75<λrel<1.4)



$$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{k_{c,z} f_{c,0,d}} \le 1$$

U.C. = 0.14

Lower stud - 1st floor

stud dimension		b =	38	mm		h =	244	mm
		c.t.c. =	600	mm				
wood quality		C18		Sawn timber			γ_m =	1.3
	$E0.05$ =	6000	N/mm^2		I_y =	46001483	mm^4	i_y = 70.44
	$f_{m,k}$ =	18	N/mm^2		I_z =	1115730.7	mm^4	i_z = 10.97
	$f_{c,0,k}$ =	18	N/mm^2		A =	9272	mm^2	I_t = 4025044.107
	$f_{v,k}$ =	3.4	N/mm^2		E =	9000	N/mm^2	W_y = 377061.3333
			γG,k	γq,k				G0.05 = 560
Consequence class	CC1		1.35	1.5				

Climate class: 1 — Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year

load duration class	Short	Less than 1 week
k_{mod} =	0.9	e.g. snow, wind

buckling length	1886 mm
Gk =	0.73 kN
qk (wind)=	-0.59 kN/m

							UC
M_d (kNm) =	0.39	σ_{md} =	1.04	f_{md} =	12.46	N/mm^2	**0.08**
N_d (kN) =	0.99	$\sigma_{c,0,d}$ =	0.11	$f_{c,0,d}$ =	12.46	N/mm^2	**0.01**
V_d (kN) =	0.83	τ_d =	0.13	$f_{v,d}$ =	2.35	N/mm^2	**0.06**
wtot (mm) =	0.23	max def 1/300xL =			6.29		**0.04**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y = 26.78 — $\lambda_{rel,y}$ = 0.47

λ_z = 171.93 — $\lambda_{rel,z}$ = 3.00

k_y = 0.63 — $k_{c,y}$ = 0.96

k_z = 5.26 — $k_{c,z}$ = 0.10

Buckling y - U.C. = 0.01

Buckling z - U.C. = 0.08

Flexural torsional buckling

$$\sigma_{m,crit} = \frac{\pi}{W_y l_{ef}}\sqrt{E_{0.05} I_z G_{0.05} I_t}, \text{ where } I_t \approx \frac{1}{3} h b^3 (1 - 0.63 \cdot \frac{b}{h})$$

$l_{ef} = m * l$, where l is de span

$$\lambda_{rel} = \sqrt{\frac{f_{m,k}}{\sigma_{m,crit}}}$$

When:

$\lambda_{rel} \le 0.75$ — $k_{crit} = 1$

$0.75 < \lambda_{rel} \le 1.4$ — $k_{crit} = 1.56 - 0.75\lambda_{rel}$

$1.4 < \lambda_{rel}$ — $k_{crit} = \frac{1}{\lambda_{rel}^2}$

Requirement

$$\sigma_{m,d} < k_{crit} f_{m,d}$$

Stud type: two point support → m = 0.88

Loading type: uniform load

Leff = 1659.68 mm

$\sigma_{m,crit}$ = 19.50 N/mm^2

$\lambda_{rel,m}$ = 0.96

k_{crit} = 0.84 (0.75<λrel<1.4)

$$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{k_{c,z} f_{c,0,d}} \le 1$$

U.C. = 0.09



Higher stud - ground floor

stud dimension		b =	38	mm		h =	244	mm	
		c.t.c. =	600	mm					
wood quality		C18		Sawn timber				γ_m =	1.3
	E0.05 =	6000	N/mm^2		I_y =	46001483	mm^4	i_y =	70.44
	$f_{m,k}$ =	18	N/mm^2		I_z =	1115730.7	mm^4	i_z =	10.97
	$f_{c,0,k}$ =	18	N/mm^2		A =	9272	mm^2	I_t =	4025044.107
	$f_{v,k}$ =	3.4	N/mm^2		E =	9000	N/mm^2	W_y =	377061.3333
				γG,k	γq,k			G0.05 =	560
Consequence class		CC1		1.35	1.5				

Climate class: 1 — Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year

load duration class	Short	Less than 1 week
k_{mod} =	0.9	e.g. snow, wind

buckling length	2300 mm
Gk =	5.84 kN
qk (wind)=	-0.40 kN/m

							UC
M_d (kNm) =	0.39	σ_{md} =	1.04	f_{md} =	12.46	N/mm^2	**0.08**
N_d (kN) =	7.89	$\sigma_{c,0,d}$ =	0.85	$f_{c,0,d}$ =	12.46	N/mm^2	**0.07**
V_d (kN) =	0.68	τ_d =	0.11	$f_{v,d}$ =	2.35	N/mm^2	**0.05**
wtot (mm) =	0.35	max def 1/300xL =			7.67		**0.05**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	32.65	$\lambda_{rel,y}$ =	0.57
λ_z =	209.67	$\lambda_{rel,z}$ =	3.66
k_y =	0.69	$k_{c,y}$ =	0.93
k_z =	7.52	$k_{c,z}$ =	0.07

Buckling y - U.C. = 0.07
Buckling z - U.C. = 0.96

Flexural torsional buckling

$$\sigma_{m,crit} = \frac{\pi}{W_y l_{ef}}\sqrt{E_{0.05} I_z G_{0.05} I_t}, \text{ where } I_t \approx \frac{1}{3} h b^3 (1 - 0.63 \cdot \frac{b}{h})$$

$l_{ef} = m * l$, where l is de span

$$\lambda_{rel} = \sqrt{\frac{f_{m,k}}{\sigma_{m,crit}}}$$

When:

$\lambda_{rel} \le 0.75$	$k_{crit} = 1$
$0.75 < \lambda_{rel} \le 1.4$	$k_{crit} = 1.56 - 0.75\lambda_{rel}$
$1.4 < \lambda_{rel}$	$k_{crit} = \frac{1}{\lambda_{rel}^2}$

Requirement

$$\sigma_{m,d} < k_{crit} f_{m,d}$$

Stud type: two point support → m = 0.88
Loading type: uniform load
Leff = 2024 mm

$\sigma_{m,crit}$ = 15.99 N/mm^2

$\lambda_{rel,m}$ = 1.06

k_{crit} = 0.76 (0.75<λrel<1.4)

$$\left\{\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right\}^2 + \frac{\sigma_{c,0,d}}{k_{c,z} f_{c,0,d}} \le 1$$ **U.C. = 0.97**



Lower stud - ground floor

stud dimension		b =	38	mm		h =	244	mm	
		c.t.c. =	600	mm					
wood quality		C18		Sawn timber			γ_m =	1.3	
	$E_{0.05}$ =	6000	N/mm^2		I_y =	46001483	mm^4	i_y =	70.44
	$f_{m,k}$ =	18	N/mm^2		I_z =	1115730.7	mm^4	i_z =	10.97
	$f_{c,0,k}$ =	18	N/mm^2		A =	9272	mm^2	I_t =	4025044.107
	$f_{v,k}$ =	3.4	N/mm^2		E =	9000	N/mm^2	W_y =	377061.3333
			$\gamma_{G,k}$	$\gamma_{q,k}$				$G_{0.05}$ =	560
Consequence class	CC1		1.35	1.5					

Climate class: 1 — Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year

load duration class	Short	Less than 1 week
k_{mod} =	0.9	e.g. snow, wind

buckling length	2300 mm
Gk =	5.34 kN
qk (wind)=	-0.59 kN/m

							UC
M_d (kNm) =	0.58	σ_{md} =	1.55	f_{md} =	12.46	N/mm^2	**0.12**
N_d (kN) =	7.21	$\sigma_{c,0,d}$ =	0.78	$f_{c,0,d}$ =	12.46	N/mm^2	**0.06**
V_d (kN) =	1.02	τ_d =	0.16	$f_{v,d}$ =	2.35	N/mm^2	**0.07**
wtot (mm) =	0.52	max def 1/300xL =			7.67		**0.07**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	32.65	$\lambda_{rel,y}$ =	0.57
λ_z =	209.67	$\lambda_{rel,z}$ =	3.66
k_y =	0.69	$k_{c,y}$ =	0.93
k_z =	7.52	$k_{c,z}$ =	0.07

Buckling y - U.C. = 0.07

Buckling z - U.C. = 0.88

Flexural torsional buckling

$$\sigma_{m,crit} = \frac{\pi}{W_y l_{ef}}\sqrt{E_{0.05} I_z G_{0.05} I_t}\ , \text{ where } I_t \approx \frac{1}{3} h b^3 (1 - 0.63 \cdot \frac{b}{h})$$

$l_{ef} = m * l$, where l is de span

$$\lambda_{rel} = \sqrt{\frac{f_{m,k}}{\sigma_{m,crit}}}$$

When:

$\lambda_{rel} \le 0.75$	$k_{crit} = 1$
$0.75 < \lambda_{rel} \le 1.4$	$k_{crit} = 1.56 - 0.75\lambda_{rel}$
$1.4 < \lambda_{rel}$	$k_{crit} = \frac{1}{\lambda_{rel}^2}$

Requirement

$$\sigma_{m,d} < k_{crit} f_{m,d}$$

Stud type: two point support → m = 0.88

Loading type: uniform load

Leff = 2024 mm

$\sigma_{m,crit}$ = 15.99 N/mm^2

$\lambda_{rel,m}$ = 1.06

k_{crit} = 0.76 (0.75<λrel<1.4)

$$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{k_{c,z} f_{c,0,d}} \le 1$$

U.C. = 0.91



Front/back façade				*ground*	*2.6*	*m*
height	h	4.675	m	*1st floor*	*2.075*	*m*
building width	b	6	m			
building depth	d	8	m			
Geometric factor	e min(b,2h)	6	m	>d		

Dead loads

North façade

Dead load for HSB with cladding	0.75	kN/m2		
Average dead load per m	3.51	kN/m		
Max dead load (full height stud)	1.40 (ground lvl)	0.62 (1st lvl)	kN	*(c.t.c. - 400mm)*

South façade

Dead load for HSB with brick cladding	1.06	kN/m2		
Average dead load per m	4.97	kN/m		
Max dead load (full height stud)	1.99 (ground lvl)	0.88 (1st lvl)	kN	*(c.t.c. - 400mm)*

Transferred load

	dead		live (wind)		
Level : Ground	kN/m	kN	kN/m	kN	
North façade	2.90	**1.16**	0.88	**0.35**	**(per stud)**
South façade	1.86	**0.74**	0.88	**0.35**	**(per stud)**

Wind loads

Peak veloc. Pressure q_p (z) 0.63 kN/m^2 (z = 4.675m)

0.6 kN/m^2 (z = 0)

Side wind

For e>d, the walls are loaded by Zone A suction for length of e/5 =1.2m from its sides and Zone B for the central area.

The C_{pe} factors are: Zone A : -1.2

Zone B : -0.8

Wind towards the front façade

		Zone D	Zone E
For a h/d factor of :	h/d = 0.58	0.74	-0.39

Internal loads

internal pressure -0.3

internal suction 0.2

The internal load factors will be added accordingly to the extrnal wind load factors.

	Max suction			Max pressure		
	factor (max ext. suction + int. pressure)	load (kN/m)		factor (max ext. pressure + int. suction)	load (kN/m)	
		top	ground		top	ground
stud in distance < 1.2m from side	-1.5	-0.57	-0.54	0.94	0.36	0.34

W2. Front façade - Studs subjected to bending or bending and compression

Full height stud - Ground floor (**critical**)

stud dimension		b =	38	mm		h =	170	mm	
		c.t.c. =	400	mm					
wood quality		C18		Sawn timber			γ_m =	1.3	
	$E_{0.05}$ =	6000	N/mm^2		I_y =	15557833	mm^4	i_y =	49.07
	$f_{m,k}$ =	18	N/mm^2		I_z =	777353.33	mm^4	i_z =	10.97
	$f_{c,0,k}$ =	18	N/mm^2		A =	6460	mm^2	I_t =	2671534.773
	$f_{v,k}$ =	3.4	N/mm^2		E =	9000	N/mm^2	W_y =	183033.3333
			$\gamma G,k$	$\gamma q,k$				G0.05 =	560
Consequence class	CC1		1.35	1.5					
Climate class: 1	Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year								
load duration class	Short	Less than 1 week							
k_{mod} =	0.9	e.g. snow, wind							

buckling length	2100 mm
Gk =	2.92 kN
qk (wind)=	-0.55 kN/m

							UC
M_d (kNm) =	0.46	σ_{md} =	2.50	f_{md} =	12.46	N/mm^2	**0.20**
N_d (kN) =	3.94	$\sigma_{c,0,d}$ =	0.61	$f_{c,0,d}$ =	12.46	N/mm^2	**0.05**
V_d (kN) =	0.87	τ_d =	0.20	$f_{v,d}$ =	2.35	N/mm^2	**0.09**
wtot (mm) =	1.00		max def 1/300xL =		7.00		**0.14**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y = 42.79 $\lambda_{rel,y}$ = 0.75

λ_z = 191.44 $\lambda_{rel,z}$ = 3.34

k_y = 0.82 $k_{c,y}$ = 0.85

k_z = 6.37 $k_{c,z}$ = 0.08

Buckling y - U.C. = 0.06

Buckling z - U.C. = 0.58

Flexural torsional buckling

$$\sigma_{m,crit} = \frac{\pi}{W_y l_{ef}}\sqrt{E_{0.05} I_z G_{0.05} I_t}, \text{ where } I_t \approx \frac{1}{3} h b^3 (1 - 0.63 \cdot \frac{b}{h})$$

$l_{ef} = m * l$, where l is de span

$$\lambda_{rel} = \sqrt{\frac{f_{m,k}}{\sigma_{m,crit}}}$$

When:

$\lambda_{rel} \le 0.75$ $k_{crit} = 1$

$0.75 < \lambda_{rel} \le 1.4$ $k_{crit} = 1.56 - 0.75\lambda_{rel}$

$1.4 < \lambda_{rel}$ $k_{crit} = \frac{1}{\lambda_{rel}^2}$

Requirement

$$\sigma_{m,d} < k_{crit} f_{m,d}$$



Stud type: two point support → m = 0.88

Loading type: uniform load

Leff = 1848 mm

$\sigma_{m,crit}$ = 24.53 N/mm^2

$\lambda_{rel,m}$ = 0.86

k_{crit} = 0.92 (0.75<λrel<1.4)

$$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{k_{c,z} f_{c,0,d}} \le 1$$

U.C. = 0.63

W3. Back façade - Studs subjected to bending or bending and compression

Full height stud - Ground floor

stud dimension		b =	38	mm		h =	105	mm
		c.t.c. =	400	mm				
wood quality		C18		Sawn timber			γ_m =	1.3
	E0.05 =	6000	N/mm²		I_y =	3665812.5	mm⁴	i_y = 30.31
	$f_{m,k}$ =	18	N/mm²		I_z =	480130	mm⁴	i_z = 10.97
	$f_{c,0,k}$ =	18	N/mm²		A =	3990	mm²	I_t = 1482641.44
	$f_{v,k}$ =	3.4	N/mm²		E =	9000	N/mm²	W_y = 69825
			γG,k	γq,k				G0.05 = 560
Consequence class	CC1		1.35	1.5				

Climate class: 1 — Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year

load duration class	Short	Less than 1 week
k_{mod} =	0.9	e.g. snow, wind

buckling length	1920 mm
Gk =	2.73 kN
qk (wind)=	-0.55 kN/m

							UC
M_d (kNm) =	0.38	σ_{md} =	5.48	f_{md} =	12.46	N/mm²	**0.44**
N_d (kN) =	3.69	$\sigma_{c,0,d}$ =	0.92	$f_{c,0,d}$ =	12.46	N/mm²	**0.07**
V_d (kN) =	0.80	τ_d =	0.20	$f_{v,d}$ =	2.35	N/mm²	**0.08**
wtot (mm) =	2.97		max def 1/300xL =		6.40	mm	**0.46**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y = 63.34 — $\lambda_{rel,y}$ = 1.10

λ_z = 175.03 — $\lambda_{rel,z}$ = 3.05

k_y = 1.19 — $k_{c,y}$ = 0.61

k_z = 5.43 — $k_{c,z}$ = 0.10

Buckling y - U.C. = 0.12

Buckling z - U.C. = 0.74

Flexural torsional buckling

$$\sigma_{m,crit} = \frac{\pi}{W_y l_{ef}}\sqrt{E_{0.05} I_z G_{0.05} I_t}, \text{ where } I_t \approx \frac{1}{3} h b^3 (1 - 0.63 \cdot \frac{b}{h})$$

$l_{ef} = m * l$, where l is de span

$$\lambda_{rel} = \sqrt{\frac{f_{m,k}}{\sigma_{m,crit}}}$$

When:

$\lambda_{rel} \le 0.75$ — $k_{crit} = 1$

$0.75 < \lambda_{rel} \le 1.4$ — $k_{crit} = 1.56 - 0.75\lambda_{rel}$

$1.4 < \lambda_{rel}$ — $k_{crit} = \frac{1}{\lambda_{rel}^2}$

Requirement

$$\sigma_{m,d} < k_{crit} f_{m,d}$$



Stud type: two point support → m = 0.88

Loading type: uniform load

Leff = 1689.6 mm

$\sigma_{m,crit}$ = 41.18 N/mm²

$\lambda_{rel,m}$ = 0.66

k_{crit} = 1.06 (0.75<λrel<1.4)

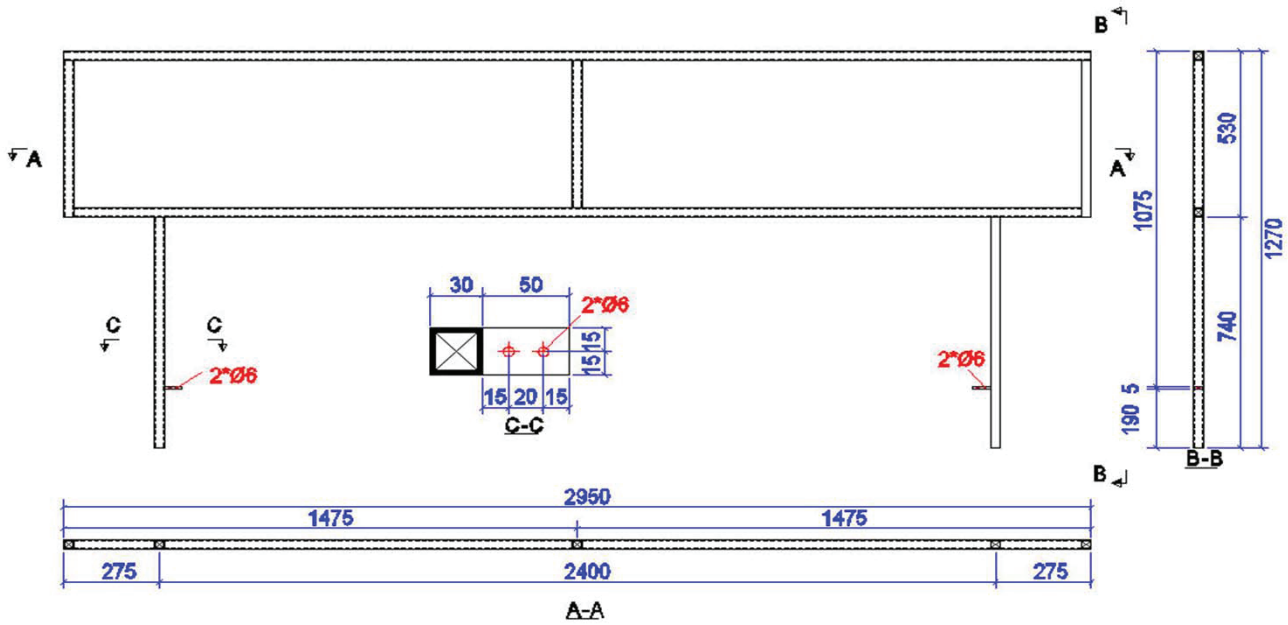
$$\left(\frac{\sigma_{m,d}}{k_{crit} f_{m,d}}\right)^2 + \frac{\sigma_{c,0,d}}{k_{c,z} f_{c,0,d}} \le 1$$

U.C. = 0.91

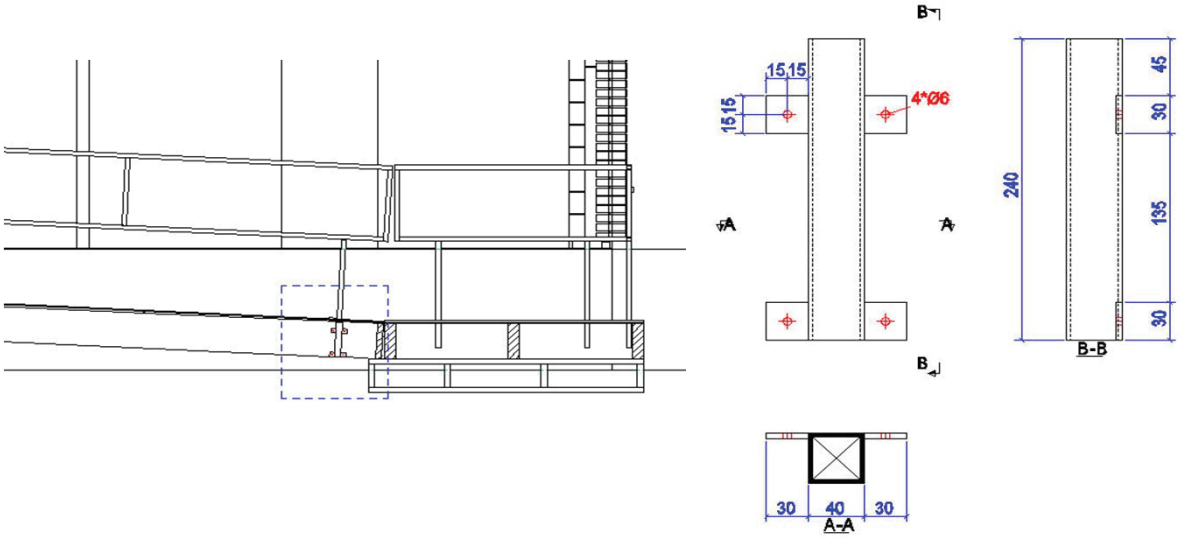
H. Handrail verification

Below the handrail connection with the panel will be verified.

The handrail is made of profiles QHS 30x3 and a steel quality of S235. The bolts are taken as M6, 8.8 quality. It is placed only in the public area of the, ground floor and its general form is presented below:



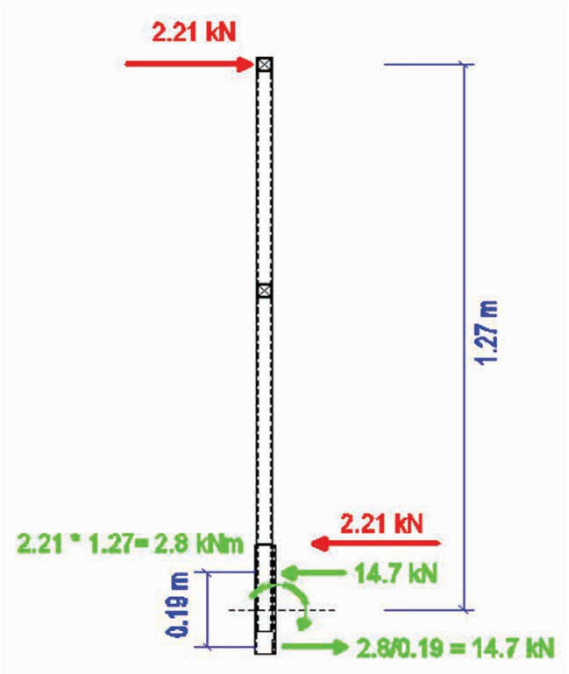
The connection seen above provides the in plane resistance and stability of the handrail structure. For the out of plane resistance, the extensions seen above are inserted in a steel socket that is then bolted on the sides of the timber floor panel. This connection is designed as:

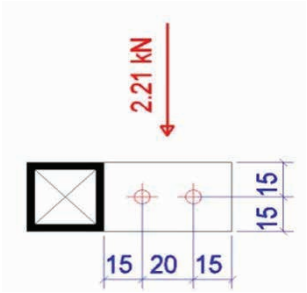


According the French standard NF P 01-012 and the SD BC 51.6 (2) the handrail has to be verified against a horizontal live load of 1.0 kN/m (public space) applied at 1.00m. The self weight will not be taken into account, as it is applied vertically and its minor in comparison with the horizontal live load.

Each handrail column and connection will receive half of the design horizontal load that is applied in the total length of the handrail which is L = 2950mm. Therefore the total design load would be:
$F_d = q_d * L /2 = q * \gamma_d * L /2 = 1.5 * 1 * 2.95 /2 = 2.21kN$

This design load will be cause to the column a shear force and a bending moment as shown in the following.





Shear force

It is assumed that because of its positioning the first in plane connetion will resist the horizontal load with its shear resistance.

The shear resistance of one bolt for one shear plane is:

$F_{v,d} = 0.48*f_{t;b;rep}*A_b /\gamma_{m2} = 0.48 * 800 *0.25*\pi*6^2 /1.25= 10.86$ kN

The bearing resistance, assuming that the steel plate will be the weakest plane, is:

$F_{v;u;d} = 2*a_c*a_{red1}*f_{t;rep}*d_{bnorm}*t /\gamma_m = 2* \min(1;15/3*7;800/235)*1*235*6*3/1.05= 5.76$ kN

Unity check: 2.21/5.76 = 0.4

Therefore the upper in plane connection can easily carry the horizontal force.

Bending moment

The bending moment will be taken by the lower connection through the tensile resistance of the bolts.

As seen in the figure above, each pair of bolts receives 14.7kN, therefore the design tension per bolt will be 14.7/2 = 7.39kN

The shear resistance of one bolt is:

$F_{v,d} = 0.72*a_{red2}*f_{t;b;rep}*A_b /\gamma_{m2} = 0.72 * 800 *0.25*\pi*6^2 /1.25= 16.29$ kN

Unity check: 7.39/16.29 = 0.45

Therefore the lower/out of plane connection can easily carry the bending moment.

A. Assembly load verification

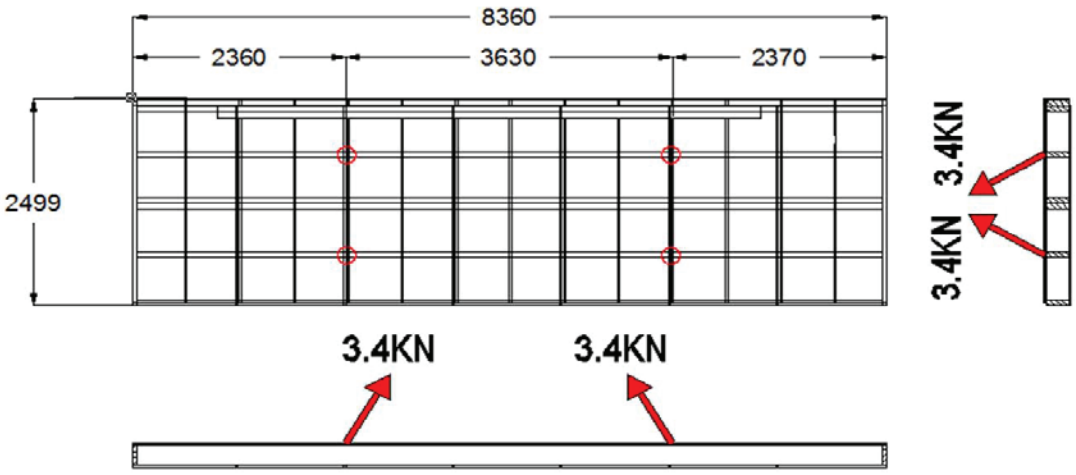
In the following the loads from self weight that the building elements have to withstand during assembly will be calculated and validated.

The loading points have been found according to the construction sequence that was followed in the first test construction of the Prototype house in the Netherlands. The load is the self-weight of the panels, distributed at this loading points.

The drawings below have been extracted from final construction documents of the timber frame panels and represent the worst case scenario for each component type. Their self weight is calculated by multiplying the panel's net area (without the openings) with the weight per m2 as calculated before.

The verification will follow the same procedure as before, depending on the type and the direction of the load in relation with the element.

Ground floor panel



Net area (m^2): 20.89	weight	1194.4	kg
		11.9	kN
	Rv=	3.0	kN
	R=	3.4	kN
	Rh=	1.7	kN

Verification needed:

Buckling against the horizontal load Rh and for a length of 3.63m.

The bending check for the self weight has been already performed before, as the lifting points are about the same as the support points in the structure.

Ground floor panel - buckling

stud dimension		b =	71	mm		h =	245	mm	
		c.t.c. =	600	mm					
wood quality		C18		Sawn timber			γ_m =	1.3	
	$E_{0.05}$ =	6000	N/mm^2		I_y =	87011240	mm^4	i_y =	70.73
	$f_{m,k}$ =	18	N/mm^2		I_z =	7307349.6	mm^4	i_z =	20.50
	$f_{c,0,k}$ =	18	N/mm^2		A =	17395	mm^2	I_t =	23892945.32
	$f_{v,k}$ =	3.4	N/mm^2		E =	9000	N/mm^2	W_y =	710295.8333
			γG,k	γq,k				$G_{0.05}$ =	560
Consequence class	CC1		1.35	1.5					

Climate class: 1 — Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year

load duration class: Instantaneous

k_{mod} = 1.1

buckling length	3630 mm
Gk =	1.70 kN
qk (wind)=	0.00 kN/m

							UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23	N/mm^2	**0.00**
N_d (kN) =	2.30	$\sigma_{c,0,d}$ =	0.13	$f_{c,0,d}$ =	15.23	N/mm^2	**0.01**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88	N/mm^2	**0.00**
wtot (mm) =	0.00		max def 1/300xL =		12.10		**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c.0.k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

Requirement

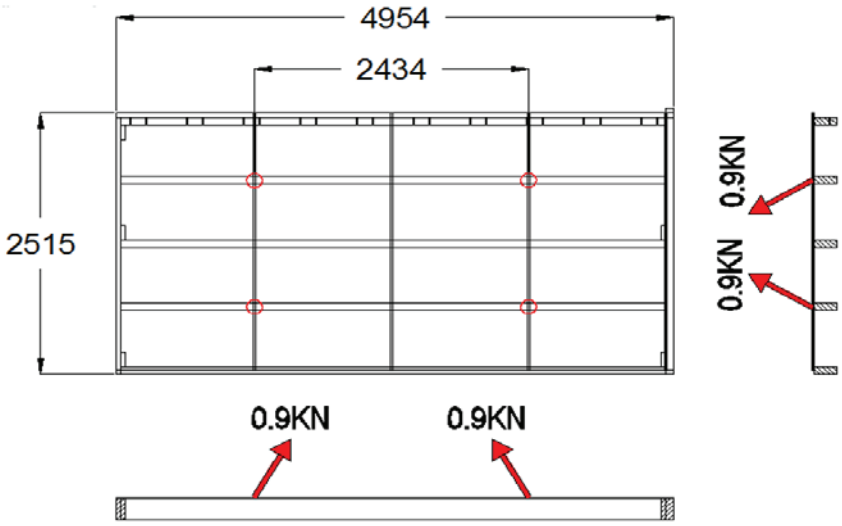
$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	51.33	$\lambda_{rel,y}$ =	0.89
λ_z =	177.11	$\lambda_{rel,z}$ =	3.09
k_y =	0.96	$k_{c,y}$ =	0.77
k_z =	5.55	$k_{c,z}$ =	0.10

Buckling y - U.C. = 0.01

Buckling z - U.C. = 0.09

1st floor panel



Net area (m^2): 11.92	weight	320.3	kg
		3.2	kN
	Rv=	0.8	kN
	R=	0.9	kN
	Rh=	0.5	kN

Verification needed:

Buckling against the horizontal load Rh and for a length of 2.434m.

The bending check for the self weight has been already performed before, as the lifting points are about the same as the support points in the structure.

1st floor panel - buckling

stud dimension		b =	70	mm		h =	196	mm	
		c.t.c. =	600	mm					
wood quality		C18		Sawn timber			γ_m =	1.3	
	$E_{0.05}$ =	6000	N/mm^2		I_y =	43922293	mm^4	i_y =	56.58
	$f_{m,k}$ =	18	N/mm^2		I_z =	5602333.3	mm^4	i_z =	20.21
	$f_{c,0,k}$ =	18	N/mm^2		A =	13720	mm^2	I_t =	17367233.33
	$f_{v,k}$ =	3.4	N/mm^2		E =	9000	N/mm^2	W_y =	448186.6667
			$\gamma G,k$	$\gamma q,k$				G0.05 =	560
Consequence class	CC1		1.35	1.5					

Climate class: 1 — Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year

load duration class — Instantaneous

k_{mod} = 1.1

buckling length	2.434 mm
Gk =	0.50 kN
qk (wind)=	0.00 kN/m

							UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23	N/mm^2	**0.00**
N_d (kN) =	0.68	$\sigma_{c,0,d}$ =	0.05	$f_{c,0,d}$ =	15.23	N/mm^2	**0.00**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88	N/mm^2	**0.00**
wtot (mm) =	0.00	max def 1/300xL =			0.01		**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

Requirement

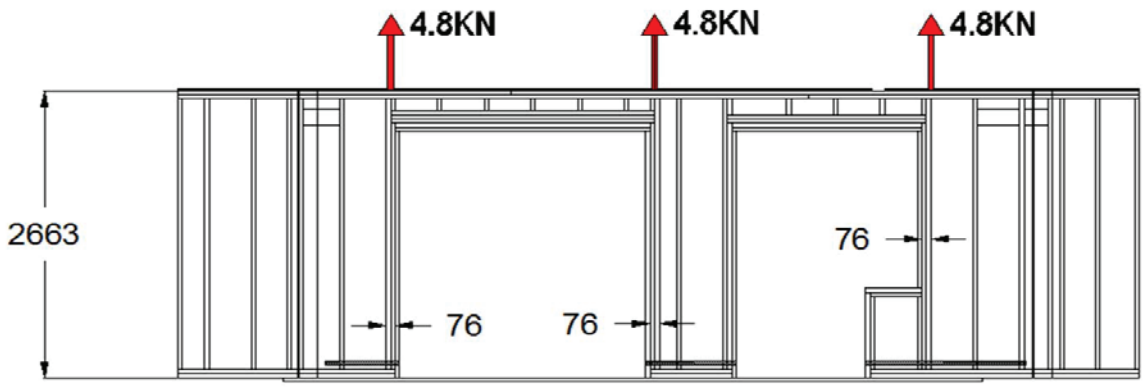
$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	0.04	$\lambda_{rel,y}$ =	0.00
λ_z =	0.12	$\lambda_{rel,z}$ =	0.00
k_y =	0.47	$k_{c,y}$ =	1.06
k_z =	0.47	$k_{c,z}$ =	1.06

Buckling y - U.C. = 0.00

Buckling z - U.C. = 0.00

South side façade - ground floor



Net area (m^2):	13.63	weight	1448.7	kg
			14.5	kN
		Rv=	4.8	kN

Verification needed:
Buckling of the weakest stud against the load Rv.

stud dimension		b =	76	mm		h =	105	mm	
		c.t.c. =	400	mm					
wood quality			C18		Sawn timber			γ_m =	1.3
	E0.05 =		6000	N/mm^2	I_y =	7331625	mm^4	i_y =	30.31
	$f_{m,k}$ =		18	N/mm^2	I_z =	3841040	mm^4	i_z =	21.94
	$f_{c,0,k}$ =		18	N/mm^2	A =	7980	mm^2	I_t =	8358103.04
	$f_{v,k}$ =		3.4	N/mm^2	E =	9000	N/mm^2	W_y =	139650
				γG,k	γq,k			G0.05 =	560
Consequence class		CC1		1.35	1.5				
Climate class: 1		Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year							
load duration class		Instantaneous							
k_{mod} =		1.1							

buckling length	2663 mm
Gk =	4.83 kN
qk (wind)=	0.00 kN/m

						UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23 N/mm^2	**0.00**
N_d (kN) =	6.52	$\sigma_{c,0,d}$ =	0.82	$f_{c,0,d}$ =	15.23 N/mm^2	**0.05**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88 N/mm^2	**0.00**
wtot (mm) =	0.00		max def 1/300xL =		8.88	**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

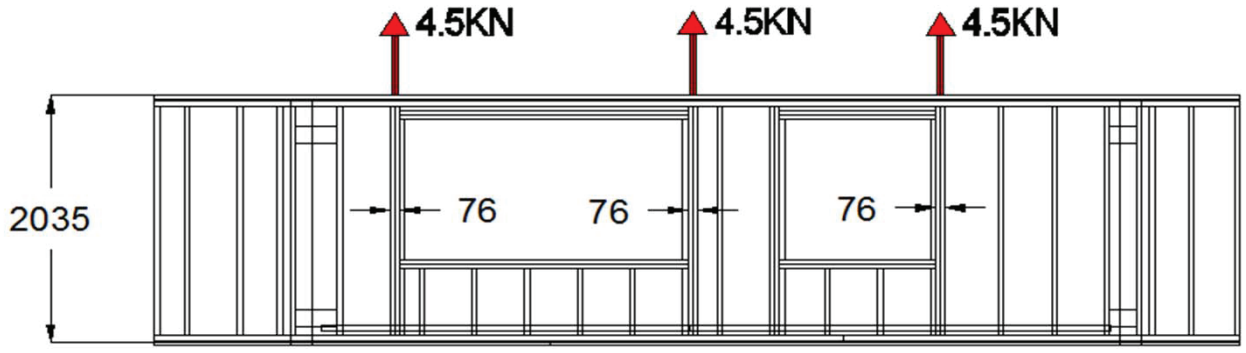
Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	87.86	$\lambda_{rel,y}$ =	1.53
λ_z =	121.38	$\lambda_{rel,z}$ =	2.12
k_y =	1.80	$k_{c,y}$ =	0.37
k_z =	2.92	$k_{c,z}$ =	0.20

Buckling y - U.C. = 0.15
Buckling z - U.C. = 0.26

South side façade - first floor



Net area (m^2):	12.78	weight	1358.4	kg
			13.6	kN
		Rv=	4.5	kN

Verification needed:
Buckling of the weakest stud against the load Rv.

stud dimension		b =	76	mm		h =	105	mm
		c.t.c. =	400	mm				
wood quality		C18		Sawn timber			γ_m =	1.3
	$E_{0.05}$ =	6000	N/mm²		I_y =	7331625	mm⁴	i_y = 30.31
	$f_{m,k}$ =	18	N/mm²		I_z =	3841040	mm⁴	i_z = 21.94
	$f_{c,0,k}$ =	18	N/mm²		A =	7980	mm²	I_t = 8358103.04
	$f_{v,k}$ =	3.4	N/mm²		E =	9000	N/mm²	W_y = 139650
			γG,k	γq,k				G0.05 = 560
Consequence class	CC1		1.35	1.5				
Climate class: 1	Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year							
load duration class	Instantaneous							
k_{mod} =	1.1							

buckling length	2035	mm
Gk =	4.53	kN
qk (wind)=	0.00	kN/m

							UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23	N/mm²	**0.00**
N_d (kN) =	6.11	$\sigma_{c,0,d}$ =	0.77	$f_{c,0,d}$ =	15.23	N/mm²	**0.05**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88	N/mm²	**0.00**
wtot (mm) =	0.00	max def 1/300xL =			6.78		**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

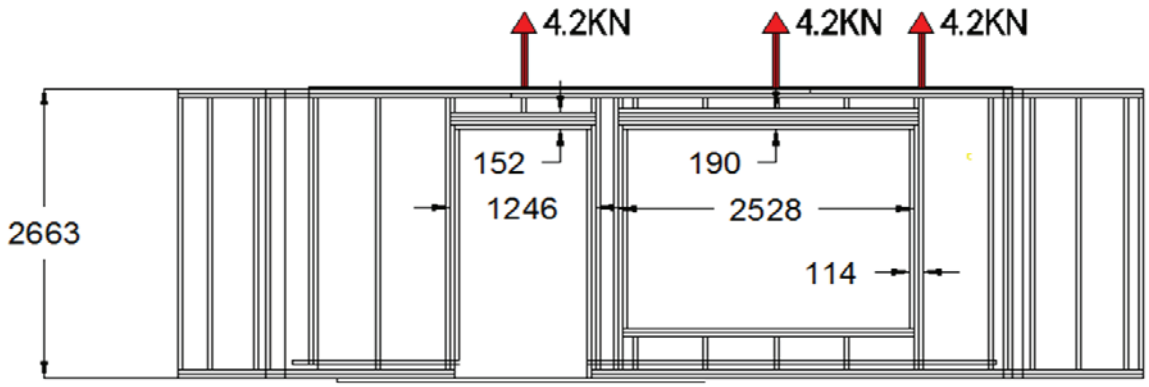
Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	67.14	$\lambda_{rel,y}$ =	1.17
λ_z =	92.76	$\lambda_{rel,z}$ =	1.62
k_y =	1.27	$k_{c,y}$ =	0.56
k_z =	1.94	$k_{c,z}$ =	0.33

Buckling y - U.C. = 0.09
Buckling z - U.C. = 0.15

North side façade - ground floor



Net area (m^2):	16.70	weight	1254.0	kg
			12.5	kN
		Rv=	4.2	kN

Verification needed:

Buckling of the weakest stud against the load Rv.

stud dimension		b =	114	mm		h =	170	mm	
		c.t.c. =	400	mm					
wood quality			C18		Sawn timber			γ_m =	1.3
	E0.05 =		6000	N/mm^2		I_y =	46673500	mm^4	i_y = 49.07
	$f_{m,k}$ =		18	N/mm^2		I_z =	20988540	mm^4	i_z = 32.91
	$f_{c,0,k}$ =		18	N/mm^2		A =	19380	mm^2	I_t = 48485996.64
	$f_{v,k}$ =		3.4	N/mm^2		E =	9000	N/mm^2	W_y = 549100
				γG,k	γq,k				G0.05 = 560
Consequence class		CC1		1.35	1.5				
Climate class: 1		Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year							
load duration class		Instantaneous							
k_{mod} =		1.1							

buckling length	2663 mm
Gk =	4.18 kN
qk (wind)=	0.00 kN/m

						UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23 N/mm^2	**0.00**
N_d (kN) =	5.64	$\sigma_{c,0,d}$ =	0.29	$f_{c,0,d}$ =	15.23 N/mm^2	**0.02**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88 N/mm^2	**0.00**
wtot (mm) =	0.00	max def 1/300xL =			8.88	**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	54.26	$\lambda_{rel,y}$ =	0.95
λ_z =	80.92	$\lambda_{rel,z}$ =	1.41
k_y =	1.01	$k_{c,y}$ =	0.73
k_z =	1.61	$k_{c,z}$ =	0.42

Buckling y - U.C. = 0.03

Buckling z - U.C. = 0.05

North side façade - ground floor (bending verification)

Model: 2 point support beam
Check: for vertical forces

Input data

material:	Sawn timber		load duration class:	Instantaneous
wood quality:	C18		resulting class:	CC1
			climate class:	1
b =	170	mm		
h =	190	mm	*In the height of the cross section the thickness of plywood*	
length =	2528	mm	*is also added as a minimum T-beam cooperation*	

Cross-section properties (*the effective width from the plywood plate is not taken into account)*

$f_{m,k}$ =	18	$f_{m,d}$ =	15.23	N/mm^2	A =	32300	mm^2
$f_{t,0,k}$ =	11	$f_{t,0,d}$ =	9.31	N/mm^2	W_y =	1022833	mm^3
$f_{t,90,k}$ =	0.4	$f_{t,90,d}$ =	0.31	N/mm^2	I_y =	9.7E+07	mm^4
$f_{c,0,k}$ =	18	$f_{c,0,d}$ =	15.23	N/mm^2	$\rho_{g,k}$ =	320	kg/m^3
$f_{c,90,k}$ =	2.2	$f_{c,90,d}$ =	1.69	N/mm^2			
$f_{v,k}$ =	3.4	$f_{v,d}$ =	2.88	N/mm^2	γ_m =	1.3	
$E_{0.05}$ =	6000	N/mm^2			k_{mod} =	1.1	
E =	9000	N/mm^2			$k_{mod,ft,90,k}$ =	1	
$G_{0.05}$ =	560	N/mm^2			k_{def} =	0.6	

Loads

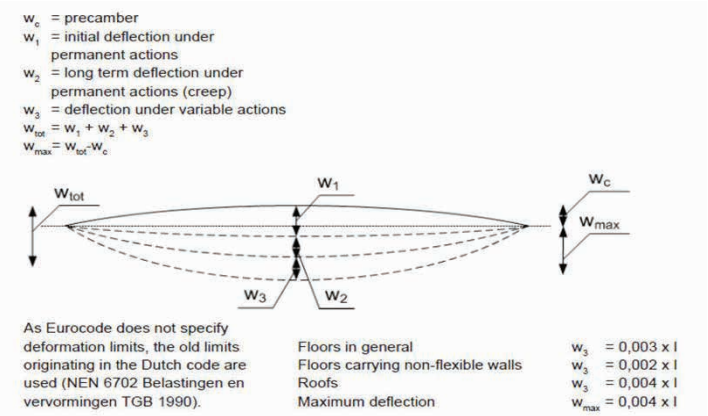
Lineload	permanent	$g_{k,j}$ =	0.00	kN/m	
	live (imposed)	$q_{k,j}$ =	0.00	kN/m	
	ULS		0.00	kN/m	
	SLS		0.00	kN/m	
Pointload	permanent	$G_{k,j}$ =	4.20	kN	
	live	$Q_{k,j}$ =	0.00	kN	
	ULS		5.67	kN	
	SLS		4.20	kN	

Load factors

ULS	γ_g =	1.35
	γ_q =	1.5
SLS	γ_g =	1
	γ_q =	1

Deflections (in mm)

		Calculated	*Allowed*
	w_0 =	0	-
	w_1 =	1.62	-
	w_2 =	0.97	-
(taken as roof)	w_3 =	0.00	10.112
	$w_{ins,max}$ =	1.62	10.112
	$w_{fin,max}$ =	2.59	10.112



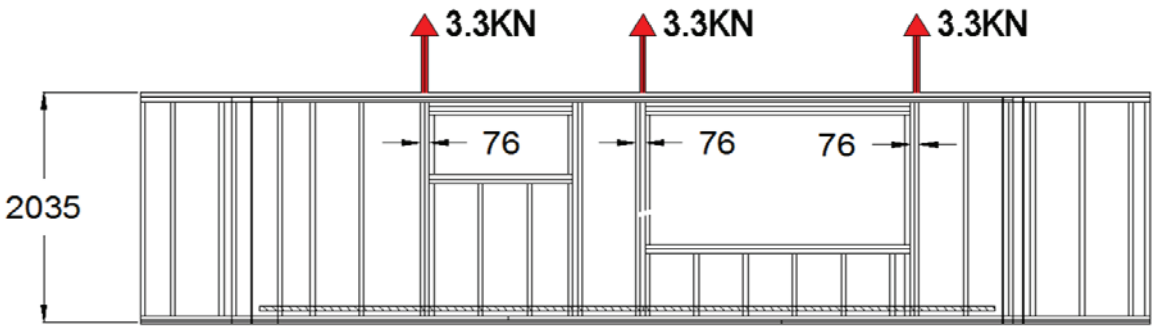
Resulting forces and stresses

	F_d	V_d	$M_{y,d}$	σ_m	τ_d
Calculated	0.00	2.84	3.58	3.50	0.13
Allowed	-	-	-	15.23	2.88
	kN	kN	kNm	N/mm	N/mm^2

Unity Check

deflection from live	**0.00**
total deflection	**0.26**
bending stress	**0.23**
shear stress	**0.05**

North side façade - first floor



Net area (m^2):	13.12	weight	985.5	kg
			9.9	kN
		Rv=	3.3	kN

Verification needed:
Buckling of the weakest stud against the load Rv.

stud dimension		b =	76	mm		h =	170	mm
		c.t.c. =	400	mm				
wood quality			C18		Sawn timber		γ_m =	1.3
	E0.05 =		6000	N/mm^2	I_y =	31115667	mm^4	i_y = 49.07
	$f_{m,k}$ =		18	N/mm^2	I_z =	6218826.7	mm^4	i_z = 21.94
	$f_{c,0,k}$ =		18	N/mm^2	A =	12920	mm^2	I_t = 17869249.71
	$f_{v,k}$ =		3.4	N/mm^2	E =	9000	N/mm^2	W_y = 366066.6667
				γG,k	γq,k			G0.05 = 560
Consequence class		CC1		1.35	1.5			
Climate class: 1		Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year						
load duration class		Instantaneous						
k_{mod} =		1.1						

buckling length	2035 mm
Gk =	3.28 kN
qk (wind)=	0.00 kN/m

						UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23 N/mm^2	**0.00**
N_d (kN) =	4.43	$\sigma_{c,0,d}$ =	0.34	$f_{c,0,d}$ =	15.23 N/mm^2	**0.02**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88 N/mm^2	**0.00**
wtot (mm) =	0.00		max def 1/300xL =		6.78	**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

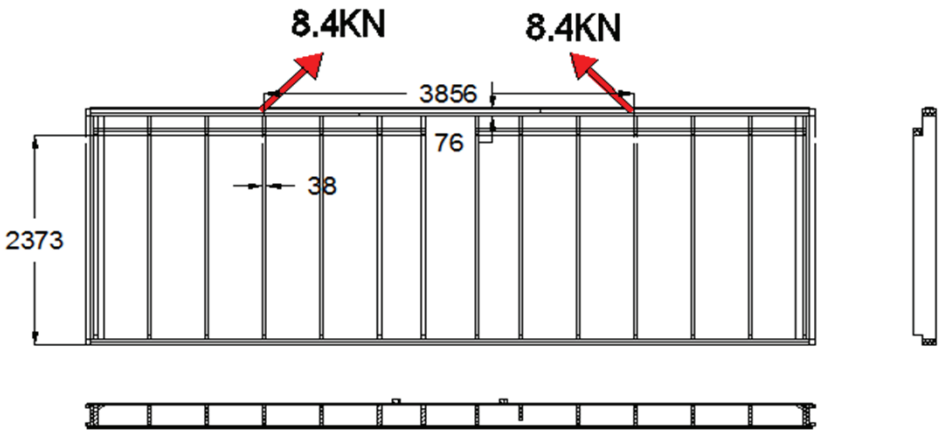
Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	41.47	$\lambda_{rel,y}$ =	0.72
λ_z =	92.76	$\lambda_{rel,z}$ =	1.62
k_y =	0.80	$k_{c,y}$ =	0.87
k_z =	1.94	$k_{c,z}$ =	0.33

Buckling y - U.C. = 0.03
Buckling z - U.C. = 0.07

Side wall



Net area (m^2): 20.27	weight	1190.0	kg
		11.9	kN
	Rv=	6.0	kN
	R=	8.4	kN
	Rh=	6.0	kN

Verification needed:

Buckling of the weakest stud against the load Rv.

stud dimension		b =	38	mm		h =	244	mm	
		c.t.c. =	600	mm					
wood quality		C18		Sawn timber			γ_m =	1.3	
	E0.05 =	6000	N/mm²		I_y =	46001483	mm⁴	i_y =	70.44
	$f_{m,k}$ =	18	N/mm²		I_z =	1115730.7	mm⁴	i_z =	10.97
	$f_{c,0,k}$ =	18	N/mm²		A =	9272	mm²	I_t =	4025044.107
	$f_{v,k}$ =	3.4	N/mm²		E =	9000	N/mm²	W_y =	377061.3333
			γG,k	γq,k				G0.05 =	560
Consequence class	CC1		1.35	1.5					
Climate class: 1	Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year								
load duration class	Instantaneous								
k_{mod} =	1.1								

buckling length	2373	mm
Gk =	5.95	kN
qk (wind)=	0.00	kN/m

							UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23	N/mm²	**0.00**
N_d (kN) =	8.03	$\sigma_{c,0,d}$ =	0.87	$f_{c,0,d}$ =	15.23	N/mm²	**0.06**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88	N/mm²	**0.00**
wtot (mm) =	0.00	max def 1/300xL =			7.91		**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	33.69	$\lambda_{rel,y}$ =	0.59
λ_z =	216.32	$\lambda_{rel,z}$ =	3.77
k_y =	0.70	$k_{c,y}$ =	0.92
k_z =	7.96	$k_{c,z}$ =	0.07

Buckling y - U.C. = 0.06

Buckling z - U.C. = 0.85

Verification needed:
Buckling of the upper beam between the loading points against the load Rh

stud dimension		b =	76	mm		h =	244	mm	
		c.t.c. =	600	mm					
wood quality		C18		Sawn timber			γ_m =	1.3	
	$E_{0.05}$ =	6000	N/mm^2		I_y =	92002965	mm^4	i_y =	70.44
	$f_{m,k}$ =	18	N/mm^2		I_z =	8925845.3	mm^4	i_z =	21.94
	$f_{c,0,k}$ =	18	N/mm^2		A =	18544	mm^2	I_t =	28697324.37
	$f_{v,k}$ =	3.4	N/mm^2		E =	9000	N/mm^2	W_y =	754122.6667
			γG,k	γq,k				G0.05 =	560
Consequence class	CC1		1.35	1.5					

Climate class: 1 — Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year

load duration class — Instantaneous

k_{mod} = 1.1

buckling length	3866 mm
Gk =	5.95 kN
qk (wind)=	0.00 kN/m

							UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23	N/mm^2	**0.00**
N_d (kN) =	8.03	$\sigma_{c,0,d}$ =	0.43	$f_{c,0,d}$ =	15.23	N/mm^2	**0.03**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88	N/mm^2	**0.00**
wtot (mm) =	0.00	max def 1/300xL =			12.89		**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0,05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

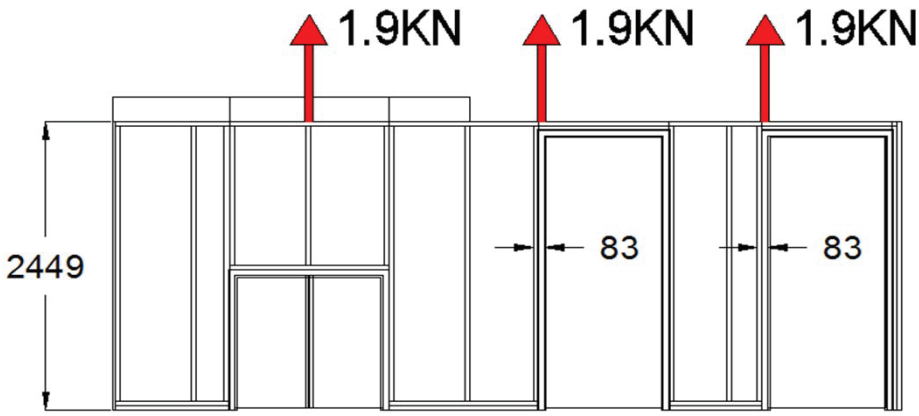
Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	54.89	$\lambda_{rel,y}$ =	0.96
λ_z =	176.21	$\lambda_{rel,z}$ =	3.07
k_y =	1.02	$k_{c,y}$ =	0.72
k_z =	5.50	$k_{c,z}$ =	0.10

Buckling y - U.C. = 0.04
Buckling z - U.C. = 0.29

Interior wall



Net area (m^2): 11.30	weight	565.0	kg
		5.7	kN
	Rv=	1.9	kN

Verification needed:
Buckling of the weakest stud against the load Rv.

stud dimension		b =	83	mm		h =	114	mm	
		c.t.c. =	600	mm					
wood quality		C18		Sawn timber			γ_m =	1.3	
	E0.05 =	6000	N/mm^2		I_y =	10247346	mm^4	i_y =	32.91
	$f_{m,k}$ =	18	N/mm^2		I_z =	5431976.5	mm^4	i_z =	23.96
	$f_{c,0,k}$ =	18	N/mm^2		A =	9462	mm^2	I_t =	11761658.59
	$f_{v,k}$ =	3.4	N/mm^2		E =	9000	N/mm^2	W_y =	179778
			$\gamma G,k$	$\gamma q,k$				G0.05 =	560
Consequence class	CC1		1.35	1.5					
Climate class: 1	Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year								
load duration class	Instantaneous								
k_{mod} =	1.1								

buckling length	2449	mm
Gk =	1.88	kN
qk (wind)=	0.00	kN/m

							UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23	N/mm^2	**0.00**
N_d (kN) =	2.54	$\sigma_{c,0,d}$ =	0.27	$f_{c,0,d}$ =	15.23	N/mm^2	**0.02**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88	N/mm^2	**0.00**
wtot (mm) =	0.00		max def 1/300xL =		8.16		**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

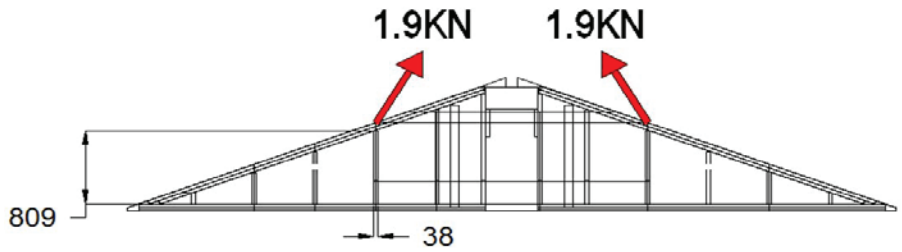
Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	74.42	$\lambda_{rel,y}$ =	1.30
λ_z =	102.21	$\lambda_{rel,z}$ =	1.78
k_y =	1.44	$k_{c,y}$ =	0.48
k_z =	2.24	$k_{c,z}$ =	0.28

Buckling y - U.C. = 0.04
Buckling z - U.C. = 0.06

Roof triangle wall



Net area (m^2): 5.63	weight	330.7	kg
		3.3	kN
	Rv=	1.7	kN
	R=	1.9	kN
	Rh=	1.0	kN

Verification needed:
Buckling of the weakest stud against the load Rv.

stud dimension		b =	83	mm		h =	244	mm	
		c.t.c. =	600	mm					
wood quality		C18		Sawn timber			γ_m =	1.3	
	E0.05 =	6000	N/mm^2		I_y =	100476923	mm^4	i_y =	70.44
	$f_{m,k}$ =	18	N/mm^2		I_z =	11626336	mm^4	i_z =	23.96
	$f_{c,0,k}$ =	18	N/mm^2		A =	20252	mm^2	I_t =	36539095.26
	$f_{v,k}$ =	3.4	N/mm^2		E =	9000	N/mm^2	W_y =	823581.3333
			$\gamma G,k$	$\gamma q,k$				G0.05 =	560
Consequence class	CC1		1.35	1.5					

Climate class: 1 — Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year

load duration class — Instantaneous

k_{mod} = 1.1

buckling length	809	mm
Gk =	1.65	kN
qk (wind)=	0.00	kN/m

							UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23	N/mm^2	**0.00**
N_d (kN) =	2.23	$\sigma_{c,0,d}$ =	0.11	$f_{c,0,d}$ =	15.23	N/mm^2	**0.01**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88	N/mm^2	**0.00**
wtot (mm) =	0.00	max def 1/300xL =			2.70		**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

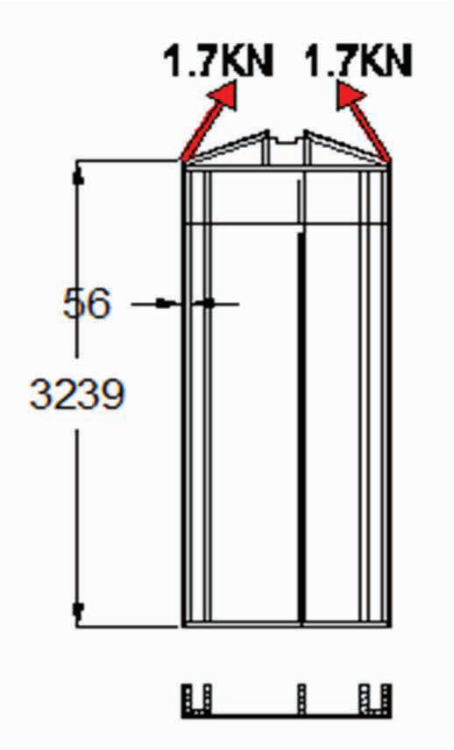
Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	11.49	$\lambda_{rel,y}$ =	0.20
λ_z =	33.76	$\lambda_{rel,z}$ =	0.59
k_y =	0.51	$k_{c,y}$ =	1.02
k_z =	0.70	$k_{c,z}$ =	0.92

Buckling y - U.C. = 0.01
Buckling z - U.C. = 0.01

Chimney wall



Net area (m^2): 4.95	weight	290.6	kg
		2.9	kN
	Rv=	1.5	kN
	R=	1.7	kN
	Rh=	0.8	kN

Verification needed:
Buckling of the weakest stud against the load Rv.

stud dimension		b =	83	mm		h =	244	mm	
		c.t.c. =	600	mm					
wood quality		C18		Sawn timber			γ_m = 1.3		
	E0.05 =	6000	N/mm^2		I_y =	100476923	mm^4	i_y =	70.44
	$f_{m,k}$ =	18	N/mm^2		I_z =	11626336	mm^4	i_z =	23.96
	$f_{c,0,k}$ =	18	N/mm^2		A =	20252	mm^2	I_t =	36539095.26
	$f_{v,k}$ =	3.4	N/mm^2		E =	9000	N/mm^2	W_y =	823581.3333
			$\gamma G,k$	$\gamma q,k$				G0.05 =	560
Consequence class		CC1	1.35	1.5					

Climate class: 1 — Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year

load duration class — Instantaneous

k_{mod} = 1.1

buckling length	3239 mm
Gk =	1.45 kN
qk (wind)=	0.00 kN/m

							UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23	N/mm^2	**0.00**
N_d (kN) =	1.96	$\sigma_{c,0,d}$ =	0.10	$f_{c,0,d}$ =	15.23	N/mm^2	**0.01**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88	N/mm^2	**0.00**
wtot (mm) =	0.00	max def 1/300xL =			10.80		**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

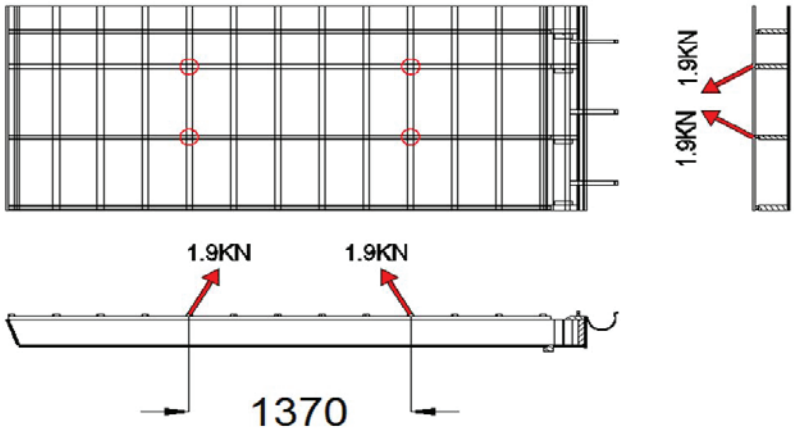
Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	45.98	$\lambda_{rel,y}$ =	0.80
λ_z =	135.18	$\lambda_{rel,z}$ =	2.36
k_y =	0.87	$k_{c,y}$ =	0.82
k_z =	3.48	$k_{c,z}$ =	0.17

Buckling y - U.C. = 0.01
Buckling z - U.C. = 0.04

South roof panel



Net area (m^2): 7.37	weight	658.2	kg
		6.6	kN
	Rv=	1.6	kN
	R=	1.9	kN
	Rh=	1.0	kN

Verification needed:

Buckling against the horizontal load Rh and for a length of 1.370m.

The bending check for the self weight has been already performed before, as the lifting points are about the same as the support points in the structure.

South roof panel - buckling

stud dimension		b =	38	mm		h =	215	mm	
		c.t.c. =	600	mm					
wood quality		C18		Sawn timber			γ_m =	1.3	
	E0.05 =	6000	N/mm^2		I_y =	31471521	mm^4	i_y =	62.07
	$f_{m,k}$ =	18	N/mm^2		I_z =	983123.33	mm^4	i_z =	10.97
	$f_{c,0,k}$ =	18	N/mm^2		A =	8170	mm^2	I_t =	3494614.773
	$f_{v,k}$ =	3.4	N/mm^2		E =	9000	N/mm^2	W_y =	292758.3333
			γG,k	γq,k				G0.05 =	560
Consequence class		CC1	1.35	1.5					

Climate class: 1 — Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year

load duration class — Instantaneous

k_{mod} = 1.1

buckling length	1.37	mm
Gk =	0.95	kN
qk (wind)=	0.00	kN/m

							UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23	N/mm^2	**0.00**
N_d (kN) =	1.28	$\sigma_{c,0,d}$ =	0.16	$f_{c,0,d}$ =	15.23	N/mm^2	**0.01**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88	N/mm^2	**0.00**
wtot (mm) =	0.00		max def 1/300xL =		0.00		**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c.0.k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2, glulam and LVL: β=0.1

Requirement

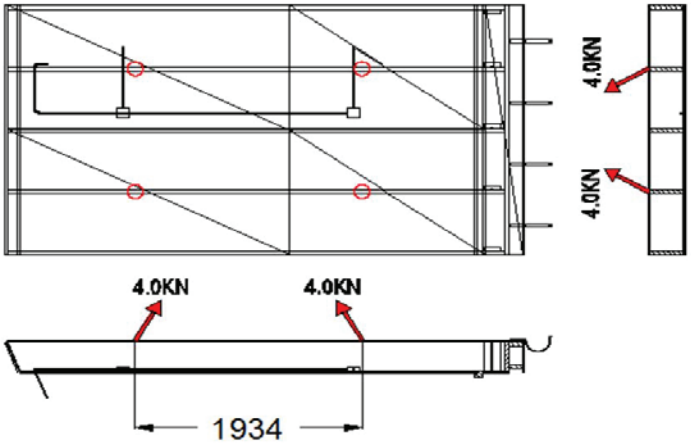
$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y =	0.02	$\lambda_{rel,y}$ =	0.00
λ_z =	0.12	$\lambda_{rel,z}$ =	0.00
k_y =	0.47	$k_{c,y}$ =	1.06
k_z =	0.47	$k_{c,z}$ =	1.06

Buckling y - U.C. = 0.01

Buckling z - U.C. = 0.01

North roof panel



Net area (m^2): 10.35	weight	1429.2	kg
		14.3	kN
	Rv=	3.6	kN
	R=	4.1	kN
	Rh=	2.1	kN

Verification needed:

Buckling against the horizontal load Rh and for a length of 1.934m

The bending check for the self weight has been already performed before, as the lifting points are about the same as the support points in the structure.

North roof panel - buckling

stud dimension		b =	38	mm		h =	285	mm	
		c.t.c. =	600	mm					
wood quality		C18		Sawn timber				γ_m =	1.3
	E0.05 =	6000	N/mm^2		I_y =	73305563	mm^4	i_y =	82.27
	$f_{m,k}$ =	18	N/mm^2		I_z =	1303210	mm^4	i_z =	10.97
	$f_{c,0,k}$ =	18	N/mm^2		A =	10830	mm^2	I_t =	4774961.44
	$f_{v,k}$ =	3.4	N/mm^2		E =	9000	N/mm^2	W_y =	514425
			γG,k	γq,k				G0.05 =	560
Consequence class	CC1		1.35	1.5					

Climate class: 1 — Climate Class 1 is characterized by a moisture content in the material which corresponds to a temperature of 20 ° C and a relative humidity of the surrounding air higher than 65% for only few weeks per year

load duration class: Instantaneous

k_{mod} = 1.1

buckling length	1.934 mm
Gk =	2.06 kN
qk (wind)=	0.00 kN/m

							UC
M_d (kNm) =	0.00	σ_{md} =	0.00	f_{md} =	15.23	N/mm^2	**0.00**
N_d (kN) =	2.78	$\sigma_{c,0,d}$ =	0.26	$f_{c,0,d}$ =	15.23	N/mm^2	**0.02**
V_d (kN) =	0.00	τ_d =	0.00	$f_{v,d}$ =	2.88	N/mm^2	**0.00**
wtot (mm) =	0.00	max def 1/300xL =			0.01		**0.00**

Buckling

$$k_c = \frac{1}{k + \sqrt{k^2 - \lambda_{rel}^2}}$$

$$\lambda_{rel} = \frac{\lambda}{\pi}\sqrt{\frac{f_{c,0,k}}{E_{0.05}}}$$

$$k = 0.5(1 + \beta(\lambda_{rel} - 0.3) + \lambda_{rel}^2)$$

sawn timber: β=0.2. glulam and LVL: β=0.1

Requirement

$$\sigma_{c,0,d} < k_c f_{c,0,d}$$

λ_y = 0.02 $\lambda_{rel,y}$ = 0.00

λ_z = 0.18 $\lambda_{rel,z}$ = 0.00

k_y = 0.47 $k_{c,y}$ = 1.06

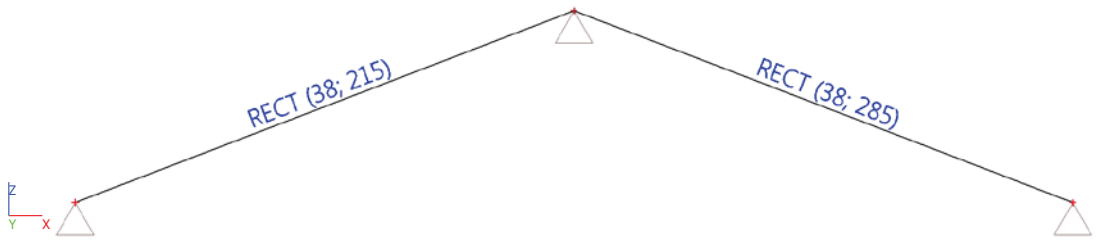
k_z = 0.47 $k_{c,z}$ = 1.06

Buckling y - U.C. = 0.02

Buckling z - U.C. = 0.02

Structural analysis of house roof beams

1. Structural model

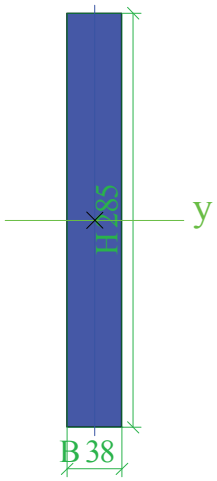
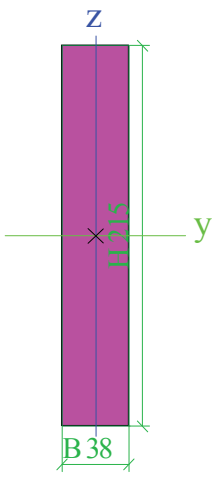


2. Members

Name	CrossSection	Layer	Length [m]	Shape	Beg. node	End node	Type	FEM type
B1	left beam (south side) - RECT (38; 215)	Layer1	4,285	Line	N1	N2	general (0)	standard
B3	right beam (north side) - RECT (38; 285)	Layer1	4,285	Line	N2	N4	general (0)	standard

3. Cross-sections

right beam (north side)		
Type	RECT	
Detailed	38; 285	
Shape type	Thick-walled	
Item material	C24	
Fabrication	timber	
A [m^2]	1,0830e-02	
Ay [m^2], Az [m^2]	9,0251e-03	9,0250e-03
Iy [m^4], Iz [m^4]	7,3306e-05	1,3032e-06
Welz [m^3], Wely [m^3]	6,8590e-05	5,1443e-04
Wplz [m^3], Wply [m^3]	8,2308e-05	6,1731e-04
Iw [m^6], It [m^4]	7,9303e-09	4,7525e-06
dy [mm], dz [mm]	0	0
cYUCS [mm], cZUCS [mm]	19	143
α [deg]	0,00	
Mply+ [Nm], Mply- [Nm]	1,30e+04	1,30e+04
Mplz+ [Nm], Mplz- [Nm]	1,73e+03	1,73e+03
AL [m^2/m], AD [m^2/m]	6,4600e-01	6,4600e-01
β y [mm], β z [mm]	0	0

Picture		
left beam (south side)		
Type	RECT	
Detailed	38; 215	
Shape type	Thick-walled	
Item material	C24	
Fabrication	timber	
A [m²]	8,1700e-03	
Ay [m²], Az [m²]	6,8084e-03	6,8083e-03
Iy [m⁴], Iz [m⁴]	3,1472e-05	9,8312e-07
Welz [m³], Wely [m³]	5,1743e-05	2,9276e-04
Wplz [m³], Wply [m³]	6,2092e-05	3,5131e-04
Iw [m⁶], It [m⁴]	3,2437e-09	3,4822e-06
dy [mm], dz [mm]	0	0
cYUCS [mm], cZUCS [mm]	19	108
α [deg]	0,00	
Mply+ [Nm], Mply- [Nm]	7,38e+03	7,38e+03
Mplz+ [Nm], Mplz- [Nm]	1,30e+03	1,30e+03
AL [m²/m], AD [m²/m]	5,0600e-01	5,0600e-01
β y [mm], β z [mm]	0	0
Picture		

Explanations of symbols	
A	Area
Ay	Shear Area in principal y-direction - Calculated by 2D FEM analysis
Az	Shear Area in principal z-direction - Calculated by 2D FEM analysis
Iy	Second moment of area about the principal y-axis
Iz	
Welz	Elastic section modulus about the principal z-axis
Wely	Elastic section modulus about the principal y-axis
Wplz	Plastic section modulus about the principal z-axis
Wply	Plastic section modulus about the principal y-axis

Explanations of symbols	
Iw	Warping constant - Calculated by 2D FEM analysis
It	
dy	from the centroid - Calculated by 2D FEM analysis
dz	Shear center coordinate in principal z-direction measured from the centroid - Calculated by 2D FEM analysis
cYUCS	Centroid coordinate in Y-direction of Input axis system
cZUCS	Centroid coordinate in Z-direction of Input axis system
α	Rotation angle of the principal axis system
IYZLCS	Product moment of area in the LCS system
Mply+	Plastic moment about the principal y-axis for a positive My moment
Mply-	Plastic moment about the principal y-axis for a negative My moment
Mplz+	Plastic moment about the principal z-axis for a positive Mz moment
Mplz-	Plastic moment about the principal z-axis for a negative Mz moment
AL	Circumference per unit length
AD	Drying surface per unit length
β y	Mono-symmetry constant about the principal y-axis
β z	Mono-symmetry constant about the principal z-axis

4. Load cases

Name	Description	Action type	LoadGroup	Load type	Spec	Direction	Duration	Master load ca
self weight		Permanent	LG1	Self weight		-Z		
dead load		Permanent	LG1	Standard				
maintenance		Variable	Live	Static	Standard		Short	None
SN	Snow loads	Variable	Snow	Static	Standard		Short	None
WND - LO	Wind from the left - overpressure	Variable	Wind	Static	Standard		Short	None
WND - LU	Wind from the left - underpressure	Variable	Wind	Static	Standard		Short	None
WND - RO	Wind from the right - overpressure	Variable	Wind	Static	Standard		Short	None
WND - RU	Wind from the right - underpressure	Variable	Wind	Static	Standard		Short	None

5. Line force

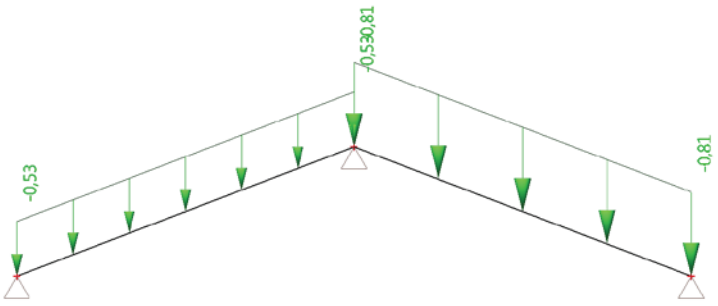
Name	Load case	System	Distribution	Value - P_1 [kN/m] Value - P_2 [kN/m]	Pos x_2	Loc		Ecc ey [m] Ecc ez [m]
LF1	B1	Force	Z	-0,53	0.000	Rela	From start	
	dead load	GCS	Uniform		1.000	Length		0,000
LF2	B3	Force	Z	-0,81	0.000	Rela	From start	
	dead load	GCS	Uniform		1.000	Length		0,000
LF20	B1	Snow	Z	-0,34	0.003	Abso	From start	
	SN - Snow loads	GCS	Uniform	-0,34	4.285	Projection		0,000
LF21	B3	Snow	Z	-0,34	0.000	Abso	From start	
	SN - Snow loads	GCS	Uniform	-0,34	4.282	Projection		0,000
LF22	B1	Wind	Z	0,39	0.003	Abso	From start	
	WND - LO - Wind from the left - overpressure	LCS	Uniform	0,39	0.332	Length		0,000
LF23	B1	Wind	Z	0,21	0.332	Abso	From start	
	WND - LO - Wind from the left - overpressure	LCS	Uniform	0,21	4.285	Length		0,000
LF24	B3	Wind	Z	0,45	0.000	Abso	From start	
	WND - LO - Wind from the left - overpressure	LCS	Uniform	0,45	0.329	Length		0,000
LF25	B3	Wind	Z	0,27	0.329	Abso	From start	
	WND - LO - Wind from the left - overpressure	LCS	Uniform	0,27	4.282	Length		0,000
LF26	B1	Wind	Z	0,17	0.003	Abso	From start	
	WND - LU - Wind from the left - underpressure	LCS	Uniform	0,17	0.332	Length		0,000
LF27	B1	Wind	Z	-0,02	0.332	Abso	From start	
	WND - LU - Wind from the left - underpressure	LCS	Uniform	-0,02	4.285	Length		0,000
LF28	B3	Wind	Z	0,22	0.000	Abso	From start	
	WND - LU - Wind from the left - underpressure	LCS	Uniform	0,22	0.329	Length		0,000
LF29	B3	Wind	Z	0,04	0.329	Abso	From start	
	WND - LU - Wind from the left -	LCS	Uniform	0,04	4.282	Length		0,000
LF30	B1	Wind	Z	0,27	0.003	Abso	From start	
	WND - RO - Wind from the right - overpressure	LCS	Uniform	0,27	3.956	Length		0,000
LF31	B1	Wind	Z	0,45	3.956	Abso	From start	

Name	Member	Type	Dir	Value - P_1 [kN/m]	Pos x_1	Coor	Orig	Ecc ey [m]
	Load case	System	Distribution	Value - P_2 [kN/m]	Pos x_2	Loc		Ecc ez [m]
	WND - RO - Wind from the right - overpressure	LCS	Uniform	0,45	4.285	Length		0,000
LF32	B3	Wind	Z	0,21	0.000	Abso	From start	
	WND - RO - Wind from the right - overpressure	LCS	Uniform	0,21	3.953	Length		0,000
LF33	B3	Wind	Z	0,39	3.953	Abso	From start	
	WND - RO - Wind from the right - overpressure	LCS	Uniform	0,39	4.282	Length		0,000
LF34	B1	Wind	Z	0,04	0.003	Abso	From start	
	WND - RU - Wind from the right - underpressure	LCS	Uniform	0,04	3.956	Length		0,000
LF35	B1	Wind	Z	0,22	3.956	Abso	From start	
	WND - RU - Wind from the right - underpressure	LCS	Uniform	0,22	4.285	Length		0,000
LF36	B3	Wind	Z	-0,02	0.000	Abso	From start	
	WND - RU - Wind from the right - underpressure	LCS	Uniform	-0,02	3.953	Length		0,000
LF37	B3	Wind	Z	0,17	3.953	Abso	From start	
	WND - RU - Wind from the right - underpressure	LCS	Uniform	0,17	4.282	Length		0,000
LF38	B1	Snow	Z	-0,34	0.003	Abso	From start	
	SN - Snow loads	GCS	Uniform	-0,34	4.285	Projection		0,000
LF39	B3	Snow	Z	-0,34	0.000	Abso	From start	
	SN - Snow loads	GCS	Uniform	-0,34	4.282	Projection		0,000

6. Point force on beam

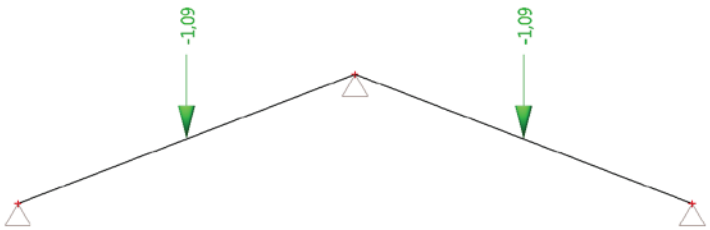
Name	Member	System	Value - F [kN]	Pos x	Coor	Rep (n)
	Load case	Dir	Type		Orig	
F1	B1	GCS	-1,09	0.500	Rela	1
	maintenance	Z	Force		From start	
F2	B3	GCS	-1,09	0.500	Rela	1

7. Dead load



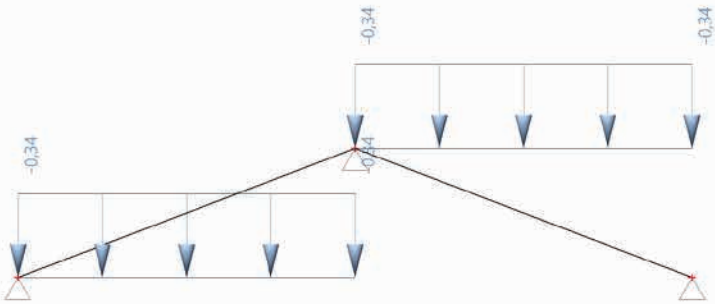


8. Maintenance load





9. Snow loads





10. Wind from the left (internal overpressure)



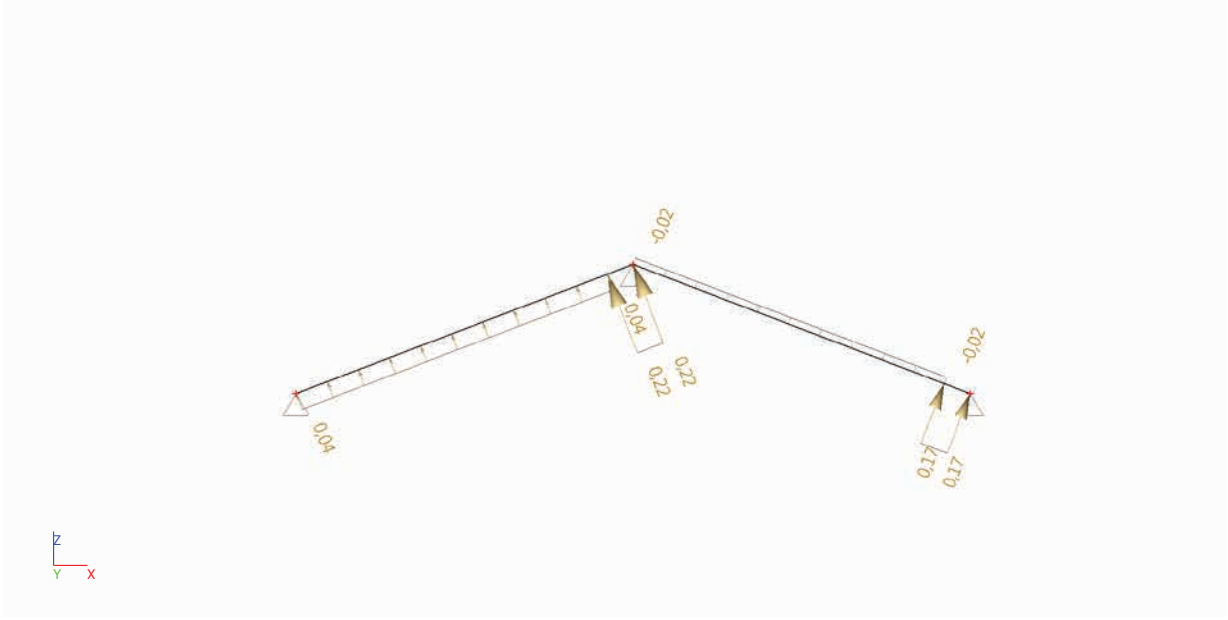
11. Wind from the left (internal underpressure)



12. Wind from the right (internal overpressure)



13. Wind from the right (internal underpressure)



14. Result classes

Name	List
All ULS	ULS1 wind left1 - Linear - ultimate
	ULS2 wind left2 - Linear - ultimate
	ULS3 wind right 1 - Linear - ultimate
	ULS4 wind right 2 - Linear - ultimate
	ULS5 snow - Linear - ultimate
	ULS6 maintenance - Linear - ultimate
All SLS	SLS1 wind left1 - Linear - serviceability
	SLS2 wind left2 - Linear - serviceability
	SLS3 wind right 1 - Linear - serviceability
	SLS4 wind right 2 - Linear - serviceability
	SLS5 snow - Linear - serviceability
	SLS6 maintenance - Linear - serviceability
All ULS+SLS	ULS1 wind left1 - Linear - ultimate
	ULS3 wind right 1 - Linear - ultimate
	ULS4 wind right 2 - Linear - ultimate
	ULS5 snow - Linear - ultimate

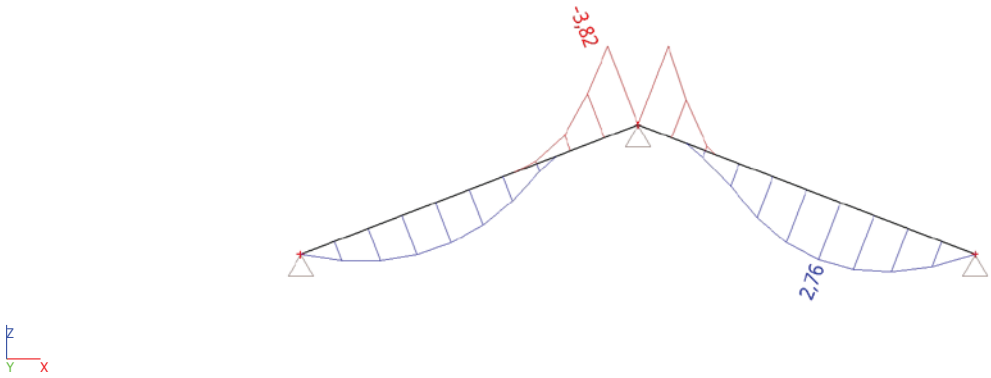
Name	List
	ULS6 maintenance - Linear - ultimate
	SLS3 wind right 1 - Linear - serviceability
	SLS4 wind right 2 - Linear - serviceability
	SLS5 snow - Linear - serviceability
	SLS6 maintenance - Linear - serviceability

15. Internal forces on member

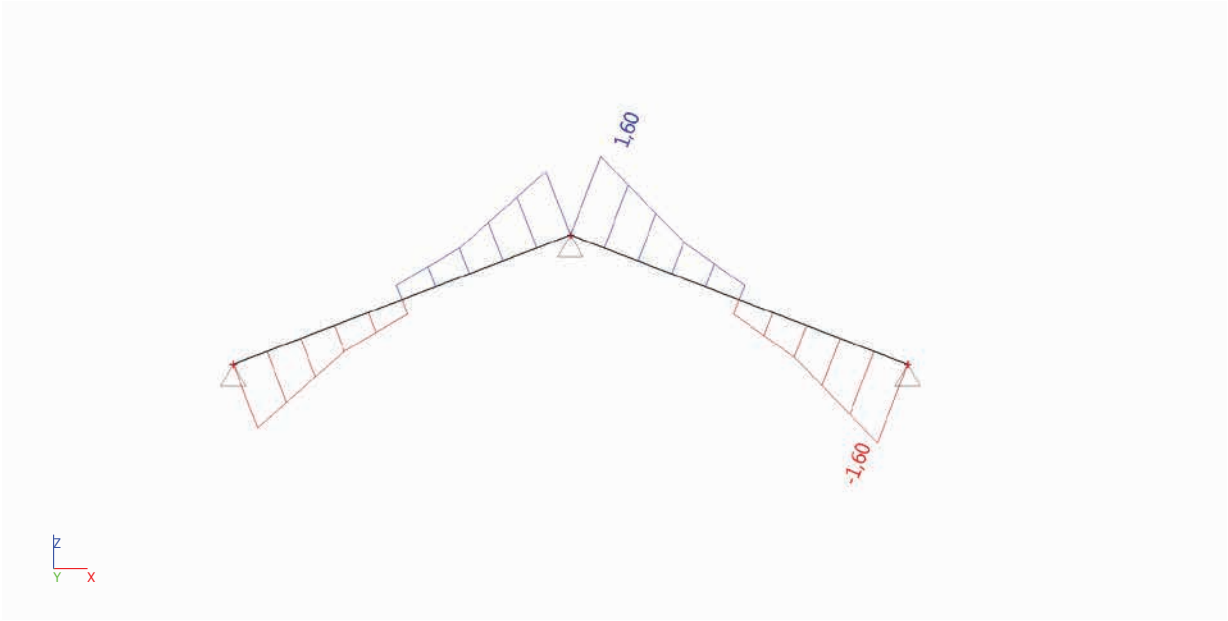
Linear calculation, Extreme : Cross-section, System : LCS
Selection : All
Class : All ULS

Member	css	dx [m]	Case	N [kN]	Vz [kN]	My [kNm]
B1	left beam (south side) - RECT	0,000	ULS5 snow/1	-1,30	2,49	0,00
B1	left beam (south side) - RECT	4,285	ULS5 snow/1	1,30	**-4,27**	**-3,82**
B1	left beam (south side) - RECT	1,714	ULS5 snow/1	-0,26	-0,22	1,95
B3	right beam (north side) - RECT	4,285	ULS5 snow/1	**-1,60**	-3,28	0,00
B3	right beam (north side) - RECT	0,000	ULS5 snow/1	**1,60**	**5,06**	-3,82
B3	right beam (north side) - RECT	2,571	ULS5 snow/1	-0,32	0,06	**2,76**

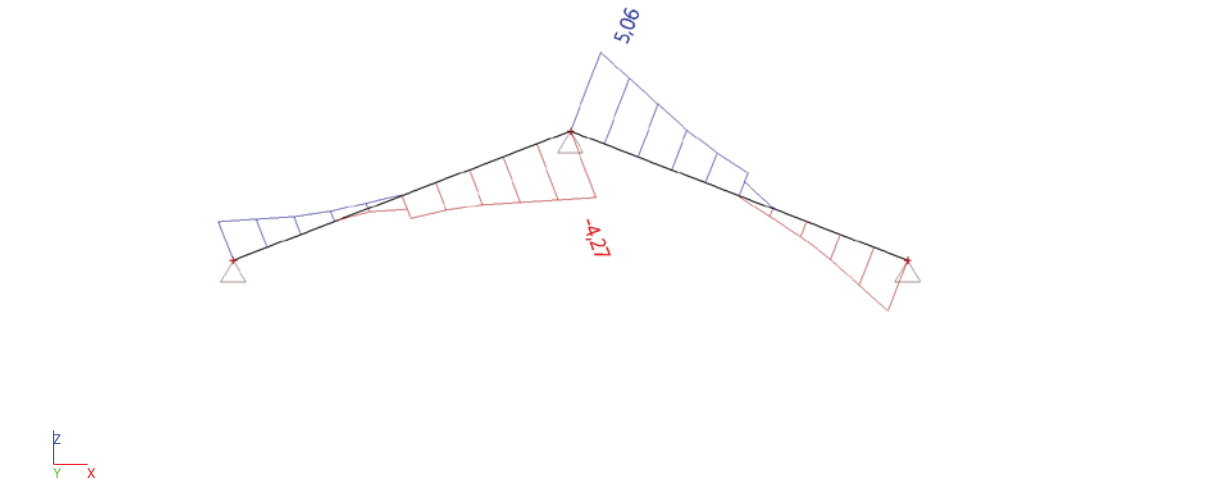
16. Internal forces on member; My



17. Internal forces on member; N



18. Internal forces on member; Vz

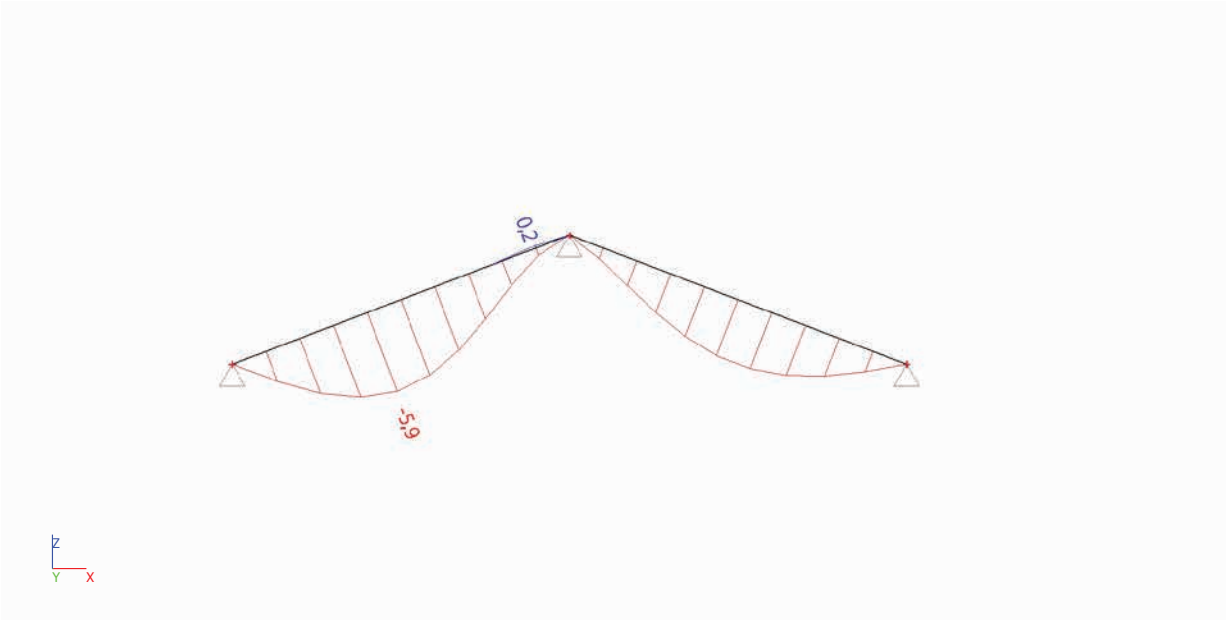


19. Deformations on member

Linear calculation, Extreme : Cross-section
Selection : All
Class : All SLS

Member	dx [m]	Case	ux [mm]	uz [mm]	fiy [mrad]	Resultant [mm]
B1	2,142	SLS5 snow/2	**0,0**	-5,6	-1,2	5,6
B1	0,000	SLS1 wind left1/3	0,0	0,0	1,2	**0,0**
B1	1,714	SLS5 snow/2	0,0	**-5,9**	0,4	**5,9**
B1	3,856	SLS3 wind right 1/4	0,0	**0,2**	0,2	0,2
B1	2,999	SLS5 snow/2	0,0	-3,4	-3,2	3,4
B1	0,000	SLS5 snow/2	0,0	0,0	**5,1**	0,0
B3	2,142	SLS5 snow/2	**0,0**	-4,2	0,5	4,2
B3	2,571	SLS5 snow/2	0,0	-4,2	-0,5	4,2
B3	4,285		0,0	0,0		0,0
B3	0,857	SLS5 snow/2	0,0	-1,8	2,1	1,8

20. Deformations on member; uz



Stelcon®

N-plaat zonder hoekstalen omranding

De toepassing

Stelcon platen kennen vele toepassingsmogelijkheden. In de industrie, voor transport-, en overslagbedrijven, maar ook als (tijdelijke) verharding bij bouwprojecten. De Stelcon N-plaat is leverbaar in verschillende diktes en afmetingen. Voor elke toepassing een oplossing. Stelcon platen zijn eenvoudig te leggen en te verplaatsen. Zo blijft de ondergrond altijd bereikbaar. Onderhoudskosten als gevolg van zettingen en zakkingen blijven tot een minimum beperkt. Door de grote afmetingen van de elementen kunnen ze lasten prima spreiden naar de onderliggende lagen.

Kenmerken

BETON: Stelcon N-platen zijn bedrijfsvloerplaten voorzien van een niet constructieve wapening. De spanningen die in de plaat optreden bij het belasten, worden geheel opgenomen door het beton.

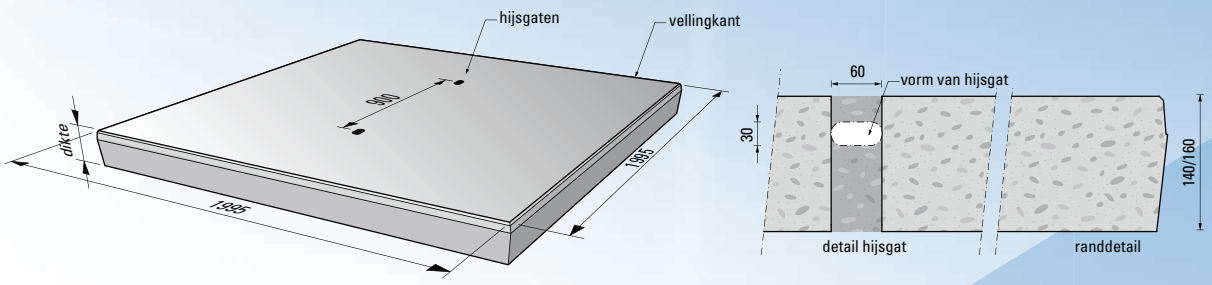
WAPENING: De wapening in de Stelcon N-plaat heeft een transport-, of verankerings functie.

DEKLAAG: De platen zijn voorzien van een deklaag met een hoge slijtvastheid. Dit wordt verkregen door een toeslagmateriaal van veredeld kwarts.
Indien een gekleurde deklaag is gewenst, worden kleurpigmenten als hulpstof toegepast.

RAND: De randen van de plaat zijn voorzien van een vellingkant.

BRL 1104: De Stelcon N-plaat voldoet aan de BRL 1104 'Bedrijfsvloerplaten van constructief beton'.

Vorm en afmeting



Specificaties

MATERIAAL:

Beton	sterkteklasse C50/60 volgens NEN-EN 206-1
Wapening	staalkwaliteit FeB500 volgens NEN 6008

Meteoor
Flexibel in beton

AFMETINGEN [mm]		1995 x 1995	1995 x 1495	1995 x 995
CODE		A A	A D	A E
GEWICHT	**140 mm dik:**	1340 kg	1005 kg	670 kg
	160 mm dik:	1540 kg	1155 kg	770 kg
TOLERANTIES [mm]	**lengte/breedte**	-3 tot +3	-3 tot +3	-3 tot +3
VOLGENS NEN 3682	**dikte**	-1 tot +5	-1 tot +5	-1 tot +5
	vlakheid bovenzijde	-3 tot +3	-3 tot +3	-3 tot +3
	scheluwte	5	5	5
	diagonaalverschil	5	5	5

	boven	**onder**	
MILIEUKLASSEN			
WAARAAN BLOOTGESTELD	XC1 t/m XC4	XC1 t/m XC4	Corrosie ingeleid door carbonatatie
MAG WORDEN VOLGENS	XD1 t/m XD3	–	Corrosie ingeleid door chloriden
NEN-EN 206-1, NEN 6720	XS1 t/m XS3	–	Corrosie ingeleid door chloriden afkomstig uit zeewater
	XF1 t/m XF4	XF1 en XF3	Aantasting door vorst/dooi wisselingen met of zonder dooizouten
	XA1 t/m XA3	–	Chemische aantasting

Toelaatbare lasten

			140 mm	**160 mm**
	verkeersklasse volgens BRL 1104 (bijlage 3)		450	600
	aslasten		150 kN (15 ton)	200 kN (20 ton)
TOELAATBARE PUNTLASTEN	**rand***	150 x 150mm	40 kN (4 ton)	55 kN (5,5 ton)
		200 x 200mm	45 kN (4,5 ton)	60 kN (6 ton)
	centrum	150 x 150mm	65 kN (6,5 ton)	90 kN (9 ton)
		200 x 200mm	75 kN (7,5 ton)	95 kN (9,5 ton)

**) rand = midden van de zijkant op een halve plaatdikte uit de rand.*

		140 mm	**160 mm**
TOELAATBARE HEFTRUCK BELASTINGEN	hefvermogen	6 ton	9 ton
	(aslast)	137,7 kN	208,5 kN

Legbed, fundatie en ondergrond

Bovenstaande belastingen zijn alleen toelaatbaar als de fundatie en het legbed aan de volgende eisen voldoen:

DRAAGKRACHT De fundatie moet voldoende draagkrachtig zijn. De draagkracht wordt uitgedrukt in een beddinggetal. Dit beddinggetal dient minimaal 0,06 N/mm^3.

VERDICHTING De verdichtingsgraad van de fundatie en het legbed moet goed zijn. De mate van verdichting wordt uitgedrukt in een Proctor-waarde. De eis is een minimale Proctorwaarde van 98% t.o.v de referentiedichtheid.

HEMELWATER Voor buitenbevloering dient de hemelwaterafvoer in het advies te worden betrokken. Door juiste maatregelen (drainage, grondwaterstand) moet een drooglegging van ca. 0,7 m onder het vloeroppervlak verkregen worden.

LEVERINGSCONDITIE Af fabriek, per vrachtauto gelost of gelegd in het werk.

OPSLAG, STAPELEN EN LEGGEN Zie brochure stapel- en legvoorschriften.

www.meteoor.nl

Schaarweg 4, 6991 GV Rheden | Postbus 2, 6990 AA Rheden | Tel.: 026 4975600, Fax: 026 4954028, E-mail: stelcon@meteoor.nl

Structural design approval (Glasshouse)

(the glasshouse structure was calculated and verified by the construction company Daenen B.V. instead of the main structural advisor, prof. ir. R. Nijsse)

According to rule 6.1 b, the structural provisions of the Solar Decathlon Europe Building Code have been met by the design and the structure is safe to be used and visited by the general public, if it is constructed the way it is designed.

The documents revised and certified are the following:

Drawings certified

Structural

ST-202 Glasshouse – overview
ST-203 Glasshouse – structural sections overview
ST-204 Glasshouse – dimensioning
ST-303 Glasshouse – main details
ST-304 Glasshouse – frame details

Project manual pages certified

Structural

Project Manual #5 pp. ……..

Date: 29/04/2014

Certified by:

Adviesbureau Daenen B.V.
Postbus 170
2670 AD Naaldwijk
T 0174-235552
M 06-23333045
E info@daenenadvies.nl
I www.daenenadvies.nl

Staalconstructie
Prêt-à-Loger
Versailles en Delft

BER-01 Hoofdberekening staalconstructie
blad 1 t/m 30

Werknr.	14025
Datum	14-03-14
Constructeur	D. Daenen

Adviesbureau Daenen B.V.
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E info@daenenadvies.nl
I www.daenenadvies.nl

Op deze rapportage is de DNR 2011 (Rechtsverhouding opdrachtgever-architect, ingenieur en adviseur) van toepassing, welke een aansprakelijkheidsbeperking bevat.

Summary of Comments on Berekening -02 bijgebouw

Page: 1

Number: 1 Author: Translation Date: 26/04/2014 20:37:52
Main calculation of the steel construction of the Pret-a-Loger design for Delft + Versailles, page 1 to 30

Inhoudsopgave

	blad
Algemeen	2
Belastingen	3
Koudgezette gordingen	5
Dakliggers midden	5
Dakliggers rand	5
Stalen ligger langs de nok	14
Horizontale ligger kopgevels	14
Stalen portaal langsgevel	21

Number: 1 Author: Translation Date: 26/04/2014 18:08:32
Index

- General
- Loads
- Cold formed purlins
- Middle roof beams
- Edge roof beams
- Steal beam along the ridge
- Horizontal beam in the front facades
- Steel portal side facade

Algemeen

1 opdrachtgever: Nobutec Tuinbouwprojecten B.V.
Maasdijkseweg 113
2291 PJ Wateringen

architect: ---

omschrijving: Voor de oorspronkelijke gevel en half boven het oorspronkelijke dak van een (model)woning wordt een glasdak en glazen voorzetgevel geplaatst met op het dek zonnepanelen en in de gevel openslaande deuren. Gevel en dek worden gedragen door een staalconstructie. De stabiliteit wordt in de richting // aan de nok verzorgd door een stabiel portaal in de langsgevel en door koppeling van de staalconstructie aan de woning. In de richting loodrecht op de nok wordt de stabiliteit verzorgd door koppelingen aan de woning op verdiepingsniveau en ter plaatse van de schoorstenen. De fundering van de staalconstructie en constructie van de (model)woning maken geen deel uit van deze berekening.

2

De constructie wordt berekend op de Nederlandse situatie. *** Clarification Note

3 normen:

NEN-EN 1990	Grondslagen van het constructief ontwerp
NEN-EN 1991	Belastingen op constructies
NEN-EN 1992	Ontwerp en berekening van betonconstructies
NEN-EN 1993	Ontwerp en berekening van staalconstructies
NEN-EN 1994	Ontwerp en berekening van staal-betonconstructies
NEN-EN 1995	Ontwerp en berekening van houtconstructies
NEN-EN 1996	Ontwerp en berekening van constructies van metselwerk
NEN-EN 1997	Geotechnisch ontwerp

Gevolgklasse CC1 (zie NEN-EN 1990/NB)

Betrouwbaarheidsklasse RC1 → K_{FI} = 0,9 (zie NEN-EN 1990 B3.3)

Ontwerplevensduurklasse 3 (zie NEN-EN 1990/NB)
Ontwerplevensduur 50 jaar (zie NEN-EN 1990/NB)

materialen (tenzij anders aangegeven):
Beton C20/25
Betonstaal B 500
Staalkwaliteit walsprofielen S235JRG2 4
buisprofielen S235JOH
kokerprofielen S235JOH
Boutkwaliteit 8.8 gerolde draad
Moerkwaliteit 8
Ankerkwaliteit 4.6 gerolde draad
Houtkwaliteit C18

milieuklasse: n.v.t.

brandwerendheidseis: -- minuten

Number: 1 Author: Translation Date: 26/04/2014 18:09:18
Client

Number: 2 Author: Translation Date: 26/04/2014 18:19:02
In front of the original facade and half above the original roof of a standard house,
a glass roof and a glass facade are placed, with solar panels on top and in the
facade folding doors. Facade and roof are supported by a steel structure. The
stability parallel to the ridge is created by a stable portal in the side facade
and by linking the steel structure to the house. In the direction perpendicular to the ridge
the stability is provided by links to the house at floor level and around □□the chimneys. The foundation of the steel structure and construction of the standard house are not part of this calculation.

The structure is calculated for the situation in Delft, Netherlands.

It has to be clarified that only the above Delft situation is analysed here, as it is the most unfavourable in relation with the wind load. That is by far the most critical loading on the glasshouse, as the self-weight of the steel structure and the PV panels is not significant and due to the inclination of the roof there is no uniform imposed load.

The characteristic wind load value is taken for Delft and the post-competition "rural" location of the house as qk = 0.75kN/m2. Furthermore, due to the reliability class for dutch residential buildings, a reduction factor of 0.9 is applied to the load factors leading to values of γg = 1.35*0.9=1.2 and γq = 1.5*0.9=1.35, that are used below in the calculation.

For the french situation in Versailles, the load factors are taken from the SD Building Code as γg = 1.35 and γq = 1.5, for there is no reduction factor allowed. Nevertheless the worse wind load for the Versailles situation is calculated as qk = 0.55kN/m2, which is 0.55/0.75 = 0.73 times smaller than the one of Delft used here.

Therefore, as the analysis performed is linear, the Delft situation is indeed the worse case by a factor of 1.19 and can be safely assumed that the design will be adequate also for Versailles.

Number: 3 Author: Translation Date: 26/04/2014 18:21:34
norms
resulting class
reliability class
design lifetime class
design lifetime
materials
environmental class
firesafety requirement

Number: 4 Author: Translation Date: 26/04/2014 18:23:35
concrete
concrete steel
steel quality (rolled profiles, tube profiles, box profiles)
bolt quality (beaded wire)
nut quality
anchor quality (beaded wire)
wood quality

Permanente belasting 1

Hellend dak	glazen PV panelen			=	0,20	kN/m^2
	roeden en gordingen			=	0,10	kN/m^2
					0,30	kN/m^2
	dakhelling α	= 21 °	per m2 grondvlak	=	0,32	kN/m^2
Glasgevels	glas			=	0,15	kN/m^2
	roeden en regels			=	0,10	kN/m^2
					0,25	kN/m^2
Vouwdeuren	zie opgave blz. 4	= 5 x	0,75 / 6,00	=	0,63	kN/m

Veranderlijke belasting (Q) 2

	q_k	Q_k	Ψ_0	Ψ_1	Ψ_2
H- dak ($\alpha \geq 20^0$) =	0,00 kN/m^2	1,50 kN	0,00	0,00	0,00

Sneeuwbelasting (s) 3

Hellend dak met α < 30°

				Ψ_0	Ψ_1	Ψ_2
s_k	=	0,70	kN/m^2 grondvlak	0,00	0,20	0,00
μ_1	=	0,80				
s	=	0,56	kN/m^2 grondvlak			

Windbelasting op vlak terrein (we) (zie tabel NB.4 van NEN-EN 1991-1-4) 4

Gebied II; onbebouwd; hoogte h = 7,00 m

				Ψ_0	Ψ_1	Ψ_2
q_p	=	0,75	kN/m^2	0,00	0,20	0,00

Number: 1 Author: Translation Date: 26/04/2014 18:25:22
constant load

sloped roof (glass pv panels, rods and purlins, roof slope A)

glass facades (glass, rods and purlins)

folding doors

Number: 2 Author: Translation Date: 26/04/2014 18:25:59
variable load

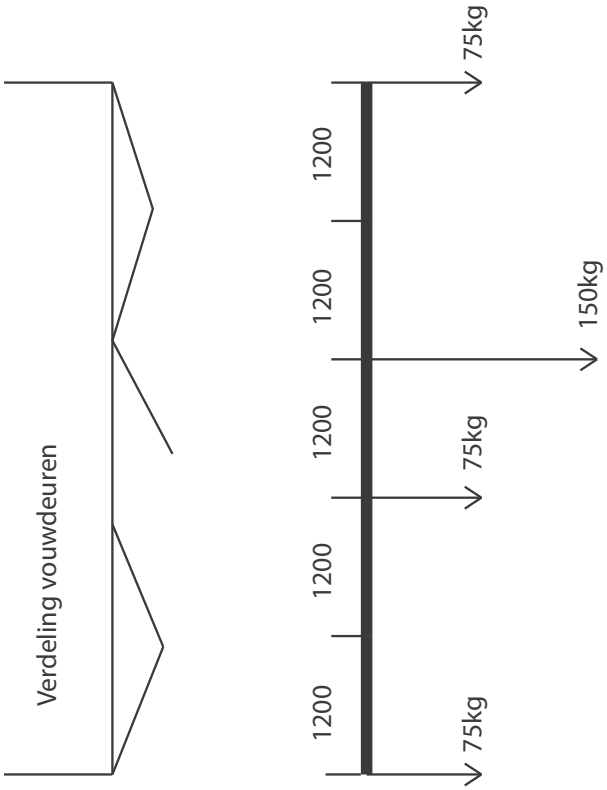
H- roof

Number: 3 Author: Translation Date: 26/04/2014 18:26:41
snow load

sloped roof with A < 30 degrees

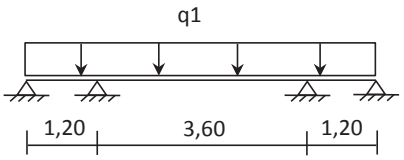
Number: 4 Author: Translation Date: 26/04/2014 18:27:26
wind load on flat ground

area II, unbuilt, height h = 7m


Verdeling vouwdeuren
1200
1200
1200
1200
75kg
150kg
75kg
75kg

Number: 1 Author: Translation Date: 26/04/2014 18:27:59
distribution folding doors

Koudgezette gordingen 1

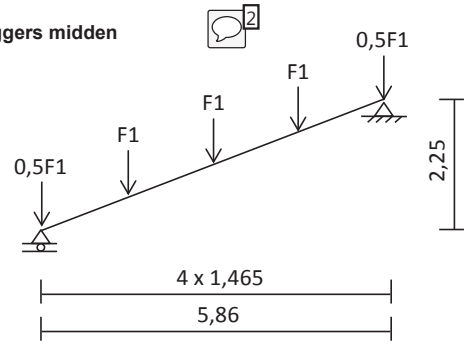


C-profiel 50x100x50x4

											perm	vb	
q1	hellend dak (sneeuw)	=	1,47	x	0,32	x	1,10		0,56	=	0,52	0,90	kN/m
	wind opwaarts	=	1,47	x	0,75	x	-1,30	x	1,10	=		-1,57	kN/m

zie blz. 6 t/m 9

Dakliggers midden 2



koker 180x100x5

F1	hellend dak (sneeuw)	zie blz. 6	=	1,84	2,85	kN
	wind opwaarts	zie blz. 7	=		-4,97	kN

zie blz. 10 t/m 13

Dakliggers rand 3

deze worden practisch gelijk gekozen als de dakliggers midden.
verticaal is de belasting slechts 25% van de dakliggers midden en de horizontale belasting (door de wind) kan worden opgenomen door alle 4 de dakliggers samen omdat deze gekoppeld zijn door de gordingen.

q hor.	wind op gevel	=	1,25	x	0,75	x	-1,10	=			-1,03	kN/m
	Mz,Ed	=	0,125	x	-1,03	x	1,35	x	6,28 ^ 2	=	-6,86	kNm
	σEd	=	6,86	x	0,25	/	300	=	0,01 N/mm^2	<	235	**akkoord** 4

Number: 1 Author: Translation Date: 26/04/2014 18:29:55
cold formed purlins

C-profile

q1 sloped roof (snow)
wind upwards

Number: 2 Author: Translation Date: 26/04/2014 18:30:04
middle roof beams

box profile

F1 sloped roof (snow)
wind upwards

Number: 3 Author: Translation Date: 26/04/2014 18:33:04
edge roof beams

these are the same as the middle roof beams. vertically the load is only 25% of the middle roof beams and the horizontal load (from the wind) can be absorped by all 4 roof beams together, because they are connected to the purlins

q hor. wind on facade

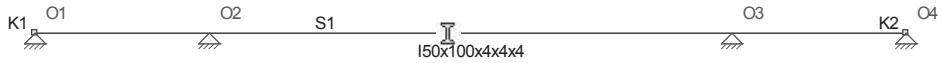
Number: 4 Author: Translation Date: 26/04/2014 18:33:08
agreed

	Adviesbureau Daenen B.V.		
Projectnaam	Prêt-à-Loger Versailles en Delft	Projectnummer	14025
Omschrijving	Koudgezette gordingen	Constructeur	D.Daenen
Opdrachtgever	Nobutec Tuinbouwprojecten B.V.	Eenheden	m, kN, kNm
Bestand	F:\Projecten\2014\14025 Pret-a-loger te Delft\koudgezette gordingen.mxf		

UITGANGSPUNTEN VAN DE ANALYSE

Lineaire Elastische Analyse uitgevoerd

AFB. GEOMETRIE 1



BALKGEOMETRIE

Positie	Profielnaam	Hoek	Traagheidsmoment	Materiaal	E-Modulus	Uitzettingcoeff	Gewicht
0,000 - L(6,000)	I50x100x4x4x4	0	1.1817e-06	S235	2.1000e+08	12.0000e-06	0.06
m -		°	m4 -		kN/m2	C°m	kN/m

OPLEGGINGEN

Oplegging	Positie	Z	Yr
O1	0,000	vast	vrij
O2	1,200	vast	vrij
O3	4,800	vast	vrij
O4	L(6,000)	vast	vrij
-	m	kN/m	kNmrad

BELASTINGSGEVALLEN

Type	Beginwaarde	Eindwaarde	Beginafstand	Eindafstand	Richting	Staaf of knoop
B.G.1: Permanent						
qG	1,00	1,00	0,000	6,000(L)	Z	S1
q	0,52	0,52	0,000	6,000(L)	Z	S1
Som lasten	**X: 0,00 kN**	**Z: 3,48 kN**				
B.G.2: VB puntlast						
F	1,50		3,000		Z	S1
Som lasten	**X: 0,00 kN**	**Z: 1,50 kN**				
B.G.3: Sneeuwbelasting						
q	0,90	0,90	0,000	6,000(L)	Z	S1
Som lasten	**X: 0,00 kN**	**Z: 5,40 kN**				
B.G.4: Windbelasting						
q	-1,57	-1,57	0,000	6,000(L)	Z	S1
Som lasten	**X: 0,00 kN**	**Z: -9,42 kN**				
-	-	-	m	m	-	-

B.G. OPLEGREACTIES

B.C.	Oplegging	Positie	Z	Yr	Z	My
B.G.1	O1	0.000	vast	vast	0.09	0.00
B.G.1	O2	1.200	vast	vast	-1.84	0.00
B.G.1	O3	4.800	vast	vast	-1.84	0.00
B.G.1	O4	0.000	vast	vast	0.09	0.00
	Som Reacties				**-3.48**	
	Som Lasten				**3.48**	
B.G.2	O1	0.000	vast	vast	0.46	0.00
B.G.2	O2	1.200	vast	vast	-1.21	0.00
B.G.2	O3	4.800	vast	vast	-1.21	0.00
B.G.2	O4	0.000	vast	vast	0.46	0.00
	Som Reacties				**-1.50**	
	Som Lasten				**1.50**	
B.G.3	O1	0.000	vast	vast	0.15	0.00
B.G.3	O2	1.200	vast	vast	-2.85	0.00
B.G.3	O3	4.800	vast	vast	-2.85	0.00
B.G.3	O4	0.000	vast	vast	0.15	0.00
	Som Reacties				**-5.40**	

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 19:02:24
cold formed purlins

Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 18:38:23
starting points of the analysis (lineair elastic analysis has been done)

beam geometry

supports

load cases

BG support reactions

Number: 3 Author: Translation Subject: Notitie Date: 26/04/2014 18:43:16
moment of inertia of the material

Number: 4 Author: Translation Subject: Notitie Date: 26/04/2014 18:38:56
free

Number: 5 Author: Translation Subject: Notitie Date: 26/04/2014 18:38:51
fixed

B.C.	Oplegging	Positie	Z	Yr	Z	My
	Som Lasten				**5.40**	
B.G.4	O1	0.000	vast	vast	-0.26	0.00
B.G.4	O2	1.200	vast	vast	4.97	0.00
B.G.4	O3	4.800	vast	vast	4.97	0.00
B.G.4	O4	0.000	vast	vast	-0.26	0.00
	Som Reacties				**9.42**	
	Som Lasten				**-9.42**	
-	**-**	**m**	**kN/m**	**kNmrad**	**kN**	**kNm**

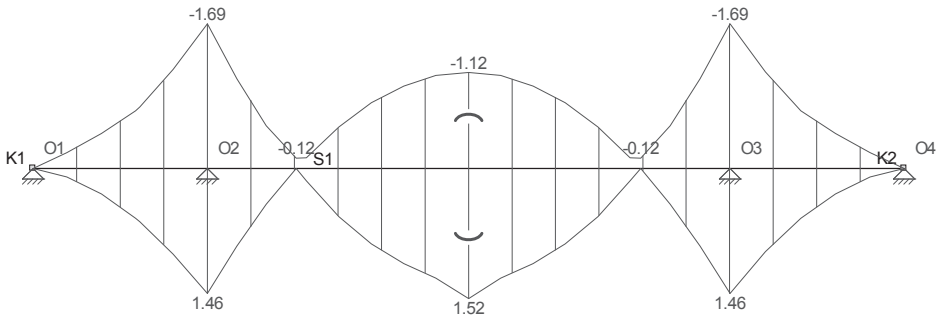
FUNDAMENTEEL BELASTINGSCOMBINATIES (TABEL)

B.G.	Omschrijving	Fu.C.1	Fu.C.2	Fu.C.3	Fu.C.4
B.G.1	Permanent	1.22	1.08	1.08	0.90
B.G.2	VB puntlast	-	1.35	-	-
B.G.3	Sneeuwbelasting	-	-	1.35	-
B.G.4	Windbelasting	-	-	-	1.35

FU.C. EXTREME OPLEGREACTIES

Oplegging	Knoop	B.C.	Zmax	My	B.C.	Z	Mymax
O1	S1	Fu.C.2	**0.72**	0.00			
O1	S1	Fu.C.4	**-0.26**	0.00			
O2	S1	Fu.C.4	**5.05**	0.00			
O2	S1	Fu.C.3	**-5.83**	0.00			
O3	S1	Fu.C.4	**5.05**	0.00			
O3	S1	Fu.C.3	**-5.83**	0.00			
O4	S1	Fu.C.2	**0.72**	0.00			
O4	S1	Fu.C.4	**-0.26**	0.00			
Globale extreme waarden							
O3	S1	Fu.C.4	**5.05**	0,00			
O3	S1	Fu.C.3	**-5.83**	0,00			
-	**-**	**-**	**kN**	**kNm**	**-**	**kN**	**kNm**

AFB. FU.C. MOMENTEN (MY) OMHULLENDE — Fundamenteel Belastingscombinaties



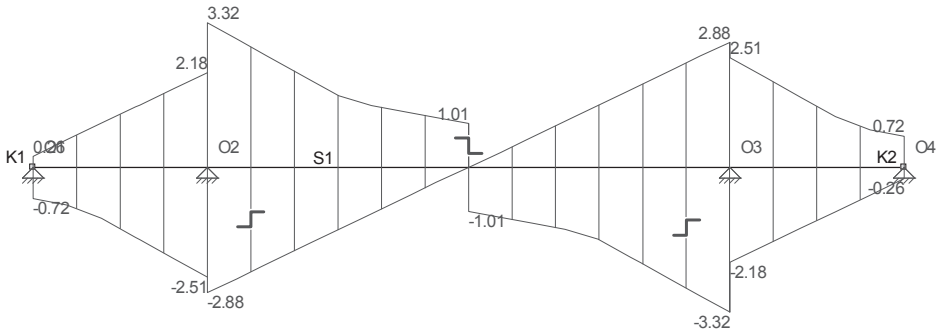
Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 18:40:50
fundamental load combinations

constant
point load
snow load
wind load

Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 18:41:11
FU.C. extreme support reactions

Number: 3 Author: Translation Subject: Notitie Date: 26/04/2014 19:16:45
bending moments

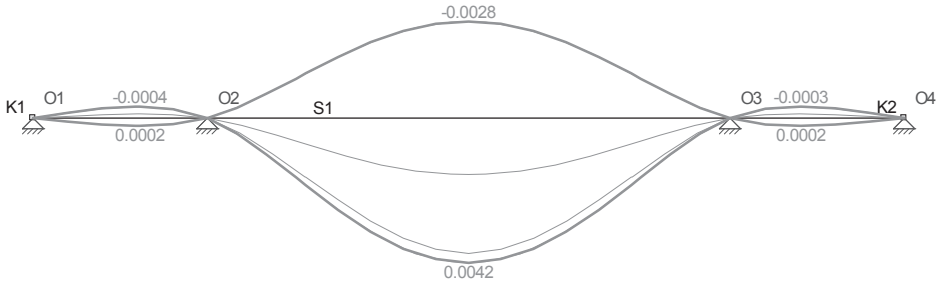
AFB. FU.C. DWARSKRACHT (VZ) OMHULLENDE 1 Fundamenteel Belastingscombinaties



KARAKTERISTIEK BELASTINGSCOMBINATIES (TABEL) 2

B.G.	Omschrijving	Ka.C.(w1)	Ka.C.1	Ka.C.2	Ka.C.3	Ka.C.4
B.G.1	Permanent	1.00	1.00	1.00	1.00	1.00
B.G.2	VB puntlast	-	-	1.00	-	-
B.G.3	Sneeuwbelasting	-	-	-	1.00	-
B.G.4	Windbelasting	-	-	-	-	1.00

AFB. KA.C. VERPLAATSINGEN OMHULLENDE 3 Karakteristiek Belastingscombinaties



KIPSTEUNENGEGEVENS 4 5 7 6

Staaf	Profiel	Begin:	Eind:	Kipsteunen boven	Kipsteunen onder	Aangrijphoogte
C1 - V1 (0.000-1.200)	P2	Vrij	Vrij			Bovenflens
C1 - V2 (1.200-4.800)	P2	Vrij	Vrij	1.2, 2.4		Bovenflens
C1 - V3 (4.800-6.000)	P2	Vrij	Vrij			Bovenflens
-	-	-	-	m	m	-

DOORBUIGINGGEGEVENS 8 9

Staaf	Constructietype	Toetsing	Zeeg Y'	Zeeg Z'	Zeegvorm	Eis U;eind	Eis U;bij
C1 - V1 (0.000-1.200)	Dak	Algemeen	0	0	Parabolisch	L/250	L/250
C1 - V2 (1.200-4.800)	Dak	Algemeen	0	0	Parabolisch	L/250	L/250
C1 - V3 (4.800-6.000)	Dak	Algemeen	0	0	Parabolisch	L/250	L/250
-	-	-	mm	mm	-	-	-

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 18:54:41
shear force

Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 18:44:40
characteristic load combinations

constant
VB point load
snow load
wind load

Number: 3 Author: Translation Subject: Notitie Date: 26/04/2014 19:17:00
displacements

Number: 4 Author: Translation Subject: Notitie Date: 26/04/2014 18:57:05
laterial-torsional buckle support statistics

Number: 5 Author: Translation Subject: Notitie Date: 26/04/2014 18:47:38
buckle support above

Number: 6 Author: Translation Subject: Notitie Date: 26/04/2014 18:49:18
handle height

upper flange
upper flange
upper flange

Number: 7 Author: Translation Subject: Notitie Date: 26/04/2014 18:47:49
buckle support beneath

Number: 8 Author: Translation Subject: Notitie Date: 26/04/2014 18:49:34
deflection statistics

Number: 9 Author: Translation Subject: Notitie Date: 26/04/2014 18:50:02
sheer shape

UNITY CHECK NEN-EN1993-1-1:2009/NB:2011

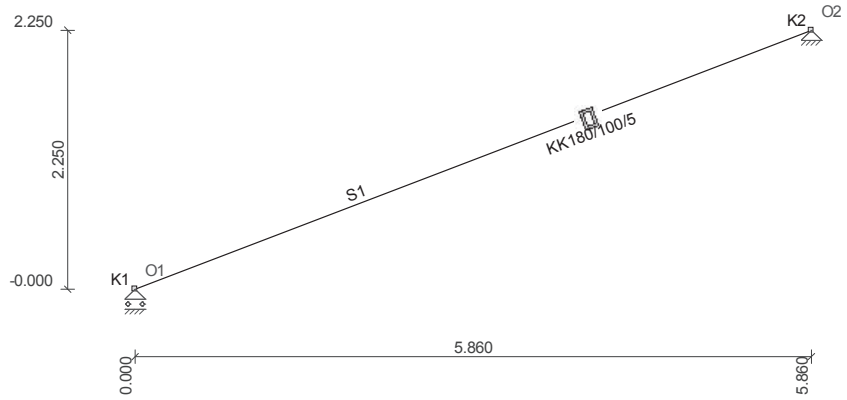
Veld	Toetsing	Combinatie	Artikel	UC max
C1-V1 (0.000-1.200)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.12)	0,26
C1-V1 (0.000-1.200)	Kiptoetsing	Fu.C.3	NEN-EN1993-1-1(6.54)	0,33
C1-V1 (0.000-1.200)	Doorbuigingstoetsing	Ka.C.4	NEN-EN1993|NEN-EN1990/NB A1.4.2	0,08
C1-V2 (1.200-4.800)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.12)	0,26
C1-V2 (1.200-4.800)	Kiptoetsing	Fu.C.4	NEN-EN1993-1-1(6.54)	0,78
C1-V2 (1.200-4.800)	Doorbuigingstoetsing	Ka.C.4	NEN-EN1993|NEN-EN1990/NB A1.4.2	0,31
C1-V3 (4.800-6.000)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.12)	0,26
C1-V3 (4.800-6.000)	Kiptoetsing	Fu.C.3	NEN-EN1993-1-1(6.54)	0,33
C1-V3 (4.800-6.000)	Doorbuigingstoetsing	Ka.C.4	NEN-EN1993|NEN-EN1990/NB A1.4.2	0,08

	Adviesbureau Daenen B.V.		
Projectnaam	Prêt-à-Loger Versailles en Delft	Projectnummer	14025
Omschrijving	Dakliggers midden	Constructeur	D.Daenen
Opdrachtgever	Nobutec Tuinbouwprojecten B.V.	Eenheden	m, kN, kNm
Bestand	F:\Projecten\2014\14025 Pret-a-loger te Delft\dakliggers midden.mxf		

UITGANGSPUNTEN VAN DE ANALYSE

Lineaire Elastische Analyse uitgevoerd

AFB. GEOMETRIE 1



STAVEN

Staaf	Knoop B		Scharnier E	Knoop E	Profiel	X-B	Z-B	X-E	Z-E	Lengte
S1	K1	NVM	NVM	K2	P1	0,000	0,000	5,860	-2,250	6,277
-	-	-	-	-	-	m	m	m	m	m

PROFIELEN

Profiel	Profielnaam	Oppervlakte	Iy	Materiaal	Hoek
P1	KK180/100/5	2.6356e-03	1.1242e-05	S235H(EN10219-1)	0
-	-	m2	m4	-	°

MATERIALEN

Materiaal	Dichtheid	E-Modulus	Uitzettingcoeff
S235H(EN10219-1)	78.50	2.1000e+08	12.0000e-06
-	kN/m3	kN/m2	C°m

OPLEGGINGEN

Oplegging	Knoop	X	Z	Yr	HoekYr
O1	K1	vrij	vast	vrij	0
O2	K2	vast	vast	vrij	0
-	-	kN/m	kN/m	kNmrad	°

BELASTINGSGEVALLEN

Type	Beginwaarde	Eindwaarde	Beginafstand	Eindafstand	Richting	Staaf of knoop
B.G.1: Permanent						
qG	0,21 (1.00x)	0,21 (1.00x)	0,000	6,277(L)	Z"	S1
N	0,92				Z	K1-K2
F	1,84		1,465		Z	S1
F	1,84		2,930		Z	S1
F	1,84		4,395		Z	S1
Som lasten	**X:**	**0,00 kN**	**Z: 8,66 kN**			
B.G.2: Sneeuwbelasting						
N	1,43				Z	K1-K2
F	2,85		1,465		Z	S1
F	2,85		2,930		Z	S1
F	2,85		4,395		Z	S1

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 19:02:00
middle roof beams

Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 18:51:15
starting points of the analysis (lineair elastic analysis has been done)

rods
profiles
materials
supports
load cases

Type	Beginwaarde	Eindwaarde	Beginafstand	Eindafstand	Richting	Staaf of knoop
Som lasten	**X:**	**0,00 kN Z: 11,41**	**kN**			
B.G.3: Windbelasting						
F	-2,49		0,000		Z'	S1
F	-4,97		1,570		Z'	S1
F	-4,97		3,140		Z'	S1
F	-4,97		4,710		Z'	S1
F	-2,48		6,277		Z'	S1
Som lasten	**X:**	**-7,12 kN Z: -18,55**	**kN**			
-	**-**	**-**	**m**	**m**	**- -**	

B.G. OPLEGREACTIES

B.G.	Oplegging	Knoop	X	Z	My
B.G.1	O1	K1	0.00	-4.33	0.00
B.G.1	O2	K2	0.00	-4.33	0.00
	Som Reacties		**0.00**	**-8,66**	
	Som Lasten		**0.00**	**8.66**	
B.G.2	O1	K1	0.00	-5.70	0.00
B.G.2	O2	K2	0.00	-5.71	0.00
	Som Reacties		**0.00**	**-11,41**	
	Som Lasten		**0.00**	**11.41**	
B.G.3	O1	K1	0.00	10.64	0.00
B.G.3	O2	K2	7.12	7.91	0.00
	Som Reacties		**7.12**	**18,55**	
	Som Lasten		**-7.12**	**-18.55**	
-	**-**	**-**	**kN**	**kN**	**kNm**

FUNDAMENTEEL BELASTINGSCOMBINATIES (TABEL)

B.G.	Omschrijving	Fu.C.1	Fu.C.2	Fu.C.3
B.G.1	Permanent	1.22	1.08	0.90
B.G.2	Sneeuwbelasting	-	1.35	-
B.G.3	Windbelasting	-	-	1.35

FU.C. EXTREME OPLEGREACTIES

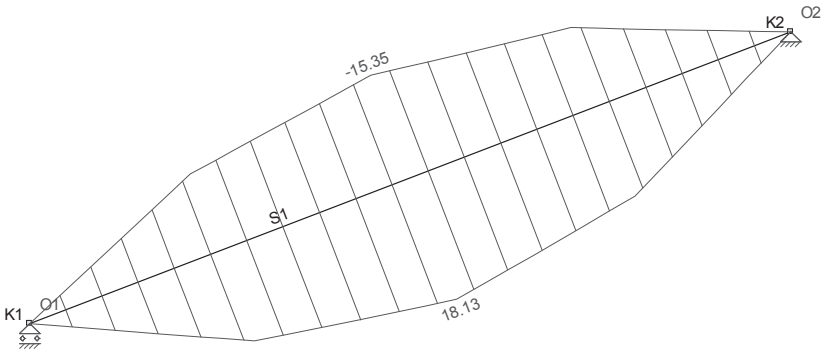
Oplegging	Knoop	B.C.	Xmax	Z	My	B.C.	X	Zmax	My	B.C.	X	Z	Mymax
O1	K1					Fu.C.3	0.00	**10.47**	0.00				
O1	K1					Fu.C.2	0.00	**-12.38**	0.00				
O2	K2	Fu.C.3	**9.62**	6.78	0.00	Fu.C.3	9.62	**6.78**	0.00				
O2	K2					Fu.C.2	0.00	**-12.38**	0.00				
Globale extreme waarden													
O2	K2	Fu.C.3	**9.62**	6.78	0.00								
O1	K1					Fu.C.3	0.00	**10.47**	0.00				
O2	K2					Fu.C.2	0.00	**-12.38**	0.00				
-	**-**	**-**	**kN**	**kN**	**kNm**	**-**	**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 18:51:44
BG support reactions

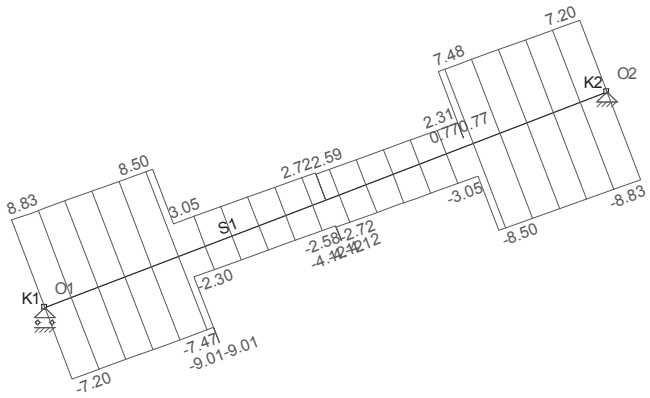
Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 18:51:59
fundamental load combinations (table)

Number: 3 Author: Translation Subject: Notitie Date: 26/04/2014 18:52:16
FU.C. extreme support reactions

AFB. FU.C. MOMENTEN (MY) OMHULLENDE 1 Fundamenteel Belastingscombinaties



AFB. FU.C. DWARSKRACHT (VZ) OMHULLENDE 2 Fundamenteel Belastingscombinaties



KARAKTERISTIEK BELASTINGSCOMBINATIES (TABEL) 3

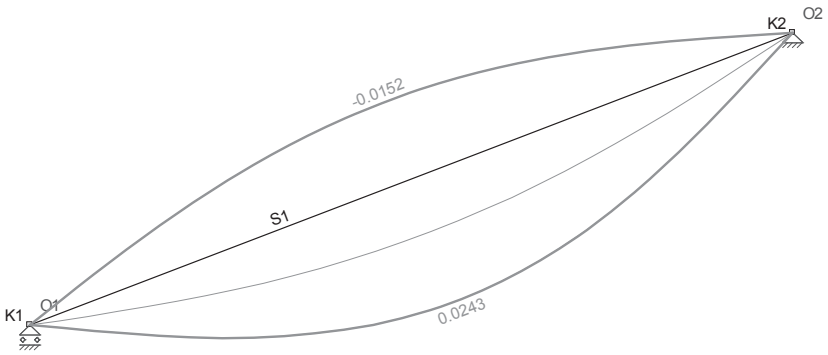
B.G.	Omschrijving	Ka.C.(w1)	Ka.C.1	Ka.C.2	Ka.C.3
B.G.1	Permanent	1.00	1.00	1.00	1.00
B.G.2	Sneeuwbelasting	-	-	1.00	-
B.G.3	Windbelasting	-	-	-	1.00

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 18:54:20
bending moments

Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 18:53:11
shear force

Number: 3 Author: Translation Subject: Notitie Date: 26/04/2014 19:18:09
characteristic load combinations

constant
snow load
wind load



KNIKLENGTEGEGEVENS 2

Staaf	Profiel		Lokale Y-as			Lokale Z-as		
		Lsys	methode	Lbuc	Lbuc/Lsys	methode	Lbuc	Lbuc/Lsys
C1 - V1 (0.000-6.277)	P1	6.280	Geschoord	6.042	0.96	Handmatige Invoer	1.570	0.25
-	-	m	-	m	-	-	m	-

DOORBUIGINGGEGEVENS 3

Staaf	Constructietype	Toetsing	Zeeg Y'	Zeeg Z'	Zeegvorm	Eis U;eind	Eis U;bij
C1 - V1 (0.000-6.277)	Dak	Algemeen	0	0	3-Punt	L/250	L/250
-	-	-	mm	mm	-	-	-

UNITY CHECK NEN-EN1993-1-1:2009/NB:2011

Veld	Toetsing	Combinatie	Artikel	UC max
C1-V1 (0.000-6.277)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.12)	0,50
C1-V1 (0.000-6.277)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,01
C1-V1 (0.000-6.277)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,01
C1-V1 (0.000-6.277)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,49
C1-V1 (0.000-6.277)	Doorbuigingstoetsing	Ka.C.3	NEN-EN1993|NEN-EN1990/NB A1.4.2	**1,10**

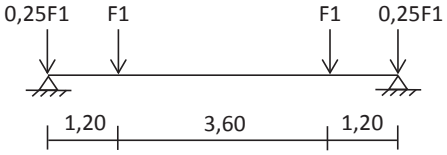
UC doorbuiging van 1,10 is toch acceptabel omdat de staafaansluitingen niet zuiver scharnierend zullen zijn en daardoor de werkelijke doorbuiging minder zal zijn.

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 18:55:00
displacements

Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 18:57:26
buckle length statistics

Number: 3 Author: Translation Subject: Notitie Date: 26/04/2014 18:57:41
deflection statistics

Stalen ligger langs de nok

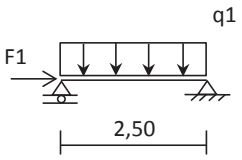


UNP180

				perm	vb	
F1	hellend dak (sneeuw)	zie blz. 11	=	4,33	5,70	kN
	wind opwaarts	zie blz. 11	=		-7,91	kN

zie blz. 15 t/m 17

Horizontale ligger in kopgevels



koker 80x80x4

q hor.	wind op kopgevel	=	2,50	x	0,75	x	-1,10	=	-2,06	kN/m
F1	wind op langsgevel	=	3,00	x	2,30	x	0,75	x	1,10	=	5,69	kN

zie blz. 18 t/m 20

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 18:58:16
steal beam next to the ridge

sloped roof (snow)
wind upwards

Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 18:58:44
horizontal beam in front facades

box profile

wind on front facade
wind of side facade

	Adviesbureau Daenen B.V.		
Projectnaam	Prêt-à-Loger Versailles en Delft	Projectnummer	14025
Omschrijving	Stalen ligger langs nok	Constructeur	D.Daenen
Opdrachtgever	Nobutec Tuinbouwprojecten B.V.	Eenheden	m, kN, kNm
Bestand	F:\Projecten\2014\14025 Pret-a-loger te Delft\ligger langs nok.mxf		

UITGANGSPUNTEN VAN DE ANALYSE

Lineaire Elastische Analyse uitgevoerd

AFB. GEOMETRIE 1



BALKGEOMETRIE

Positie	Profielnaam	Hoek	Traagheidsmoment	Materiaal	E-Modulus	Uitzettingcoeff	Gewicht
0,000 - L(6,000)	UNP180	0	1.3862e-05	S235	2.1000e+08	12.0000e-06	0.22
m -		**°**	**m4 -**		**kN/m2**	**C°m**	**kN/m**

OPLEGGINGEN

Oplegging	Positie	Z	Yr
O1	0,000	vast	vrij
O2	L(6,000)	vast	vrij
-	**m**	**kN/m**	**kNmrad**

BELASTINGSGEVALLEN

Type	Beginwaarde	Eindwaarde	Beginafstand	Eindafstand	Richting	Staaf of knoop
B.G.1: Permanent						
qG	1,00	1,00	0,000	6,000(L)	Z	S1
F	4,33		1,200		Z	S1
F	4,33		4,800		Z	S1
F	1,09		0,000		Z	S1
F	1,09		6,000		Z	S1
Som lasten	**X:**	**0,00 kN Z: 12,18 kN**				
B.G.2: Sneeuwbelasting						
F	5,70		1,200		Z	S1
F	5,70		4,800		Z	S1
F	1,43		0,000		Z	S1
F	1,43		6,000		Z	S1
Som lasten	**X:**	**0,00 kN Z: 14,26 kN**				
B.G.3: Windbelasting						
F	-7,91		1,200		Z	S1
F	-7,91		4,800		Z	S1
F	-1,98		0,000		Z	S1
F	-1,98		6,000		Z	S1
Som lasten	**X:**	**0,00 kN Z: -19,78 kN**				
-	**-**	**-**	**m**	**m**	**- -**	

B.G. OPLEGREACTIES

B.C.	Oplegging	Positie	Z	Yr	Z	My
B.G.1	O1	0.000	vast	vast	-6.09	0.00
B.G.1	O2	0.000	vast	vast	-6.09	0.00
	Som Reacties				**-12.18**	
	Som Lasten				**12.18**	
B.G.2	O1	0.000	vast	vast	-7.13	0.00
B.G.2	O2	0.000	vast	vast	-7.13	0.00
	Som Reacties				**-14.26**	
	Som Lasten				**14.26**	
B.G.3	O1	0.000	vast	vast	9.89	0.00
B.G.3	O2	0.000	vast	vast	9.89	0.00
	Som Reacties				**19.78**	

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 19:01:43
steal beam next to the ridge

Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 18:59:09
starting points of the analysis (lineair elastic analysis has been done)

beam geometry

supports

load cases

BG support reactions

B.C.	Oplegging	Positie	Z	Yr	Z	My
	Som Lasten				**-19.78**	
-	-	m	kN/m	kNmrad	kN	kNm

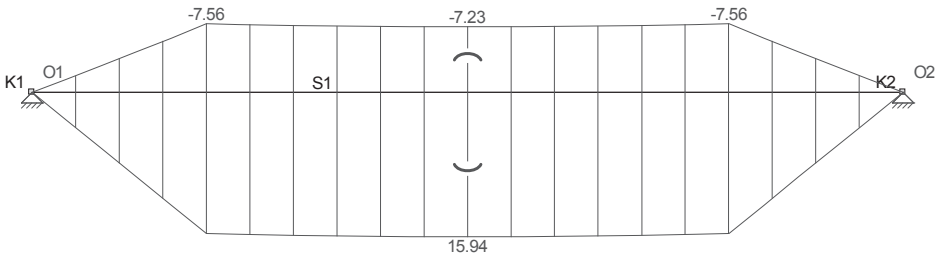
FUNDAMENTEEL BELASTINGSCOMBINATIES (TABEL)

B.G.	Omschrijving	Fu.C.1	Fu.C.2	Fu.C.3
B.G.1	Permanent	1.22	1.08	0.90
B.G.2	Sneeuwbelasting	-	1.35	-
B.G.3	Windbelasting	-	-	1.35

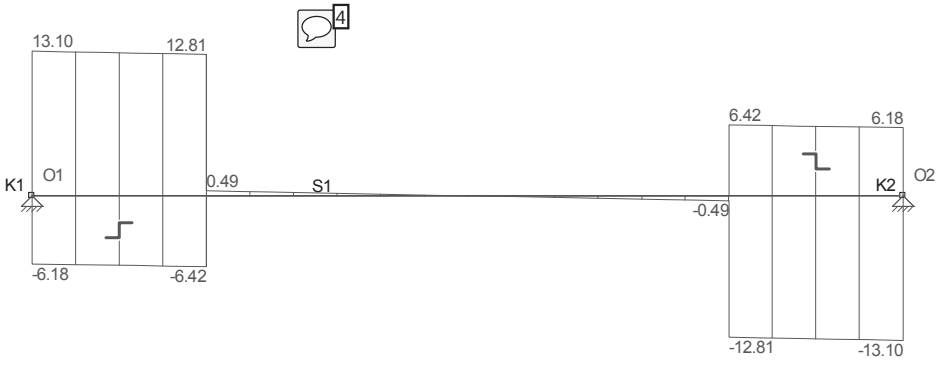
FU.C. EXTREME OPLEGREACTIES

Oplegging	Knoop	B.C.	Zmax	My	B.C.	Z	Mymax
O1	S1	Fu.C.3	**7.87**	0.00			
O1	S1	Fu.C.2	**-16.21**	0.00			
O2	S1	Fu.C.3	**7.87**	0.00			
O2	S1	Fu.C.2	**-16.21**	0.00			
Globale extreme waarden							
O2	S1	Fu.C.3	**7.87**	0,00			
O2	S1	Fu.C.2	**-16.21**	0,00			
-	-	-	kN	kNm	-	kN	kNm

AFB. FU.C. MOMENTEN (MY) OMHULLENDE — Fundamenteel Belastingscombinaties



AFB. FU.C. DWARSKRACHT (VZ) OMHULLENDE — Fundamenteel Belastingscombinaties



KARAKTERISTIEK BELASTINGSCOMBINATIES (TABEL)

B.G.	Omschrijving	Ka.C.(w1)	Ka.C.1	Ka.C.2
B.G.1	Permanent	1.00	1.00	1.00

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 18:59:35
fundamental load combinations (table)

Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 18:59:50
FU.C. extreme support reactions

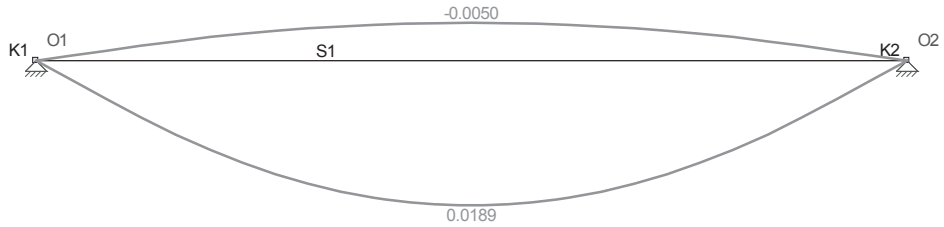
Number: 3 Author: Translation Subject: Notitie Date: 26/04/2014 19:00:00
bending moments

Number: 4 Author: Translation Subject: Notitie Date: 26/04/2014 19:15:31
shear force

Number: 5 Author: Translation Subject: Notitie Date: 26/04/2014 19:16:04
characteristic load combinations (table)

B.G.2	Sneeuwbelasting	-	1.00	-
B.G.3	Windbelasting	-	-	1.00

AFB. KA.C. VERPLAATSINGEN OMHULLENDE 1 Karakteristiek Belastingscombinaties



DOORBUIGINGGEGEVENS 2

Staaf	Constructietype	Toetsing	Zeeg Y'	Zeeg Z'	Zeegvorm	Eis U;eind	Eis U;bij
C1 - V1 (0.000-6.000)	Dak	Algemeen	0	0	Parabolisch	L/250	L/250
-	-	-	mm	mm	-	-	-

UNITY CHECK NEN-EN1993-1-1:2009/NB:2011

Veld	Toetsing	Combinatie	Artikel	UC max
C1-V1 (0.000-6.000)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.1)	0,37
C1-V1 (0.000-6.000)	Doorbuigingstoetsing	Ka.C.1	NEN-EN1993|NEN-EN1990/NB A1.4.2	0,79

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 19:00:41
displacements

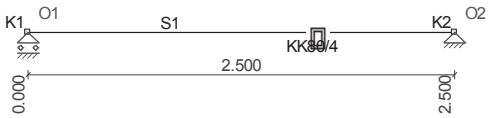
Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 19:00:51
deflection statistics

	Adviesbureau Daenen B.V.		
Projectnaam	Prêt-à-Loger Versailles en Delft	Projectnummer	14025
Omschrijving	Horizontale ligger in kopgevels	Constructeur	D.Daenen
Opdrachtgever	Nobutec Tuinbouwprojecten B.V.	Eenheden	m, kN, kNm
Bestand	F:\Projecten\2014\14025 Pret-a-loger te Delft\hor. ligger kopgevels.mxf		

UITGANGSPUNTEN VAN DE ANALYSE

Lineaire Elastische Analyse uitgevoerd

AFB. GEOMETRIE 1



STAVEN

Staaf	Knoop B	B	Scharnier E	Knoop E	Profiel	X-B	Z-B	X-E	Z-E	Lengte
S1	K1	NVM	NVM	K2	P1	0,000	0,000	2,500	0,000	2,500
-	-	-	-	-	-	m	m	m	m	m

PROFIELEN

Profiel	Profielnaam	Oppervlakte	Iy	Materiaal	Hoek
P1	KK80/4	1.1748e-03	1.1104e-06	S235H(EN10219-1)	0
-	-	m2	m4	-	°

MATERIALEN

Materiaal	Dichtheid	E-Modulus	Uitzettingcoeff
S235H(EN10219-1)	78.50	2.1000e+08	12.0000e-06
-	kN/m3	kN/m2	C°m

OPLEGGINGEN

Oplegging	Knoop	X	Z	Yr	HoekYr
O1	K1	vrij	vast	vrij	0
O2	K2	vast	vast	vrij	0
-	-	kN/m	kN/m	kNmrad	°

BELASTINGSGEVALLEN

Type	Beginwaarde	Eindwaarde	Beginafstand	Eindafstand	Richting	Staaf of knoop
B.G.1: Permanent						
qG	0,09 (1.00x)	0,09 (1.00x)	0,000	2,500(L)	Z"	S1
Som lasten	**X: 0,00 kN**	**Z: 0,23 kN**				
B.G.2: Windbelasting						
q	2,06	2,06	0,000	2,500(L)	Z'	S1
N	5,69				X	K1
Som lasten	**X: 5,69 kN**	**Z: 5,15 kN**				
-	-	-	m	m	-	-

B.G. OPLEGREACTIES

B.G.	Oplegging	Knoop	X	Z	My
B.G.1	O1	K1	0.00	-0.12	0.00
B.G.1	O2	K2	0.00	-0.12	0.00
	Som Reacties		**0.00**	**-0,23**	
	Som Lasten		**0.00**	**0.23**	
B.G.2	O1	K1	0.00	-2.58	0.00
B.G.2	O2	K2	-5.69	-2.58	0.00
	Som Reacties		**-5.69**	**-5,15**	
	Som Lasten		**5.69**	**5.15**	
-	-	-	kN	kN	kNm

FUNDAMENTEEL BELASTINGSCOMBINATIES (TABEL)

B.G.	Omschrijving	Fu.C.1	Fu.C.2
B.G.1	Permanent	1.22	1.08
B.G.2	Windbelasting	-	1.35

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 19:02:59
horizontal beam in front facades

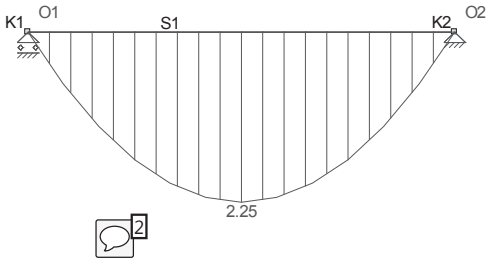
Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 19:03:26
starting points of the analysis (lineair elastic analysis has been done)

rods
profiles
materials
supports
load cases
fundamental load combinations (table)

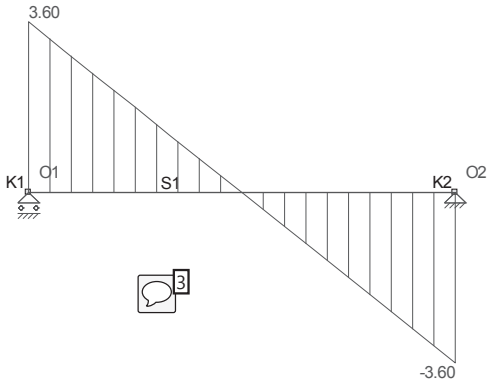
FU.C. EXTREME OPLEGREACTIES

Oplegging	Knoop	B.C.	Xmax	Z	My	B.C.	X	Zmax	My	B.C.	X	Z	Mymax
O1	K1					Fu.C.2	0.00	**-3.60**	0.00				
O2	K2	Fu.C.2	**-7.68**	-3.60	0.00	Fu.C.2	-7.68	**-3.60**	0.00				
Globale extreme waarden													
O2	K2	Fu.C.2	**-7.68**	-3.60	0.00								
O2	K2					Fu.C.2	-7.68	**-3.60**	0.00				
-	**-**	**-**	**kN**	**kN**	**kNm**	**-**	**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

AFB. FU.C. MOMENTEN (MY) — Fundamenteel
OMHULLENDE — Belastingscombinaties



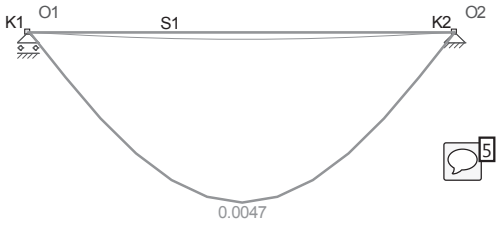
AFB. FU.C. DWARSKRACHT (VZ) — Fundamenteel
OMHULLENDE — Belastingscombinaties



KARAKTERISTIEK BELASTINGSCOMBINATIES (TABEL)

B.G.	Omschrijving	Ka.C.(w1)	Ka.C.1	Ka.C.2
B.G.1	Permanent	1.00	1.00	1.00
B.G.2	Windbelasting	-	-	1.00

AFB. KA.C. VERPLAATSINGEN — Karakteristiek
OMHULLENDE — Belastingscombinaties



KNIKLENGTEGEGEVENS

Staaf	Profiel	Lokale Y-as				Lokale Z-as			
		Lsys	methode	Lbuc	Lbuc/Lsys	methode	Lbuc	Lbuc/Lsys
C1 - V1 (0.000-2.500)	P1	2.500	Geschoord	2.406	0.96	Cons. gesch.	2.500	1.00
-	**-**	**m**	**-**	**m**	**-**	**-**	**m**	**-**

DOORBUIGINGGEGEVENS

Staaf	Constructietype	Toetsing	Zeeg Y'	Zeeg Z'	Zeegvorm	Eis U;eind	Eis U;bij
C1 - V1 (0.000-2.500)	Dak	Algemeen	0	0	Parabolisch	L/250	L/250
-	**-**	**-**	**mm**	**mm**	**-**	**-**	**-**

UNITY CHECK NEN-EN1993-1-1:2009/NB:2011

Veld	Toetsing	Combinatie	Artikel	UC max
C1-V1 (0.000-2.500)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.12)	0,29

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 19:03:42
FU.C. extreme support reactions

Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 19:03:50
bending moments

Number: 3 Author: Translation Subject: Notitie Date: 26/04/2014 19:19:11
shear force

Number: 4 Author: Translation Subject: Notitie Date: 26/04/2014 19:04:14
characteristic load combinations (table)

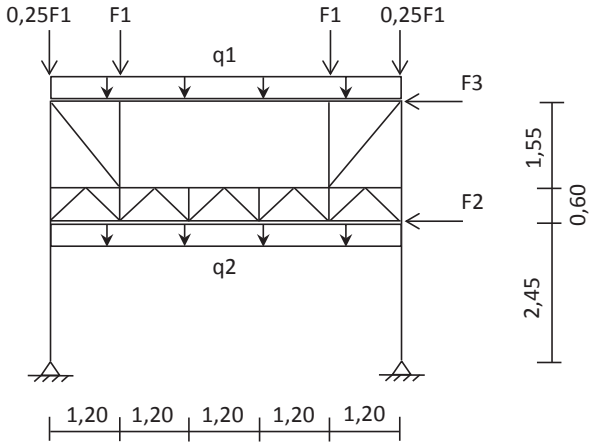
Number: 5 Author: Translation Subject: Notitie Date: 26/04/2014 19:04:18
displacements

Number: 6 Author: Translation Subject: Notitie Date: 26/04/2014 19:20:33
buckle length statistics

Number: 7 Author: Translation Subject: Notitie Date: 26/04/2014 19:04:41
deflection statistics

Veld	Toetsing	Combinatie	Artikel	UC max
C1-V1 (0.000-2.500)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,04
C1-V1 (0.000-2.500)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,04
C1-V1 (0.000-2.500)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,33
C1-V1 (0.000-2.500)	Doorbuigingstoetsing	Ka.C.2	NEN-EN1993|NEN-EN1990/NB A1.4.2	0,47

Stalen portaal langsgevel 1



kolommen koker 120x120x8
hangstijlen koker 80x80x4
bovenrand koker 120x80x5
onderrand koker 120x80x5
stijlen en diagonalen in tralie
koker 30x30x3 2

3

									perm	vb	
q1	hellend dak (sneeuw)	=	0,93	x	0,32	x	1,00	0,56	=	0,30	0,52	kN/m
	langsgevel	=	2,15	x	0,25				=	0,54		kN/m
										0,84	0,52	kN/m
q2	vouwdeuren									0,63		kN/m
F1	hellend dak (sneeuw)				zie blz. 11				=	4,33	5,70	kN
	wind opwaarts				zie blz. 11				=		-7,91	kN
F2	wind op kopgevel	=	1,25	x	2,50	x	0,75	x 1,30	=		3,05	kN
	wrijving langsgevel	=	6,00	x	2,30	x	0,75	x 0,02	=		0,21	kN
											3,25	kN
F3	wind op kopgevel	=	2,93	x	1,06	x	0,75	x 1,30	=		3,04	kN
	wrijving dak+gevel	=	6,00	x	4,29	x	0,75	x 0,02	=		0,39	kN
											3,42	kN

zie blz 22 t/m 30

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 19:04:55
steel portal front facade

Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 19:06:20
column box
hang pillar box
upper edge box
lower edge box
pillars and diagonals in bar box

Number: 3 Author: Translation Subject: Notitie Date: 26/04/2014 19:09:25
q1 sloped roof (snow)
side facade

q2 folding doors

F1 sloped roof (snow)
wind upwards

F2 wind on front facade
friction side facade

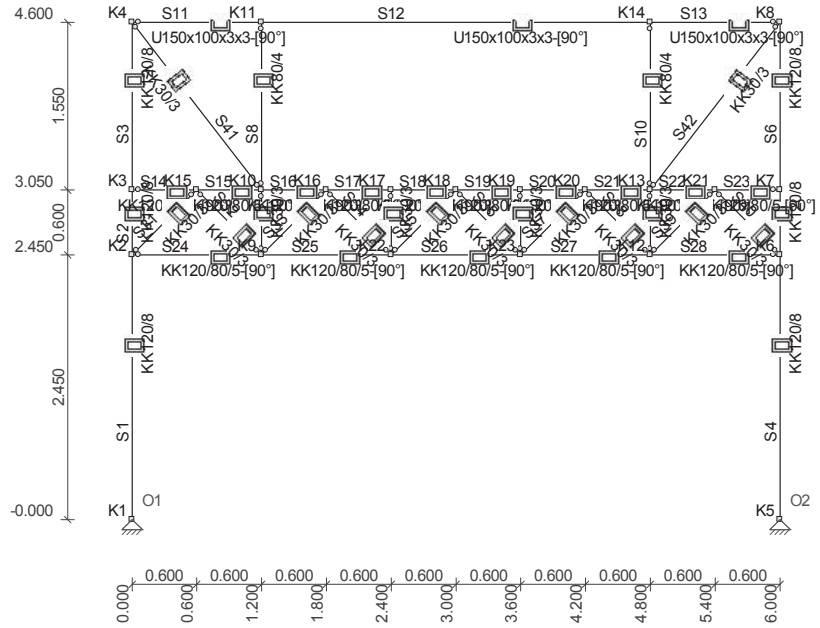
F3 wind on front facade
friction roof + facade

	Adviesbureau Daenen B.V.		
Projectnaam	Prêt-à-Loger Versailles en Delft	Projectnummer	14025
Omschrijving	Stalen portaal langsgevel	Constructeur	D.Daenen
Opdrachtgever	Nobutec Tuinbouwprojecten B.V.	Eenheden	m, kN, kNm
Bestand	F:\Projecten\2014\14025 Pret-a-loger te Delft\portaal langsgevel.mxf		

UITGANGSPUNTEN VAN DE ANALYSE

Lineaire Elastische Analyse uitgevoerd

AFB. GEOMETRIE 1



STAVEN

Staaf	Knoop B		Scharnier B	Scharnier E	Knoop E	Profiel	X-B	Z-B	X-E	Z-E	Lengte
S1	K1	NVM	NVM		K2	P1	0,000	0,000	0,000	-2,450	2,450
S2	K2	NVM	NVM		K3	P1	0,000	-2,450	0,000	-3,050	0,600
S3	K3	NVM	NVM		K4	P1	0,000	-3,050	0,000	-4,600	1,550
S4	K5	NVM	NVM		K6	P1	6,000	0,000	6,000	-2,450	2,450
S5	K6	NVM	NVM		K7	P1	6,000	-2,450	6,000	-3,050	0,600
S6	K7	NVM	NVM		K8	P1	6,000	-3,050	6,000	-4,600	1,550
S7	K9	NV-	NV-		K10	P5	1,200	-2,450	1,200	-3,050	0,600
S8	K10	NV-	NV-		K11	P3	1,200	-3,050	1,200	-4,600	1,550
S9	K12	NV-	NV-		K13	P5	4,800	-2,450	4,800	-3,050	0,600
S10	K13	NV-	NV-		K14	P3	4,800	-3,050	4,800	-4,600	1,550
S11	K4	NV-	NVM		K11	P4	0,000	-4,600	1,200	-4,600	1,200
S12	K11	NVM	NVM		K14	P4	1,200	-4,600	4,800	-4,600	3,600
S13	K14	NVM	NV-		K8	P4	4,800	-4,600	6,000	-4,600	1,200
S14	K3	NV-	NVM		K15	P2	0,000	-3,050	0,600	-3,050	0,600
S15	K15	NVM	NVM		K10	P2	0,600	-3,050	1,200	-3,050	0,600
S16	K10	NVM	NVM		K16	P2	1,200	-3,050	1,800	-3,050	0,600
S17	K16	NVM	NVM		K17	P2	1,800	-3,050	2,400	-3,050	0,600
S18	K17	NVM	NVM		K18	P2	2,400	-3,050	3,000	-3,050	0,600
S19	K18	NVM	NVM		K19	P2	3,000	-3,050	3,600	-3,050	0,600
S20	K19	NVM	NVM		K20	P2	3,600	-3,050	4,200	-3,050	0,600
S21	K20	NVM	NVM		K13	P2	4,200	-3,050	4,800	-3,050	0,600
S22	K13	NVM	NVM		K21	P2	4,800	-3,050	5,400	-3,050	0,600
S23	K21	NVM	NV-		K7	P2	5,400	-3,050	6,000	-3,050	0,600
S24	K2	NV-	NVM		K9	P2	0,000	-2,450	1,200	-2,450	1,200
S25	K9	NVM	NVM		K22	P2	1,200	-2,450	2,400	-2,450	1,200
S26	K22	NVM	NVM		K23	P2	2,400	-2,450	3,600	-2,450	1,200
S27	K23	NVM	NVM		K12	P2	3,600	-2,450	4,800	-2,450	1,200

Number: 1 Author: Translation Subject: Notitie Date: 26/04/2014 19:09:45
steel portal side facade

Number: 2 Author: Translation Subject: Notitie Date: 26/04/2014 19:10:15
starting points of the analysis (lineair elastic analysis has been done)

rods

Staaf	Knoop B	Scharnier B	Scharnier E	Knoop E	Profiel	X-B	Z-B	X-E	Z-E	Lengte
S28	K12	NVM	NV-	K6	P2	4,800	-2,450	6,000	-2,450	1,200
S29	K22	NV-	NV-	K17	P5	2,400	-2,450	2,400	-3,050	0,600
S30	K23	NV-	NV-	K19	P5	3,600	-2,450	3,600	-3,050	0,600
S31	K2	NV-	NV-	K15	P5	0,000	-2,450	0,600	-3,050	0,849
S32	K15	NV-	NV-	K9	P5	0,600	-3,050	1,200	-2,450	0,849
S33	K9	NV-	NV-	K16	P5	1,200	-2,450	1,800	-3,050	0,849
S34	K16	NV-	NV-	K22	P5	1,800	-3,050	2,400	-2,450	0,849
S35	K22	NV-	NV-	K18	P5	2,400	-2,450	3,000	-3,050	0,849
S36	K18	NV-	NV-	K23	P5	3,000	-3,050	3,600	-2,450	0,849
S37	K23	NV-	NV-	K20	P5	3,600	-2,450	4,200	-3,050	0,849
S38	K20	NV-	NV-	K12	P5	4,200	-3,050	4,800	-2,450	0,849
S39	K12	NV-	NV-	K21	P5	4,800	-2,450	5,400	-3,050	0,849
S40	K21	NV-	NV-	K6	P5	5,400	-3,050	6,000	-2,450	0,849
S41	K10	NV-	NV-	K4	P5	1,200	-3,050	0,000	-4,600	1,960
S42	K13	NV-	NV-	K8	P5	4,800	-3,050	6,000	-4,600	1,960
-	-	-	-	-	-	m	m	m	m	m

PROFIELEN

Profiel	Profielnaam	Oppervlakte	Iy	Materiaal	Hoek
P1	KK120/8	3.3643e-03	6.7688e-06	S235H(EN10219-1)	0
P2	KK120/80/5	1.8356e-03	1.8778e-06	S235H(EN10219-1)	90
P3	KK80/4	1.1748e-03	1.1104e-06	S235H(EN10219-1)	0
P4	U150x100x3x3	1.1910e-03	2.8757e-06	S235	90
P5	KK30/3	3.0855e-04	3.6698e-08	S235H(EN10219-1)	0
-	-	m2	m4	-	°

PROFIELVORMEN

Profiel	Verl. h.	hB	hE	tf	tw	tf2	B	bL	bR	Raatl.	Hoogte
P4	Nee	0.100	0.100	0.003	0.003	0.000	0.150	0.000	0.000	Nee	0.000
-	-	m	m	m	m	m	m	m	m	-	m

MATERIALEN

Materiaal	Dichtheid	E-Modulus	Uitzettingcoeff
S235H(EN10219-1)	78.50	2.1000e+08	12.0000e-06
S235	78.50	2.1000e+08	12.0000e-06
-	kN/m3	kN/m2	C°m

OPLEGGINGEN

Oplegging	Knoop	X	Z	Yr	HoekYr
O1	K1	vast	vast	vrij	0
O2	K5	vast	vast	vrij	0
-	-	kN/m	kN/m	kNmrad	°

BELASTINGSGEVALLEN

Type	Beginwaarde	Eindwaarde	Beginafstand	Eindafstand	Richting	Staaf of knoop
B.G.1: Permanent						
qG	0,26 (1.00x)	0,26 (1.00x)	0,000	2,450(L)	Z"	S1,S4
qG	0,26 (1.00x)	0,26 (1.00x)	0,000	0,600(L)	Z"	S2,S5
qG	0,26 (1.00x)	0,26 (1.00x)	0,000	1,550(L)	Z"	S3,S6
qG	0,02 (1.00x)	0,02 (1.00x)	0,000	0,600(L)	Z"	S7,S9,S29-S30
qG	0,09 (1.00x)	0,09 (1.00x)	0,000	1,550(L)	Z"	S8,S10
qG	0,09 (1.00x)	0,09 (1.00x)	0,000	1,200(L)	Z"	S11,S13
qG	0,09 (1.00x)	0,09 (1.00x)	0,000	3,600(L)	Z"	S12
qG	0,14 (1.00x)	0,14 (1.00x)	0,000	0,600(L)	Z"	S14-S23
qG	0,14 (1.00x)	0,14 (1.00x)	0,000	1,200(L)	Z"	S24-S28
qG	0,02 (1.00x)	0,02 (1.00x)	0,000	0,849(L)	Z"	S31-S40
qG	0,02 (1.00x)	0,02 (1.00x)	0,000	1,960(L)	Z"	S41-S42
q	0,84	0,84	0,000	1,200(L)	Z'	S11-S13
q	0,63	0,63	0,000	1,200(L)	Z'	S24-S28
N	4,33				Z	K11,K14
N	1,09				Z	K4,K8
Som lasten	**X:**	**0,00**	**kN**	**Z:**	**25,02**	**kN**
B.G.2: Wind opwaarts						
N	-7,91				Z	K11,K14
N	-1,98				Z	K4,K8
Som lasten	**X:**	**0,00**	**kN**	**Z:**	**-19,78**	**kN**
B.G.3: Wind v rechts						

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profiles
profile shapes
materials
supports
load cases

Type	Beginwaarde	Eindwaarde	Beginafstand	Eindafstand	Richting	Staaf of knoop
B.G.3: Wind v rechts						
N	-3,25				X	K6
N	-3,42				X	K8
Som lasten	**X:**	**-6,67 kN**	**Z: 0,00 kN**			
B.G.4: Sneeuwbelasting						
q	0,52	0,52	0,000	1,200(L)	Z'	S11-S13
N	5,70				Z	K11,K14
N	1,43				Z	K4,K8
Som lasten	**X:**	**0,00 kN**	**Z: 17,38 kN**			
-	**-**	**-**	**m**	**m**	**- -**	

B.G. OPLEGREACTIES

B.G.	Oplegging	Knoop	X	Z	My
B.G.1	O1	K1	0.09	-12.51	0.00
B.G.1	O2	K5	-0.09	-12.51	0.00
	Som Reacties		**0.00**	**-25,02**	
	Som Lasten		**0.00**	**25.02**	
B.G.2	O1	K1	-0.06	9.89	0.00
B.G.2	O2	K5	0.06	9.89	0.00
	Som Reacties		**0.00**	**19,78**	
	Som Lasten		**0.00**	**-19.78**	
B.G.3	O1	K1	3.33	-3.95	0.00
B.G.3	O2	K5	3.34	3.95	0.00
	Som Reacties		**6.67**	**0,00**	
	Som Lasten		**-6.67**	**0.00**	
B.G.4	O1	K1	0.06	-8.69	0.00
B.G.4	O2	K5	-0.06	-8.69	0.00
	Som Reacties		**0.00**	**-17,38**	
	Som Lasten		**0.00**	**17.38**	
-	**-**	**-**	**kN**	**kN**	**kNm**

FUNDAMENTEEL BELASTINGSCOMBINATIES (TABEL)

B.G.	Omschrijving	Fu.C.1	Fu.C.2	Fu.C.3	Fu.C.4
B.G.1	Permanent	1.22	1.08	0.90	1.08
B.G.2	Wind opwaarts	-	-	1.35	-
B.G.3	Wind v rechts	-	1.35	1.35	-
B.G.4	Sneeuwbelasting	-	-	-	1.35

FU.C. EXTREME OPLEGREACTIES

Oplegging	Knoop	B.C.	Xmax	Z	My	B.C.	X	Zmax	My	B.C.	X	Z	Mymax
O1	K1	Fu.C.2	**4.59**	-18.86	0.00								
O1	K1					Fu.C.4	0.18	**-25.26**	0.00				
O2	K5	Fu.C.3	**4.52**	7.42	0.00	Fu.C.3	4.52	**7.42**	0.00				
O2	K5	Fu.C.4	**-0.18**	-25.26	0.00	Fu.C.4	-0.18	**-25.26**	0.00				
Globale extreme waarden													
O1	K1	Fu.C.2	**4.59**	-18.86	0.00								
O2	K5	Fu.C.4	**-0.18**	-25.26	0.00								
O2	K5					Fu.C.3	4.52	**7.42**	0.00				
O2	K5					Fu.C.4	-0.18	**-25.26**	0.00				
-	**-**	**-**	**kN**	**kN**	**kNm**	**-**	**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

FU.C. EXTREME STAAFKRACHTEN

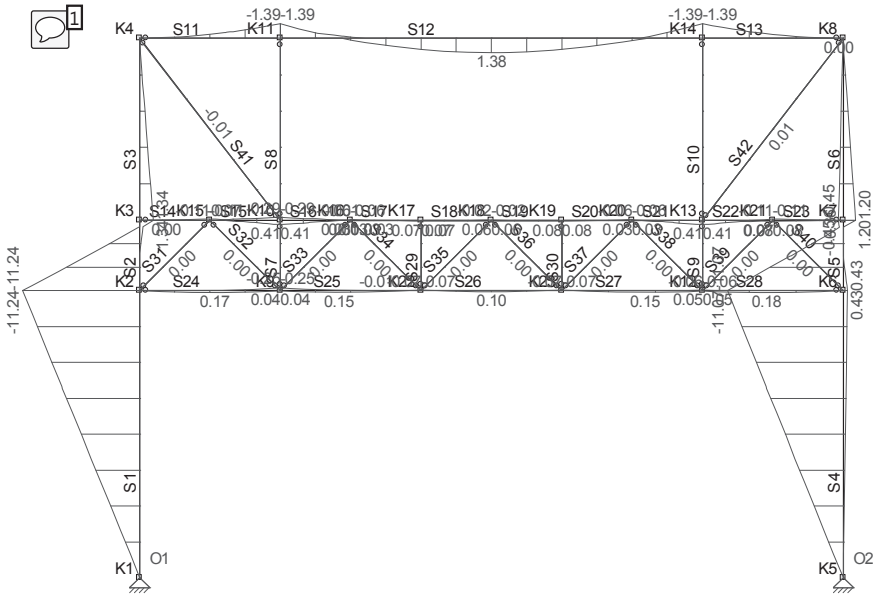
Staaf	B.C.	Mb	Mmax	xMmax	Me	x-M0	x-M0	T/D	Nmax	Vb	Vmax	Ve
S1	Fu.C.2	0.00	0.00	0.000	**-11.24**	0.000	0.000	D	-18.86	**-4.59**	**-4.59**	**-4.59**
	Fu.C.4	0.00	0.00	0.000	-0.43	0.000	0.000	D	**-25.26**	-0.18	-0.18	-0.18
S2	Fu.C.2	**-11.24**	0.00	0.000	**1.34**	0.536	0.000	D	-9.71	**20.96**	**20.96**	**20.96**
	Fu.C.3	-10.99	0.00	0.000	1.08	0.546	0.000	T	**0.71**	20.12	20.12	20.12
	Fu.C.4	-0.43	0.00	0.000	0.45	0.296	0.000	D	**-15.77**	1.47	1.47	1.47
S3	Fu.C.2	**1.34**	0.00	0.000	0.00	0.000	0.000	D	-9.64	**-0.86**	**-0.86**	**-0.86**
	Fu.C.3	1.08	0.00	0.000	0.00	0.000	0.000	T	**1.11**	-0.70	-0.70	-0.70
	Fu.C.4	0.45	0.00	0.000	0.00	0.000	0.000	D	**-15.73**	-0.29	-0.29	-0.29
S4	Fu.C.3	0.00	0.00	0.000	**-11.07**	0.000	0.000	T	**8.00**	**-4.52**	**-4.52**	**-4.52**
	Fu.C.4	0.00	0.00	0.000	**0.43**	0.000	0.000	D	**-25.26**	**0.18**	**0.18**	**0.18**
S5	Fu.C.3	**-11.07**	0.00	0.000	**1.20**	0.541	0.000	T	**4.37**	**20.45**	**20.45**	**20.45**
	Fu.C.4	**0.43**	0.00	0.000	**-0.45**	0.296	0.000	D	**-15.77**	**-1.47**	**-1.47**	**-1.47**
S6	Fu.C.3	**1.20**	0.00	0.000	0.00	0.000	0.000	T	**4.92**	**-0.77**	**-0.77**	**-0.77**

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BG support reactions
fundamental load combinations (table)
FU.C. extreme support reactions
FU.C. extreme rod forces

Staaf	B.C.	Mb	Mmax	xMmax	Me	x-M0	x-M0	T/D	Nmax	Vb	Vmax	Ve
S6	Fu.C.4	**-0.45**	0.00	0.000	0.00	0.000	0.000	D	**-15.73**	**0.29**	**0.29**	**0.29**
S7	Fu.C.3	0.00	0.00	0.000	0.00	0.000	0.000	T	**3.49**	0.00	0.00	0.00
	Fu.C.4	0.00	0.00	0.000	0.00	0.000	0.000	D	**-4.00**	0.00	0.00	0.00
S8	Fu.C.3	0.00	0.00	0.000	0.00	0.000	0.000	T	**3.90**	0.00	0.00	0.00
	Fu.C.4	0.00	0.00	0.000	0.00	0.000	0.000	D	**-17.80**	0.00	0.00	0.00
S9	Fu.C.3	0.00	0.00	0.000	0.00	0.000	0.000	T	**0.75**	0.00	0.00	0.00
	Fu.C.4	0.00	0.00	0.000	0.00	0.000	0.000	D	**-4.00**	0.00	0.00	0.00
S10	Fu.C.3	0.00	0.00	0.000	0.00	0.000	0.000	T	**4.32**	0.00	0.00	0.00
	Fu.C.4	0.00	0.00	0.000	0.00	0.000	0.000	D	**-17.80**	0.00	0.00	0.00
S11	Fu.C.3	0.00	0.00	0.000	-0.94	0.000	0.000	D	-1.35	**-0.28**	-1.29	-1.29
	Fu.C.4	0.00	0.00	0.000	**-1.39**	0.000	0.000	D	**-9.80**	-0.13	**-2.19**	**-2.19**
S12	Fu.C.2	-0.99	0.81	1.884	-0.68	0.621	3.147	D	-7.22	1.90	**1.90**	-1.73
	Fu.C.4	**-1.39**	**1.38**	1.800	**-1.39**	0.529	3.071	D	**-9.80**	**3.08**	**-3.08**	**-3.08**
S13	Fu.C.2	-0.68	**0.00**	1.162	0.00	1.124	0.000	D	-7.22	1.17	1.17	**-0.04**
	Fu.C.4	**-1.39**	0.00	0.000	0.00	0.000	0.000	D	**-9.80**	**2.19**	**2.19**	**0.13**
S14	Fu.C.2	0.00	0.00	0.000	-0.09	0.000	0.000	T	**21.83**	-0.11	-0.20	-0.20
	Fu.C.3	0.00	**0.00**	0.229	-0.01	0.459	0.000	T	20.82	**0.03**	-0.05	-0.05
	Fu.C.4	0.00	0.00	0.000	**-0.11**	0.000	0.000	T	1.75	**-0.13**	**-0.23**	**-0.23**
S15	Fu.C.3	-0.01	0.00	0.000	**-0.29**	0.000	0.000	T	**14.43**	**-0.44**	**-0.52**	**-0.52**
	Fu.C.4	**-0.11**	0.00	0.000	**0.41**	0.120	0.000	D	**-13.57**	**0.91**	**0.91**	**0.82**
S16	Fu.C.3	**-0.29**	0.00	0.000	**0.03**	0.537	0.000	T	**15.08**	**0.58**	**0.58**	**0.50**
	Fu.C.4	**0.41**	0.00	0.000	**-0.06**	0.531	0.000	D	**-4.05**	**-0.74**	**-0.83**	**-0.83**
S17	Fu.C.3	**0.03**	**0.03**	0.021	0.01	0.000	0.000	T	**3.32**	0.00	**-0.08**	**-0.08**
	Fu.C.4	**-0.06**	0.00	0.000	**0.07**	0.240	0.000	D	**-7.29**	**0.26**	**0.26**	**0.16**
S18	Fu.C.1	0.06	0.06	0.012	0.03	0.000	0.000	D	-5.24	0.00	**-0.10**	**-0.10**
	Fu.C.3	0.01	0.00	0.000	**-0.02**	0.347	0.000	T	**3.32**	**-0.01**	-0.08	-0.08
	Fu.C.4	**0.07**	**0.07**	0.164	**0.06**	0.000	0.000	D	**-7.29**	**0.03**	-0.07	-0.07
S19	Fu.C.2	0.02	0.00	0.000	**0.08**	0.000	0.000	D	**-10.72**	0.15	0.15	0.06
	Fu.C.3	**-0.02**	0.00	0.000	0.06	0.109	0.000	D	-7.07	**0.16**	**0.16**	**0.08**
	Fu.C.4	**0.06**	**0.07**	0.436	0.07	0.000	0.000	D	-7.29	0.07	0.07	**-0.03**
S20	Fu.C.2	**0.08**	0.00	0.000	-0.02	0.506	0.000	D	**-10.72**	-0.12	-0.22	-0.22
	Fu.C.3	0.06	0.00	0.000	**0.03**	0.000	0.000	D	-7.07	0.00	-0.08	-0.08
	Fu.C.4	0.07	0.00	0.000	**-0.06**	0.360	0.000	D	-7.29	**-0.16**	**-0.26**	**-0.26**
S21	Fu.C.2	-0.02	0.00	0.000	0.33	0.032	0.000	D	**-18.12**	0.63	0.63	0.53
	Fu.C.3	**0.03**	**0.04**	0.141	0.02	0.000	0.000	D	-15.52	0.02	**-0.06**	**-0.06**
	Fu.C.4	**-0.06**	0.00	0.000	**0.41**	0.069	0.000	D	-4.05	**0.83**	**0.83**	**0.74**
S22	Fu.C.2	0.33	0.00	0.000	0.00	0.595	0.000	D	**-21.33**	-0.50	-0.60	-0.60
	Fu.C.3	0.02	0.00	0.000	**0.08**	0.000	0.000	D	-13.03	**0.14**	**0.14**	**0.06**
	Fu.C.4	**0.41**	0.00	0.000	**-0.11**	0.480	0.000	D	-13.57	**-0.82**	**-0.91**	**-0.91**
S23	Fu.C.2	0.00	**0.01**	0.330	0.00	0.060	0.000	D	-20.22	0.05	0.05	-0.04
	Fu.C.3	**0.08**	0.00	0.000	0.00	0.000	0.000	D	**-21.22**	**-0.10**	**-0.18**	**-0.18**
	Fu.C.4	**-0.11**	0.00	0.000	0.00	0.000	0.000	T	**1.75**	**0.23**	**0.23**	**0.13**
S24	Fu.C.2	0.00	0.08	0.447	-0.15	0.894	0.000	D	-17.48	0.37	**-0.63**	**-0.63**
	Fu.C.3	0.00	0.03	0.302	**-0.25**	0.604	0.000	D	**-21.60**	0.21	-0.63	-0.63
	Fu.C.4	0.00	**0.17**	0.644	**0.04**	0.000	0.000	T	**6.60**	**0.54**	**0.54**	-0.47
S25	Fu.C.1	-0.06	0.11	0.594	**-0.07**	0.118	1.071	T	9.67	0.56	-0.57	-0.57
	Fu.C.2	-0.15	0.04	0.688	-0.07	0.363	1.014	D	-3.32	**0.58**	**0.58**	-0.43
	Fu.C.3	**-0.25**	**-0.01**	0.825	-0.06	0.000	0.000	D	**-12.58**	0.57	0.57	-0.26
	Fu.C.4	**0.04**	**0.15**	0.504	-0.05	1.102	0.000	T	**15.85**	0.42	**-0.58**	**-0.58**
S26	Fu.C.1	**-0.07**	**0.10**	0.600	**-0.07**	0.131	1.069	T	11.02	**0.56**	**0.56**	**-0.56**
	Fu.C.3	-0.06	0.07	0.612	-0.05	0.167	1.057	D	**-1.13**	0.43	0.43	-0.41
	Fu.C.4	-0.05	0.10	0.600	-0.05	0.117	1.083	T	**16.99**	0.50	0.50	-0.50
S27	Fu.C.1	**-0.07**	0.11	0.606	**-0.06**	0.129	1.082	T	9.67	0.57	0.57	**-0.56**
	Fu.C.2	-0.06	**0.15**	0.708	**0.05**	0.100	0.000	T	**17.48**	**0.59**	**0.59**	-0.41
S28	Fu.C.1	**-0.06**	0.14	0.652	0.00	0.105	0.000	T	3.71	**0.61**	**0.61**	-0.51
	Fu.C.2	**0.05**	**0.18**	0.547	0.00	0.000	0.000	T	**20.53**	0.46	**-0.55**	**-0.55**
S29	Fu.C.3	0.00	0.00	0.000	0.00	0.000	0.000	D	**-0.08**	0.00	0.00	0.00
	Fu.C.4	0.00	0.00	0.000	0.00	0.000	0.000	T	**0.14**	0.00	0.00	0.00
S30	Fu.C.2	0.00	0.00	0.000	0.00	0.000	0.000	T	**0.18**	0.00	0.00	0.00
S31	Fu.C.1	0.00	**0.00**	0.424	0.00	0.000	0.000	D	-6.70	**0.01**	**-0.01**	**-0.01**
	Fu.C.4	0.00	0.00	0.424	0.00	0.000	0.000	D	**-11.66**	0.01	-0.01	-0.01
S32	Fu.C.1	0.00	**0.00**	0.424	0.00	0.000	0.000	T	5.93	**0.01**	**-0.01**	**-0.01**
	Fu.C.2	0.00	0.00	0.424	0.00	0.000	0.000	T	**10.79**	0.01	-0.01	-0.01
S33	Fu.C.1	0.00	**0.00**	0.424	0.00	0.000	0.000	D	-2.52	**0.01**	**-0.01**	**-0.01**
	Fu.C.2	0.00	0.00	0.424	0.00	0.000	0.000	D	**-9.26**	0.01	-0.01	-0.01
S34	Fu.C.1	0.00	**0.00**	0.424	0.00	0.000	0.000	T	1.75	**0.01**	**-0.01**	**-0.01**

Staaf	B.C.	Mb	Mmax	xMmax	Me	x-M0	x-M0	T/D	Nmax	Vb	Vmax	Ve
S34	Fu.C.2	0.00	0.00	0.424	0.00	0.000	0.000	T	**8.88**	0.01	-0.01	-0.01
S35	Fu.C.1	0.00	**0.00**	0.424	0.00	0.000	0.000	D	-0.17	**0.01**	**-0.01**	**-0.01**
	Fu.C.3	0.00	0.00	0.424	0.00	0.000	0.000	D	**-7.55**	0.01	-0.01	-0.01
S36	Fu.C.1	0.00	**0.00**	0.424	0.00	0.000	0.000	D	**-0.17**	**0.01**	**-0.01**	**-0.01**
	Fu.C.2	0.00	0.00	0.424	0.00	0.000	0.000	T	**7.18**	0.01	-0.01	-0.01
S37	Fu.C.1	0.00	**0.00**	0.424	0.00	0.000	0.000	T	**1.75**	**0.01**	**-0.01**	**-0.01**
	Fu.C.3	0.00	0.00	0.424	0.00	0.000	0.000	D	**-6.06**	0.01	-0.01	-0.01
S38	Fu.C.1	0.00	**0.00**	0.424	0.00	0.000	0.000	D	-2.52	**0.01**	**-0.01**	**-0.01**
	Fu.C.3	0.00	0.00	0.424	0.00	0.000	0.000	T	**5.90**	0.01	-0.01	-0.01
	Fu.C.4	0.00	0.00	0.424	0.00	0.000	0.000	D	**-3.08**	0.01	-0.01	-0.01
S39	Fu.C.1	0.00	**0.00**	0.424	0.00	0.000	0.000	T	5.93	**0.01**	**-0.01**	**-0.01**
	Fu.C.3	0.00	0.00	0.424	0.00	0.000	0.000	D	**-5.70**	0.01	-0.01	-0.01
	Fu.C.4	0.00	0.00	0.424	0.00	0.000	0.000	T	**10.02**	0.01	-0.01	-0.01
S40	Fu.C.1	0.00	**0.00**	0.424	0.00	0.000	0.000	D	-6.70	**0.01**	**-0.01**	**-0.01**
	Fu.C.3	0.00	0.00	0.424	0.00	0.000	0.000	T	**5.90**	0.01	-0.01	-0.01
	Fu.C.4	0.00	0.00	0.424	0.00	0.000	0.000	D	**-11.66**	0.01	-0.01	-0.01
S41	Fu.C.1	0.00	**-0.01**	0.980	0.00	0.000	0.000	T	9.16	**-0.02**	**0.02**	**0.02**
	Fu.C.4	0.00	-0.01	0.980	0.00	0.000	0.000	T	**15.56**	-0.02	0.02	0.02
S42	Fu.C.1	0.00	**0.01**	0.980	0.00	0.000	0.000	T	9.16	**0.02**	**-0.02**	**-0.02**
	Fu.C.3	0.00	0.01	0.980	0.00	0.000	0.000	D	**-4.09**	0.01	-0.01	-0.01
	Fu.C.4	0.00	0.01	0.980	0.00	0.000	0.000	T	**15.56**	0.02	-0.02	-0.02
-	-	kNm	kNm	m	kNm	m	m	-	kN	kN	kN	kN

AFB. FU.C. MOMENTEN (MY) OMHULLENDE — Fundamenteel Belastingscombinaties

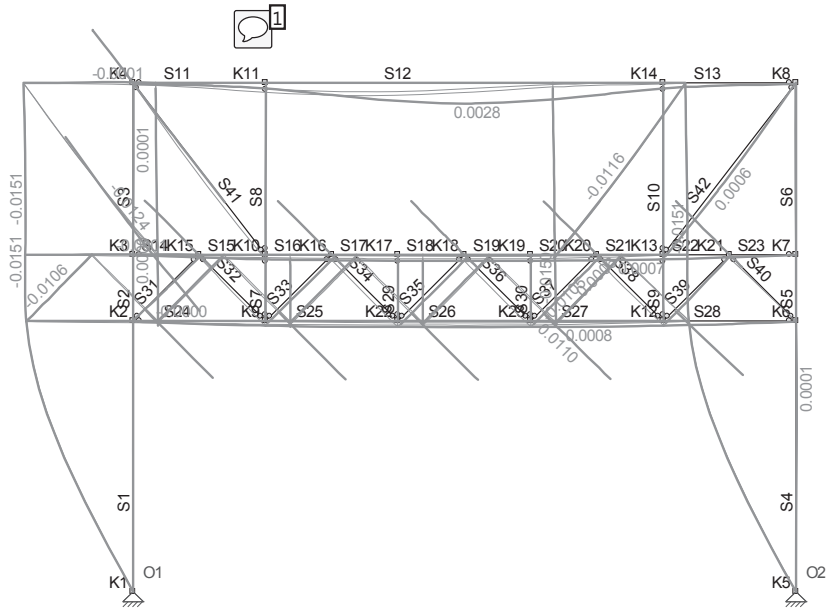


KARAKTERISTIEK BELASTINGSCOMBINATIES (TABEL)

B.G.	Omschrijving	Ka.C.(w1)	Ka.C.1	Ka.C.2	Ka.C.3
B.G.1	Permanent	1.00	1.00	1.00	1.00
B.G.2	Wind opwaarts	-	-	1.00	-
B.G.3	Wind v rechts	-	1.00	1.00	-
B.G.4	Sneeuwbelasting	-	-	-	1.00

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bending moments

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characteristic load combinations (table)





KNIKLENGTEGEGEVENS

Staaf	Profiel		Lokale Y-as			Lokale Z-as		
		Lsys	methode	Lbuc	Lbuc/Lsys	methode	Lbuc	Lbuc/Lsys
C1 - V1 (0.000-2.450)	P1	2.450	Ongeschoord	5.570	2.27	Cons. gesch.	2.450	1.00
C2 - V1 (0.000-0.600)	P1	0.600	Cons. gesch.	0.600	1.00	Handmatige Invoer	2.150	3.58
C3 - V1 (0.000-1.550)	P1	1.550	Cons. gesch.	1.550	1.00	Handmatige Invoer	2.150	1.39
C4 - V1 (0.000-2.450)	P1	2.450	Ongeschoord	5.570	2.27	Cons. gesch.	2.450	1.00
C5 - V1 (0.000-0.600)	P1	0.600	Cons. gesch.	0.600	1.00	Handmatige Invoer	2.150	3.58
C6 - V1 (0.000-1.550)	P1	1.550	Cons. gesch.	1.550	1.00	Handmatige Invoer	2.150	1.39
C7 - V1 (0.000-0.600)	P5	0.600	Cons. gesch.	0.600	1.00	Cons. gesch.	0.600	1.00
C8 - V1 (0.000-1.550)	P3	1.550	Cons. gesch.	1.550	1.00	Cons. gesch.	1.550	1.00
C9 - V1 (0.000-0.600)	P5	0.600	Cons. gesch.	0.600	1.00	Cons. gesch.	0.600	1.00
C10 - V1 (0.000-1.550)	P3	1.550	Cons. gesch.	1.550	1.00	Cons. gesch.	1.550	1.00
C15 - V1 (0.000-0.600)	P2	0.600	Handmatige Invoer	4.800	8.00	Cons. gesch.	0.600	1.00
C16 - V1 (0.000-0.600)	P2	0.600	Handmatige Invoer	4.800	8.00	Cons. gesch.	0.600	1.00
C17 - V1 (0.000-0.600)	P2	0.600	Handmatige Invoer	4.800	8.00	Cons. gesch.	0.600	1.00
C18 - V1 (0.000-0.600)	P2	0.600	Handmatige Invoer	4.800	8.00	Cons. gesch.	0.600	1.00
C19 - V1 (0.000-0.600)	P2	0.600	Handmatige Invoer	4.800	8.00	Cons. gesch.	0.600	1.00
C20 - V1 (0.000-0.600)	P2	0.600	Handmatige Invoer	4.800	8.00	Cons. gesch.	0.600	1.00
C21 - V1 (0.000-0.600)	P2	0.600	Handmatige Invoer	4.800	8.00	Cons. gesch.	0.600	1.00
C22 - V1 (0.000-0.600)	P2	0.600	Handmatige Invoer	4.800	8.00	Cons. gesch.	0.600	1.00
C23 - V1 (0.000-0.600)	P2	0.600	Handmatige Invoer	4.800	8.00	Cons. gesch.	0.600	1.00





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displacements

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Staaf	Profiel	Lokale Y-as				Lokale Z-as		
		Lsys	methode	Lbuc	Lbuc/Lsys	methode	Lbuc	Lbuc/Lsys
C24 - V1 (0.000-1.200)	P2	1.200	Handmatige Invoer	4.800	4.00	Cons. gesch.	1.200	1.00
C25 - V1 (0.000-1.200)	P2	1.200	Handmatige Invoer	4.800	4.00	Cons. gesch.	1.200	1.00
C26 - V1 (0.000-1.200)	P2	1.200	Handmatige Invoer	4.800	4.00	Cons. gesch.	1.200	1.00
C29 - V1 (0.000-0.600)	P5	0.600	Cons. gesch.	0.600	1.00	Cons. gesch.	0.600	1.00
C31 - V1 (0.000-0.849)	P5	0.850	Cons. gesch.	0.849	1.00	Cons. gesch.	0.849	1.00
C33 - V1 (0.000-0.849)	P5	0.850	Cons. gesch.	0.849	1.00	Cons. gesch.	0.849	1.00
C35 - V1 (0.000-0.849)	P5	0.850	Cons. gesch.	0.849	1.00	Cons. gesch.	0.849	1.00
C36 - V1 (0.000-0.849)	P5	0.850	Cons. gesch.	0.849	1.00	Cons. gesch.	0.849	1.00
C37 - V1 (0.000-0.849)	P5	0.850	Cons. gesch.	0.849	1.00	Cons. gesch.	0.849	1.00
C38 - V1 (0.000-0.849)	P5	0.850	Cons. gesch.	0.849	1.00	Cons. gesch.	0.849	1.00
C39 - V1 (0.000-0.849)	P5	0.850	Cons. gesch.	0.849	1.00	Cons. gesch.	0.849	1.00
C40 - V1 (0.000-0.849)	P5	0.850	Cons. gesch.	0.849	1.00	Cons. gesch.	0.849	1.00
C42 - V1 (0.000-1.960)	P5	1.960	Cons. gesch.	1.960	1.00	Cons. gesch.	1.960	1.00
-	-	m	-	m	-	-	m	-

DOORBUIGINGGEGEVENS

Staaf	Constructietype	Toetsing	Zeeg Y'	Zeeg Z'	Zeegvorm	Eis U;eind	Eis U;bij
C1 - V1 (0.000-2.450)	Kolom	Eén bouwlaag, industrieel gebouw			Parabolisch	H/150	N/B
C4 - V1 (0.000-2.450)	Kolom	Eén bouwlaag, industrieel gebouw			Parabolisch	H/150	N/B
-	-	-	mm	mm	-	-	-

UNITY CHECK NEN-EN1993-1-1:2009/NB:2011

Veld	Toetsing	Combinatie	Artikel	UC max
C1-V1 (0.000-2.450)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.12)	0,35
C1-V1 (0.000-2.450)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,06
C1-V1 (0.000-2.450)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,03
C1-V1 (0.000-2.450)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,28
C1-V1 (0.000-2.450)	Doorbuigingstoetsing	Ka.C.1	NEN-EN1993|NEN-EN1990/NB A1.4.2	0,92
C2-V1 (0.000-0.600)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.12)	0,35
C2-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,01
C2-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,01
C2-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,20
C3-V1 (0.000-1.550)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.12)	0,04
C3-V1 (0.000-1.550)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,01
C3-V1 (0.000-1.550)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,01
C3-V1 (0.000-1.550)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,04
C4-V1 (0.000-2.450)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.12)	0,34
C4-V1 (0.000-2.450)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,03
C4-V1 (0.000-2.450)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,01
C4-V1 (0.000-2.450)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,23
C4-V1 (0.000-2.450)	Doorbuigingstoetsing	Ka.C.2	NEN-EN1993|NEN-EN1990/NB A1.4.2	0,91
C5-V1 (0.000-0.600)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.12)	0,34
C5-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,01
C5-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,01
C5-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,20
C6-V1 (0.000-1.550)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.12)	0,04
C6-V1 (0.000-1.550)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,02
C6-V1 (0.000-1.550)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,02
C6-V1 (0.000-1.550)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.61&6.62)	0,03
C7-V1 (0.000-0.600)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.9)	0,06
C7-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,07
C7-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,07
C7-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.61&6.62)	0,07
C8-V1 (0.000-1.550)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.9)	0,06

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deflection statistics

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one building layer, industrial building

Veld	Toetsing	Combinatie	Artikel	UC max
C8-V1 (0.000-1.550)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,08
C8-V1 (0.000-1.550)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,08
C8-V1 (0.000-1.550)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.61&6.62)	0,08
C9-V1 (0.000-0.600)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.9)	0,06
C9-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,07
C9-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,07
C9-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.61&6.62)	0,07
C10-V1 (0.000-1.550)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.9)	0,06
C10-V1 (0.000-1.550)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,08
C10-V1 (0.000-1.550)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,08
C10-V1 (0.000-1.550)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.61&6.62)	0,08
C14-V1 (0.000-0.600)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.5)	0,05
C15-V1 (0.000-0.600)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.5)	0,03
C15-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,07
C15-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,03
C15-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.61&6.62)	0,11
C16-V1 (0.000-0.600)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.5)	0,03
C16-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,02
C16-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,01
C16-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.61&6.62)	0,06
C17-V1 (0.000-0.600)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.9)	0,02
C17-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,04
C17-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,02
C17-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.61&6.62)	0,04
C18-V1 (0.000-0.600)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.9)	0,02
C18-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,04
C18-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,02
C18-V1 (0.000-0.600)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.61&6.62)	0,05
C19-V1 (0.000-0.600)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.9)	0,02
C19-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,06
C19-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,02
C19-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,06
C20-V1 (0.000-0.600)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.9)	0,02
C20-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,06
C20-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,02
C20-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,06
C21-V1 (0.000-0.600)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.9)	0,04
C21-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,09
C21-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,04
C21-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,12
C22-V1 (0.000-0.600)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.9)	0,05
C22-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,11
C22-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,05
C22-V1 (0.000-0.600)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,14
C23-V1 (0.000-0.600)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.9)	0,05
C23-V1 (0.000-0.600)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,11
C23-V1 (0.000-0.600)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,05
C23-V1 (0.000-0.600)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.61&6.62)	0,12
C24-V1 (0.000-1.200)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.9)	0,05
C24-V1 (0.000-1.200)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,11
C24-V1 (0.000-1.200)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,06
C24-V1 (0.000-1.200)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.61&6.62)	0,13
C25-V1 (0.000-1.200)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.5)	0,04
C25-V1 (0.000-1.200)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,06
C25-V1 (0.000-1.200)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,03
C25-V1 (0.000-1.200)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.61&6.62)	0,08
C26-V1 (0.000-1.200)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.5)	0,04

Veld	Toetsing	Combinatie	Artikel	UC max
C26-V1 (0.000-1.200)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,01
C26-V1 (0.000-1.200)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,00
C26-V1 (0.000-1.200)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.61&6.62)	0,01
C27-V1 (0.000-1.200)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.5)	0,04
C28-V1 (0.000-1.200)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.5)	0,05
C29-V1 (0.000-0.600)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.5)	0,00
C29-V1 (0.000-0.600)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,00
C29-V1 (0.000-0.600)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,00
C29-V1 (0.000-0.600)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.61&6.62)	0,00
C30-V1 (0.000-0.600)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.5)	0,00
C31-V1 (0.000-0.849)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.9)	0,16
C31-V1 (0.000-0.849)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,25
C31-V1 (0.000-0.849)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,25
C31-V1 (0.000-0.849)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.61&6.62)	0,25
C32-V1 (0.000-0.849)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.5)	0,15
C33-V1 (0.000-0.849)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.9)	0,13
C33-V1 (0.000-0.849)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,20
C33-V1 (0.000-0.849)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,20
C33-V1 (0.000-0.849)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,20
C34-V1 (0.000-0.849)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.5)	0,12
C35-V1 (0.000-0.849)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.9)	0,10
C35-V1 (0.000-0.849)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,16
C35-V1 (0.000-0.849)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.46)	0,16
C35-V1 (0.000-0.849)	Stabiliteit	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0,16
C36-V1 (0.000-0.849)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.5)	0,10
C36-V1 (0.000-0.849)	Stabiliteit	Fu.C.1	NEN-EN1993-1-1(6.46)	0,00
C36-V1 (0.000-0.849)	Stabiliteit	Fu.C.1	NEN-EN1993-1-1(6.46)	0,00
C36-V1 (0.000-0.849)	Stabiliteit	Fu.C.1	NEN-EN1993-1-1(6.61&6.62)	0,01
C37-V1 (0.000-0.849)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.9)	0,08
C37-V1 (0.000-0.849)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,13
C37-V1 (0.000-0.849)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,13
C37-V1 (0.000-0.849)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.61&6.62)	0,13
C38-V1 (0.000-0.849)	Doorsnede	Fu.C.3	NEN-EN1993-1-1(6.5)	0,08
C38-V1 (0.000-0.849)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,07
C38-V1 (0.000-0.849)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,07
C38-V1 (0.000-0.849)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.61&6.62)	0,07
C39-V1 (0.000-0.849)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.5)	0,14
C39-V1 (0.000-0.849)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,12
C39-V1 (0.000-0.849)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,12
C39-V1 (0.000-0.849)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.61&6.62)	0,12
C40-V1 (0.000-0.849)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.9)	0,16
C40-V1 (0.000-0.849)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,25
C40-V1 (0.000-0.849)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.46)	0,25
C40-V1 (0.000-0.849)	Stabiliteit	Fu.C.4	NEN-EN1993-1-1(6.61&6.62)	0,25
C41-V1 (0.000-1.960)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.5)	0,21
C42-V1 (0.000-1.960)	Doorsnede	Fu.C.4	NEN-EN1993-1-1(6.5)	0,21
C42-V1 (0.000-1.960)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,27
C42-V1 (0.000-1.960)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.46)	0,27
C42-V1 (0.000-1.960)	Stabiliteit	Fu.C.3	NEN-EN1993-1-1(6.61&6.62)	0,28

FIRE SAFETY CALCULATIONS/CERTIFICATIONS

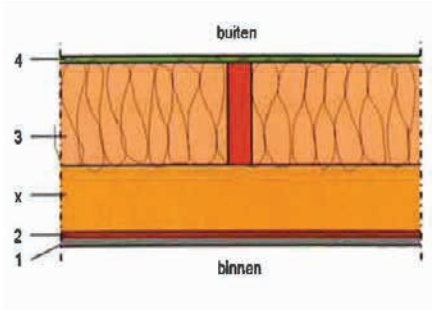
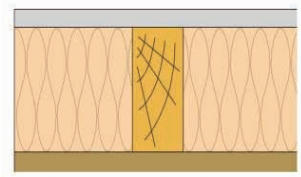
Fire resistance - House

1. Fire resistance calculations

The rules that are taken into account are the following:

Woningswet	*Housing regulations (NL)*
Bouwbesluit	*Building regulations (NL)*
NEN/EN documents	
National recommendations of practice (NPR)	
SD Building code	

For dwellings of two floors and with permanent fire density less than 500 MJ/m2, the fire resistance requirement is 30min, as in SD Building Code. The fire reaction classes of the most important materials are:

Type of material		Class (euroclass)
Covering (See Rule 51.3 Note 1)		
Wall covering : Fermacell - gypsum fibreboard		A2-s1, d0
Ceiling (See Rule 51.3 Note 2)		
Fermacell - gypsum fibreboard		A2-s1, d0
As specified in SD BC 51.3(2) the rest of the layers are		
Walls (See Rule 51.3 Note 2)		A2-s1, d0
Fermacell - gypsum fibreboard		
(the rest of the layers are protected by this layer for min 30		
Flooring		D-fl-s1
Covering : Oak floor parquet		D-fl-s1
Underlayer : Plywood *(33 min of fire resistance – see*		
Textile cover elements integrated into building		
Pile carpet - Heuga 725		B-fl-s1
Thermal screen of thermal and acoustic insulation products		**Fire resistance**
External walls 4 - 12 mm Eternit Duripanel *(B-s2,do)* 3 - glass wool x - PIR interlayer *(B-s2,do)* 2 - 9 mm OSB/3 1 - **12 mm fermacell**		34.5
Interior walls **18 mm fermacell** glass wool **18 mm fermacell**		>60

As it is also shown below in the component fire resistance calculations, all the load bearing structural elements are protected from a thermal screen of at least 30 EI.

Specifically it is:

External load bearing walls - >	12mm Fermacell gypsum fibreboard
Internal load bearing walls - >	18mm Fermacell
First floor ->	12mm Fermacell (below), 22mm SPANO plywood at least (above)
Ground floor ->	36mm SPANO plywood
Roof ->	22 mm SPANO plywood

From the above it is taken that the load bearing capacity of all the components will be preserved for at least 30min that are protected by the thermal screens.

Therefore it can be assumed that the **fire resistance of the whole house will also be at least 30min,** complying with both regulations.

It is noted that although the above method can be considered simplified, it is nevertheless accurate enough because of the fire resistant boards covering most of the interior surfaces, the small size of the house, the minimal evacuation time, the active safety measures and the overdimensioning of most structural elements.

2. Evacuation

The different areas of the house are distributed below (as seen in AR - 017):

Ground floor	**(Net m²)**
1. Entrance:	4.2
2. Livingroom:	29.5
3. Greenhouse:	16
Total:	49.7
First Floor	
4. Hall 3,8	3.8
5. Bathroom	5.2
6. Bedroom 1	14.8
7. Modelroom	11.4
Total:	35.2

Grand total	84.9

From the two floors only the ground floor is considered exhibition space. According to SD BC 51.3 (2) the occupation in this space is considered as $2m^2$/person. Therefore, the maximum capacity for evacuation is 49.7/2 = 25 people.

Taking into account the buildings fire hazard classification and the fire-resistance grade, the allowed evacuation time is 1min. Also, 2 ways of a escape are required. This is satisfied in the ground floor by the front and the back entrance (glasshouse).

Escape speed: 30m/min
Exit capacity: 41.7 people /m/min

Therefore the escape time for the ground floor is:

Regading the length of escape:	(8+4)/30 = 0.4min <1min	(longest route for the front door)
Regarding the exit capacity:	25/(1.3*41.7) = 0.46 min < 1min	

In the first floor, it is considered that only the jury and the team members can enter during the jury visits, and the occupation is much less (about 6-8 people in the first floor)

Regading the length of escape: (8+6+8)/30 = 0.73min <1min (longest route for the front door)
Regarding the exit capacity: 8/(1.3*41.7) = 0.14 min < 1min

Thus the evacuation time is below the limit of the regulation for both floors. The relevant evacuation plan can be found in the drawings: FP - 001, FP - 002

Also the geometrical requirements of SD Building Code for the evacuation elements are satisfied:

Evacuation element	Width (m)
Doors and doorways	(minimum)
Doors (for rooms with less than 100	1.2
Hallways and ramps	(minimum)
hallways	1.4m
stairs	1.2m
ramps	1.4m

3. Fire protection systems

The active measures for fire safety are: (their position can be found at the drawings FP - 001, FP - 002)

	Quantity and Efficiency
Portable fire extinguisher(s) inside the house	(total 3)
(as specified in comment in WAT and the book page: Fire Extinguishers Location)	1 Fire extinguisher/ 6L 21A-
	1 CO2 fire extinguisher
	1 Fire extinguisher/ 6L 21A-
Portable fire extinguisher(s) outside the house (only during the construction)	1 Fire extinguisher/ 6L 21A- 113B efficiency

4. Certifications

Below the different certificates and calculations can be found. The last were performed by the assigned engineering office of the main construction company of the house, Groothuis.

Specifically the order of the documents attached here are:

1) Fire resistance calculation of representative external walls (even if the composition change per wall position, the one calculated is considered the most representative)
2) Fire resistance calculation of plywood flooring system
3) Fire resistance calculation of load bearing interior wall (the last one in the brochure)
4) Declaration of performance of Fermacell gypsum fibreboard
5) Declaration of performance of Tarkett oak parquet

Fire resistance - Glasshouse

1. Fire resistance calculations

The rules that are taken into account are the following:

Woningswet	*Housing regulations (NL)*
Bouwbesluit	*Building regulations (NL)*
NEN/EN documents	
National recommendations of practice (NPR)	
SD Building code	

For dwellings of two floors and with permanent fire density less than 500 MJ/m2, the fire resistance requirement is 30min, as in SD Building Code. It has to be noted that this resistance is considered conservately the same for the glasshouse space, although it has minimal fire load and it is not fully considered as an interior housing space.

The above resistance will be proved by verifying that the steel supporting structure of the glasshouse can withstand a fire of 30 min duration by not collapsing. This verification will be performed by checking the UC factors for the accidental load combination against the steel profile resistance reduced by fire.

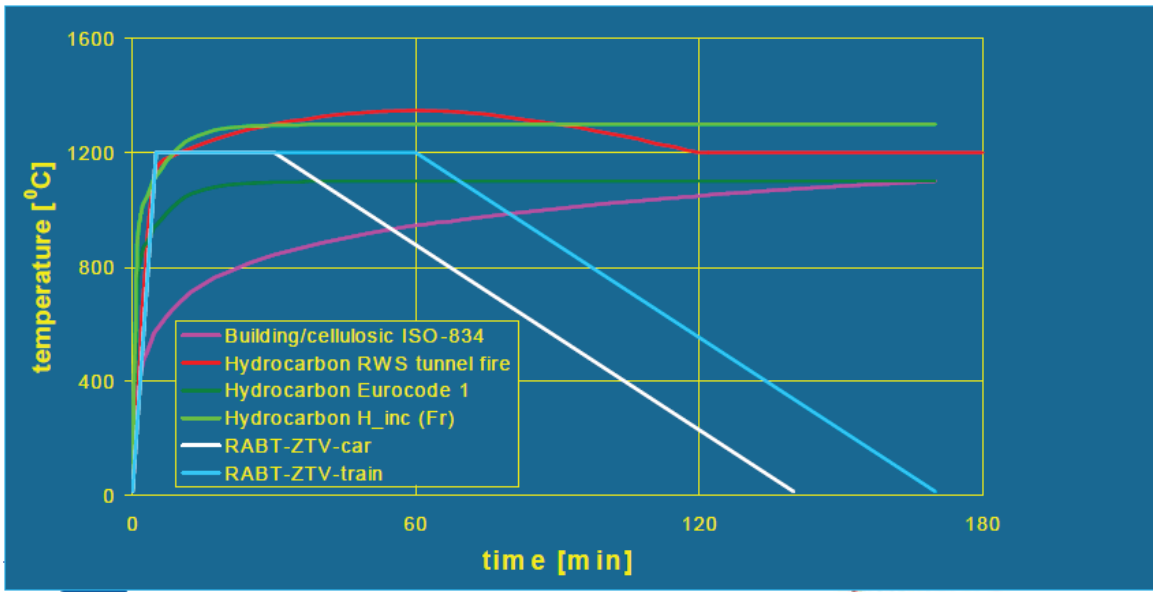
The accidental load combination will be calculated with the following factors ψ1:
(*from table NB.4 of NEN-EN 1991-1-4*)

	ψo	**ψ1**	ψ2
For the variable load Q ->	0	**0**	0
For the snow load S ->	0	**0.2**	0
For the wind load W ->	0	**0.2**	0

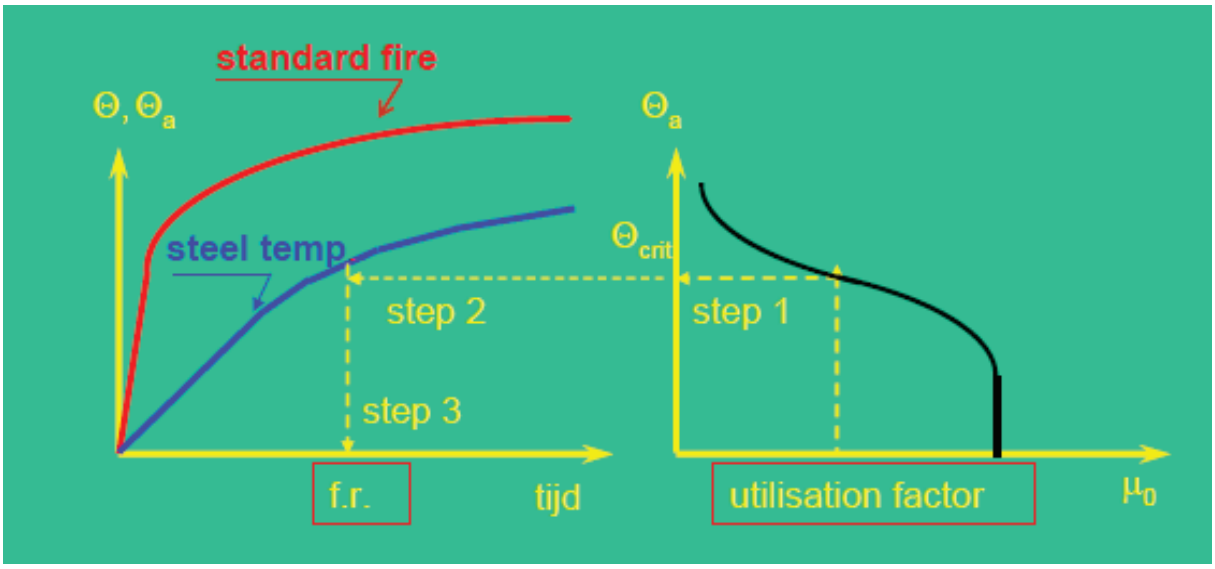
Therefore, since the snow or wind load is considered the determinant load in all the load cases and the accidental factors are taken as 1 the load combination is taken as **G+0.2Q**.

The reduction of the profile structural resistance wil be derived by fire safety engineering usual practice.

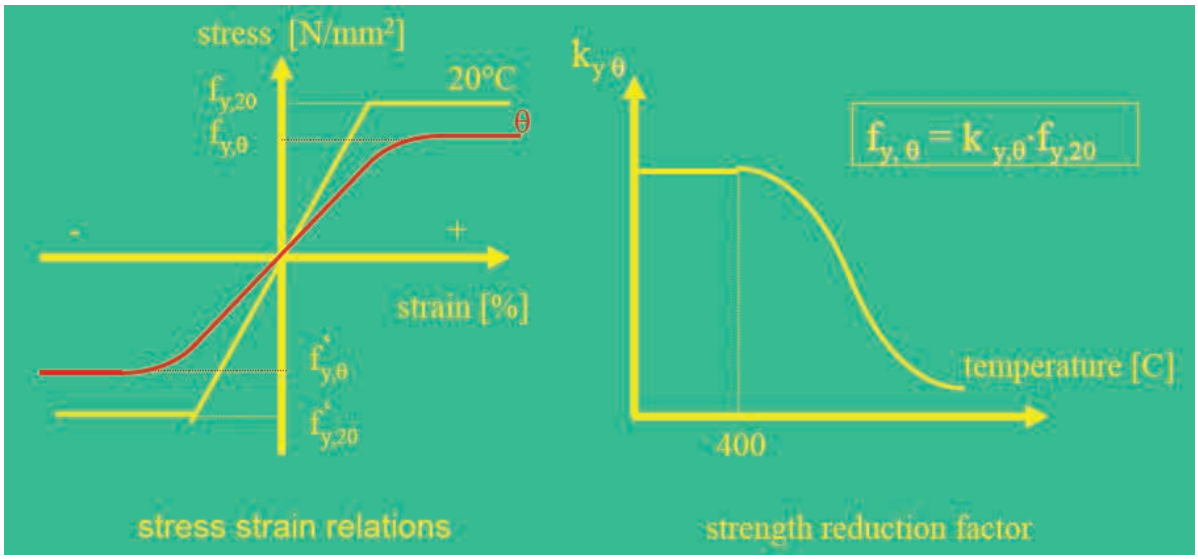
The fire curve to be used will be the ISO-834 as seen below:



The temperature of the exposed steel structure is taken from the reduced fire load curve from as seen below:



For the required fire resistance of 30min the temperature of steel will be taken as **750°C**. The reduction factor for the mechanical properties of steel for this temperature is then taken from the diagram below as **ky = 0.17**.



Finally, as the steel elements are unprotected from all 4 sides the reduction factor κ1 is considered as . For the simple supported beams, the factor κ2 is taken as 1 and for the continuous at the supports as 0.85.

Therefore, the structural calculation will be repeated for all the elements of the glasshouse to verify that they can withstand their load (G+0.2W or G+0.2S) for 30 min and thus **with a reduction of 0.17 on their structural resistance.** It has to be noted that this is a conservative simplification as the temperature will be variable and with a lesser magnitude along the space of the glasshouse because of thermal losses from the thermal capacity of the house elements, the high conductivity of the glass windows and the high infiltration rate of the enclosure.

The applied loads, member forces and the final element capacity check is shown in the next pages.

Purlin fire verification

Cross sections (cold formed U profile C50x100x50x4)



Load cases

1) Dead load from roof panels - G



2) Snow load - S



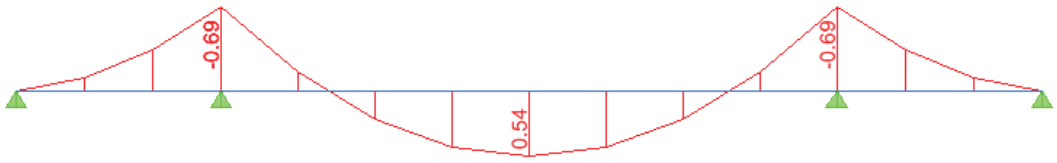
3) Wind load - W



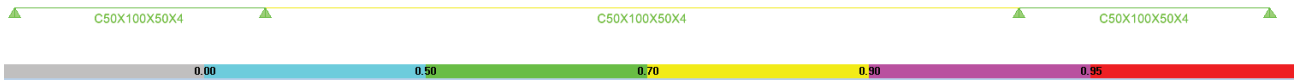
Accidental load combinations

1) $G+G_{self\text{-}weight}$
2) $G+G_{self\text{-}weight}+0.2S$
3) $G+G_{self\text{-}weight}+0.2W$

Max bending moment -> G+0.2S



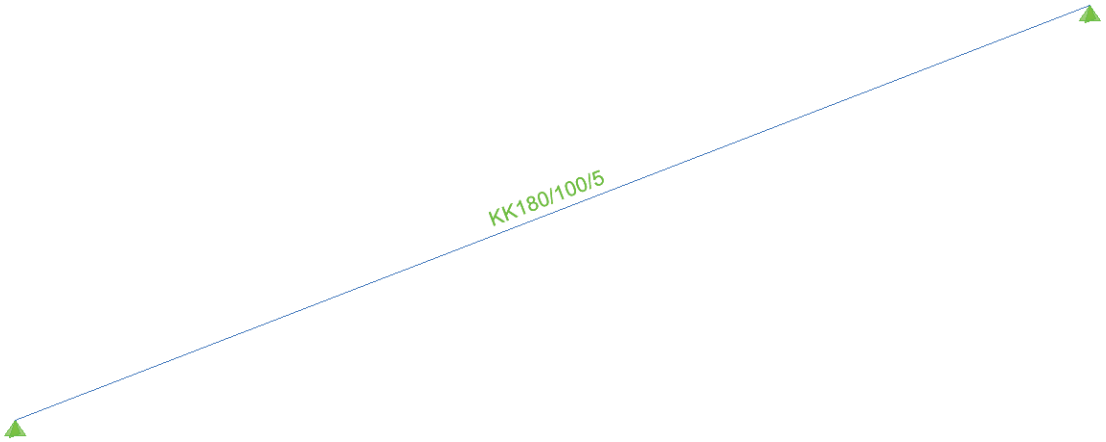
Element capacities -> max UC = 0.815



Rafter fire verification

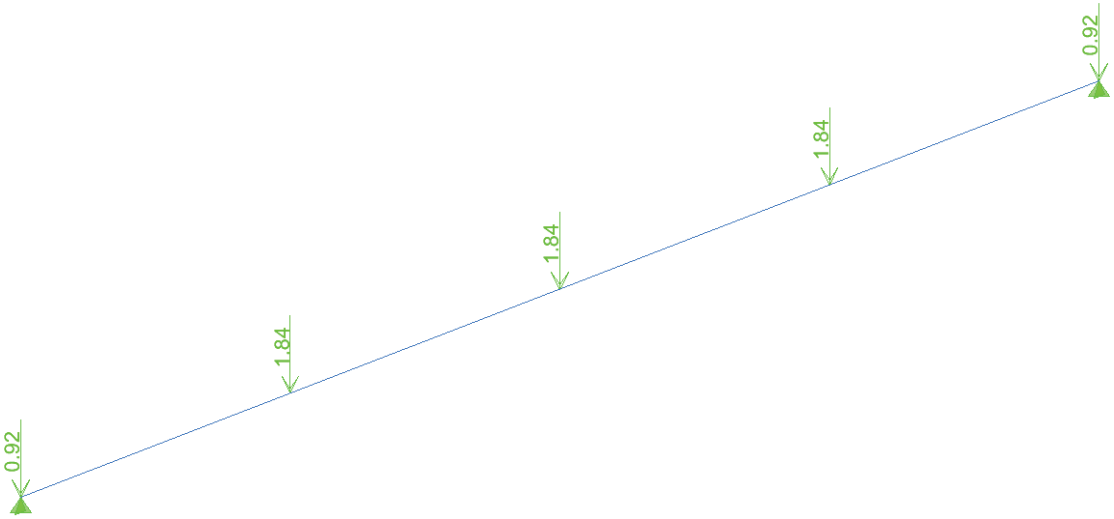
$(M_{Rd,fi} = 0.17 * M_{Rd,20\,°C})$

Cross sections (RHS profile KK180x100x5)

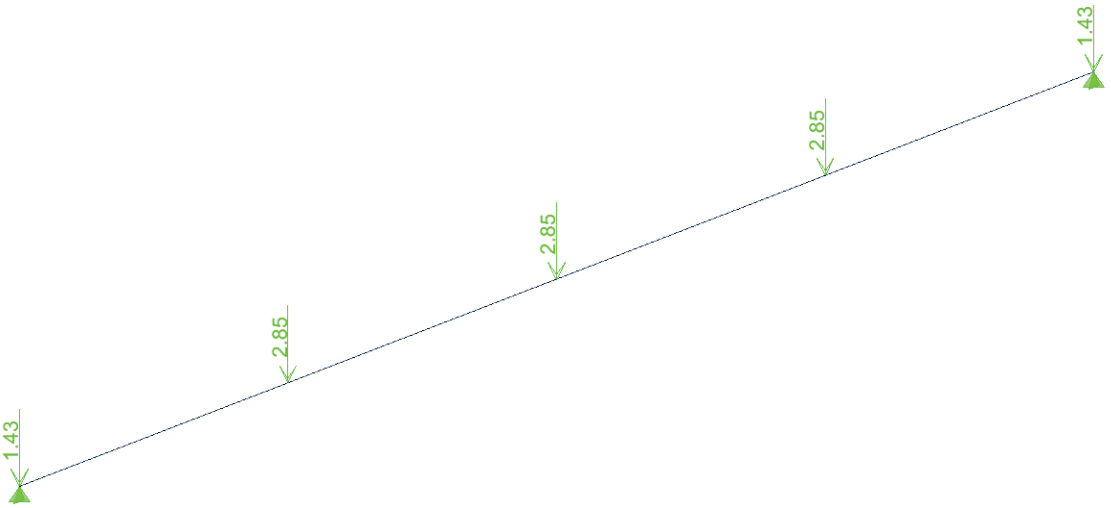


Load cases

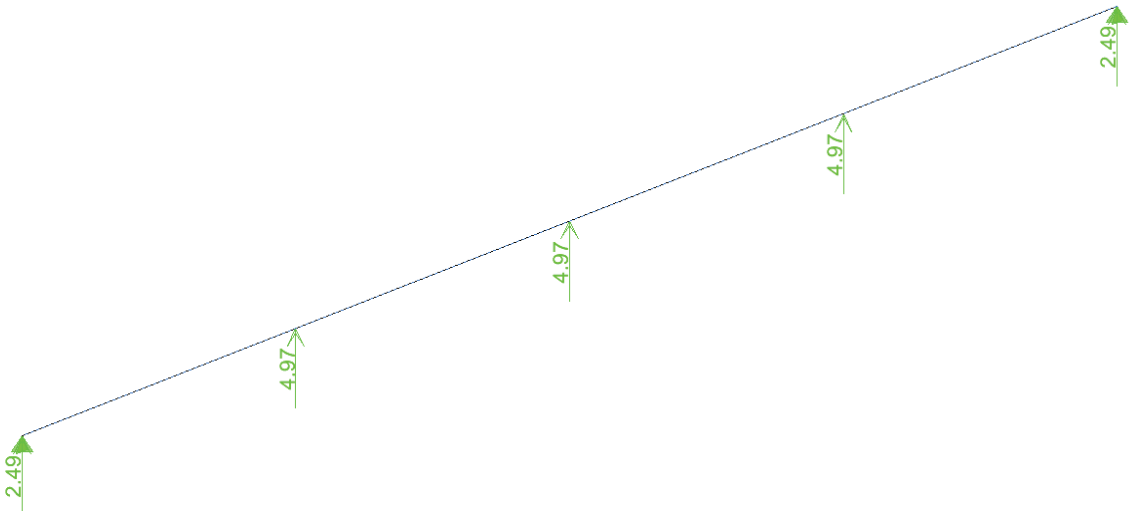
1) Dead load from roof panels - G



2) Snow load - S



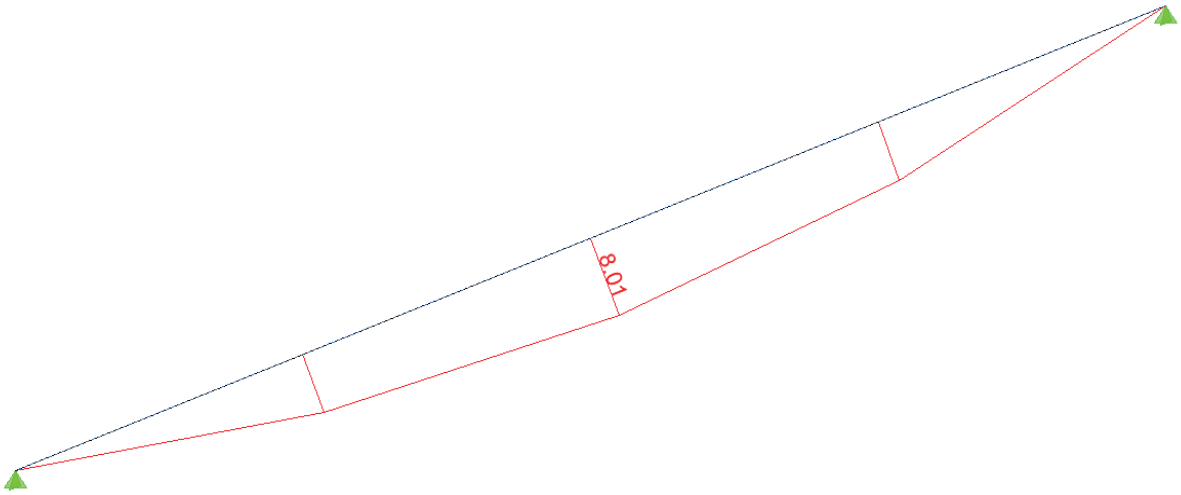
3) Wind load - W



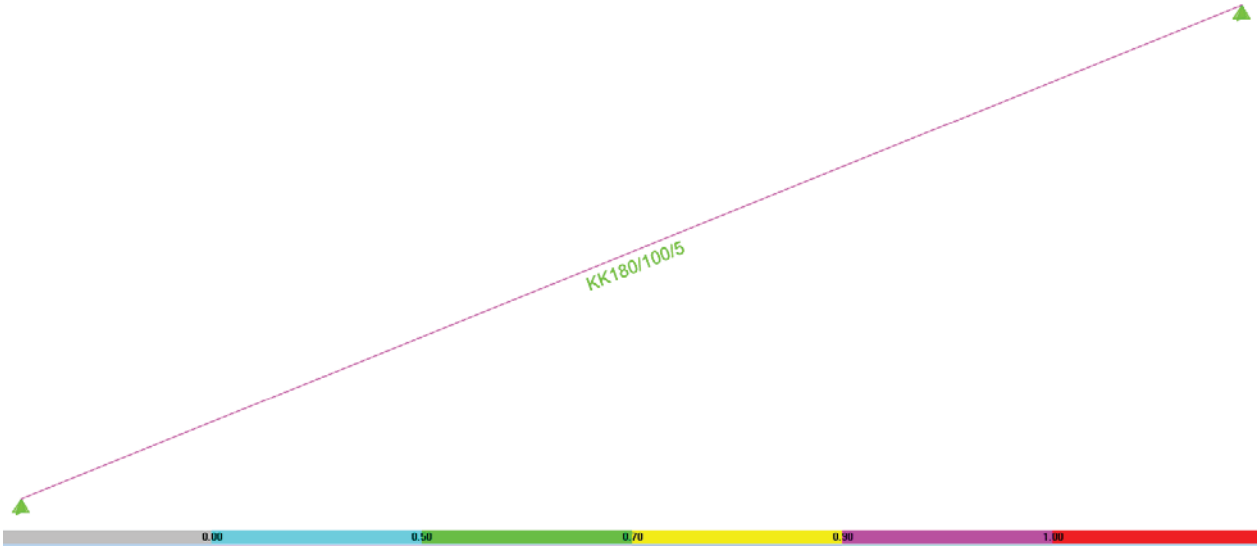
Accidental load combinations

1) $G+G_{self\text{-}weight}$
2) $G+G_{self\text{-}weight}+0.2S$
3) $G+G_{self\text{-}weight}+0.2W$

Max bending moment -> G+0.2S

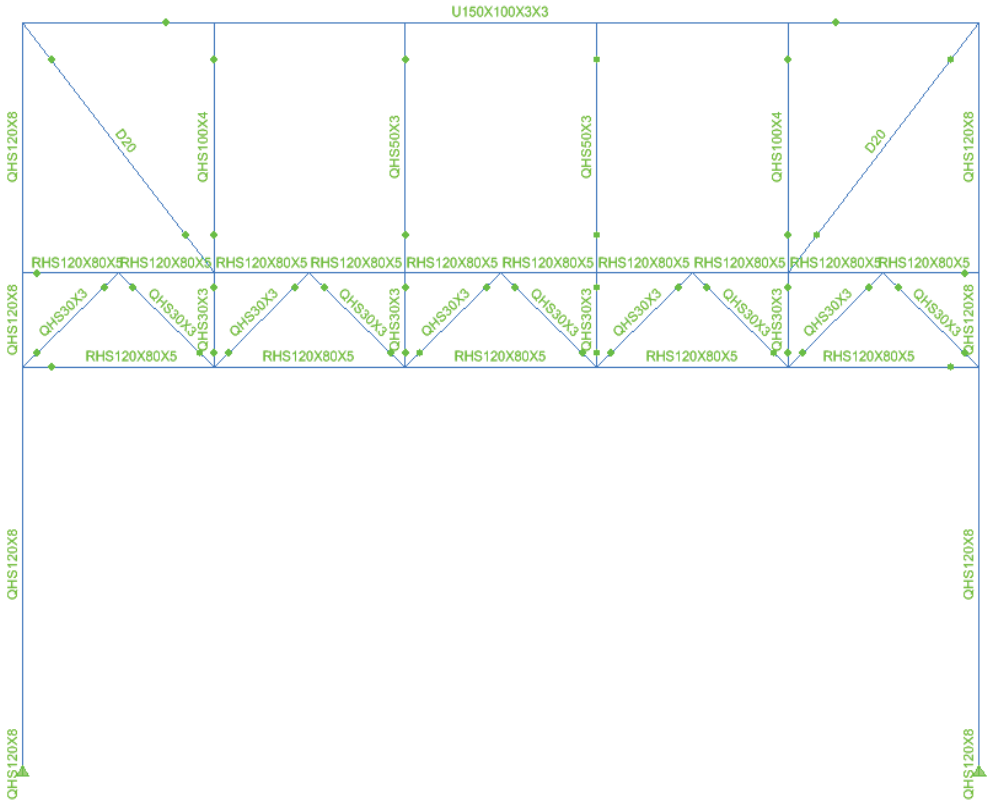


Element capacities -> max UC = 0.961 *< 1 ok*



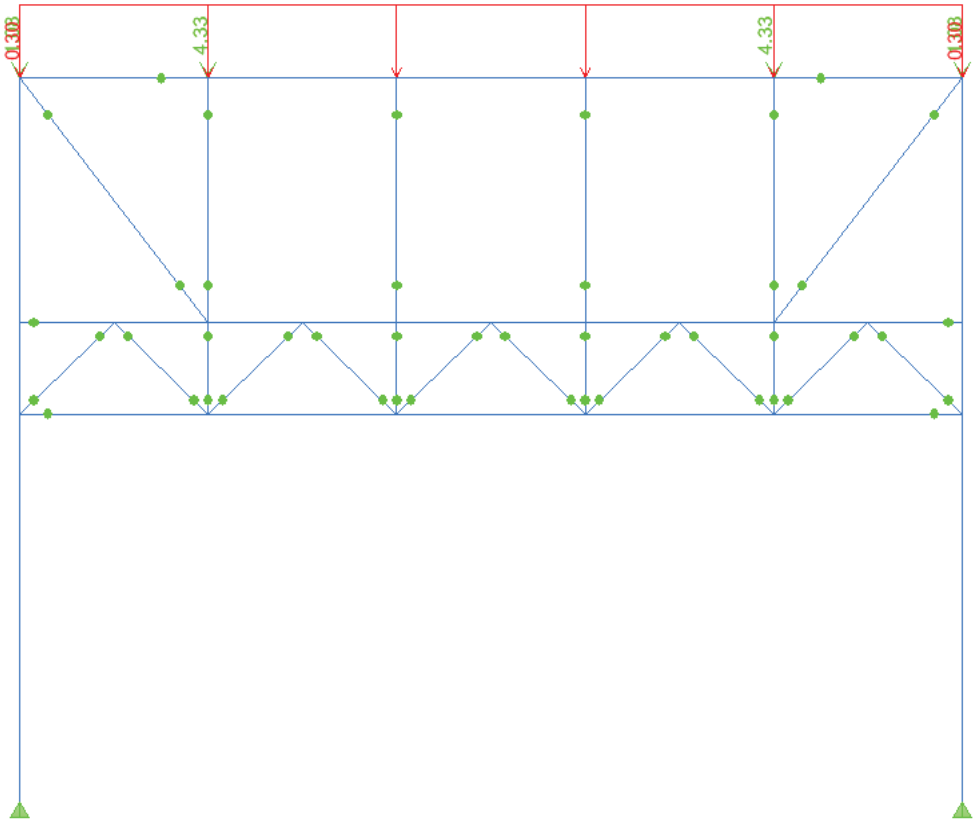
Portal frame fire verification

Cross sections

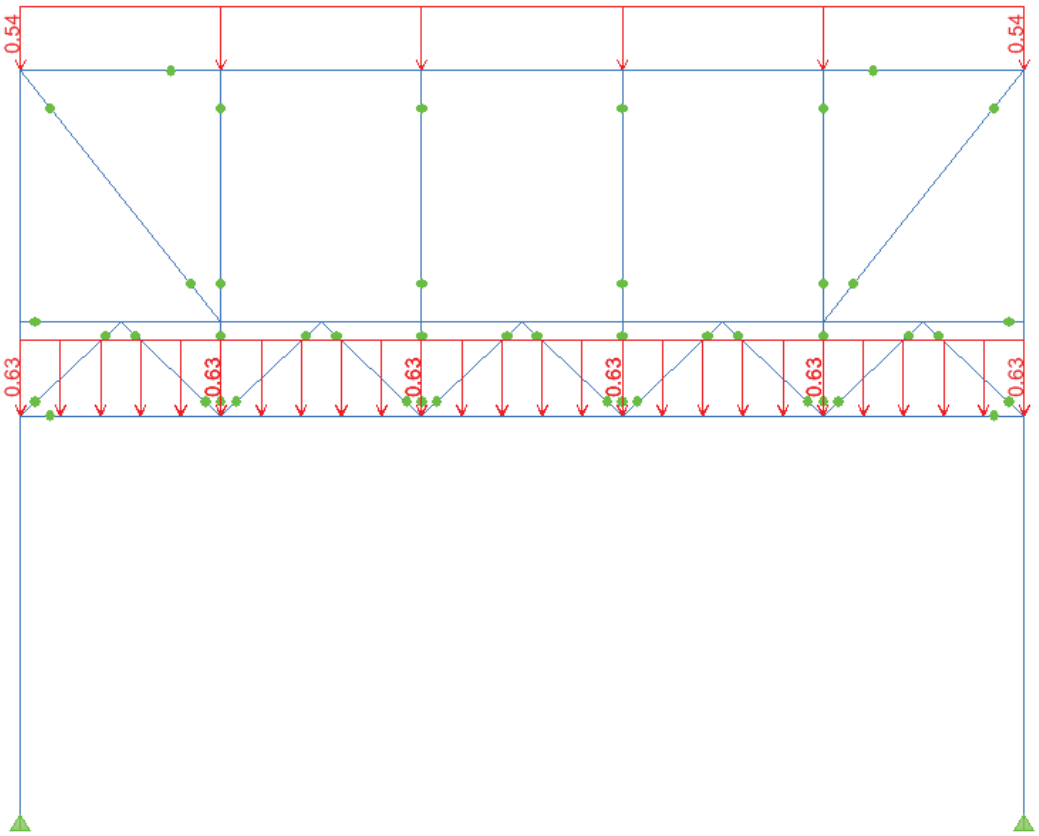


Load cases

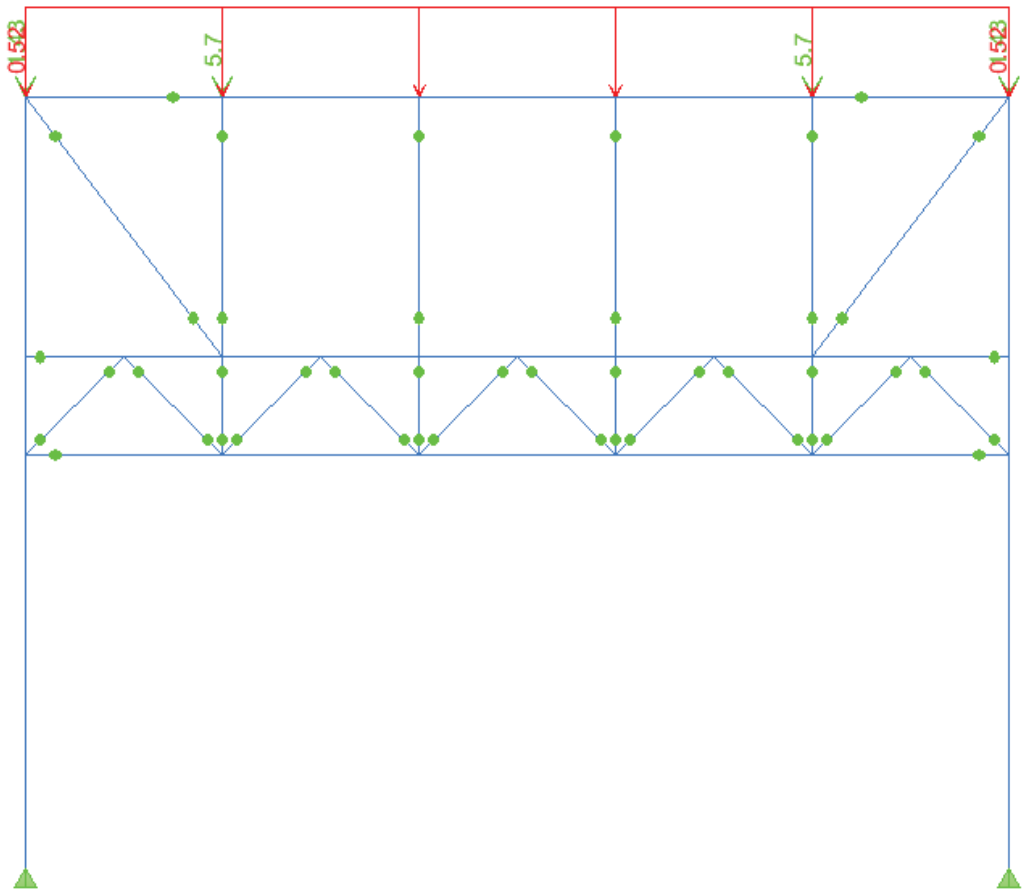
1) Dead load from roof panels - G_{roof}



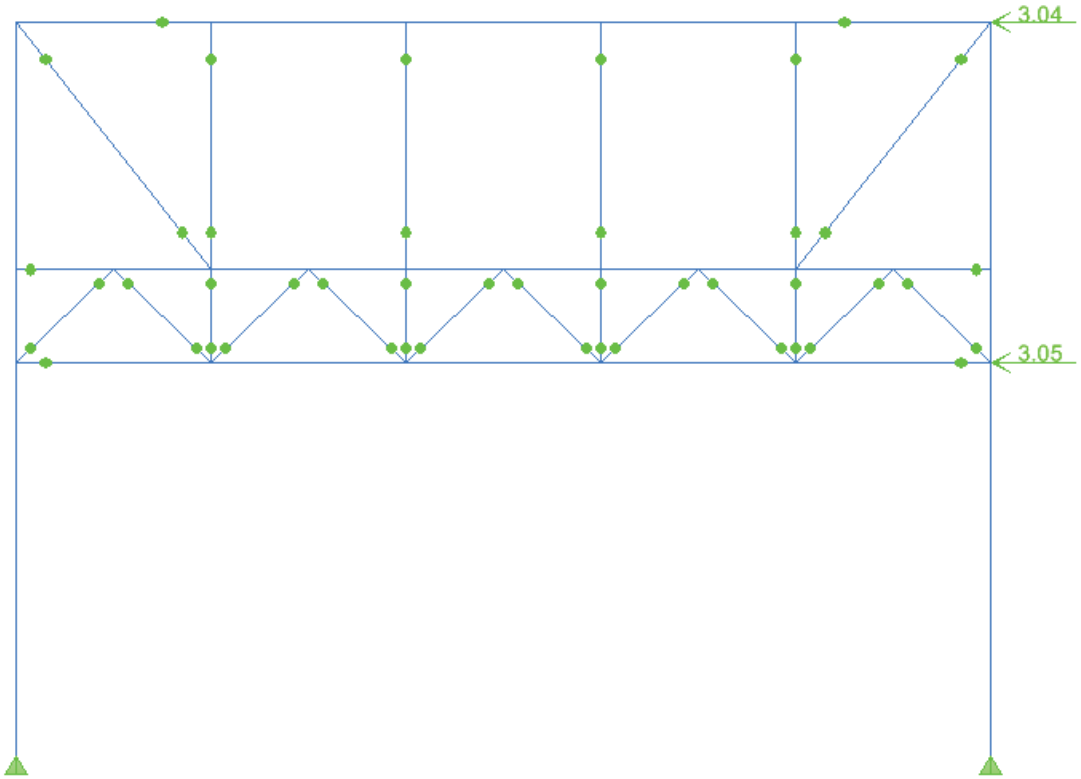
2) Dead load from facade panels - G_{facade}



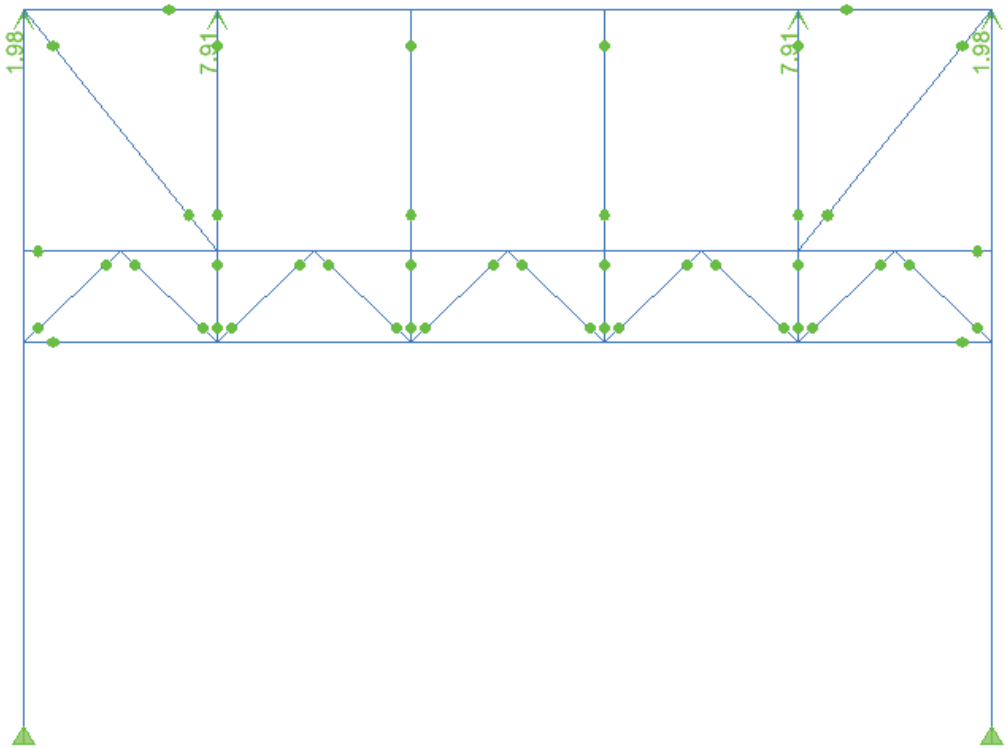
3) Snow load on roof - S



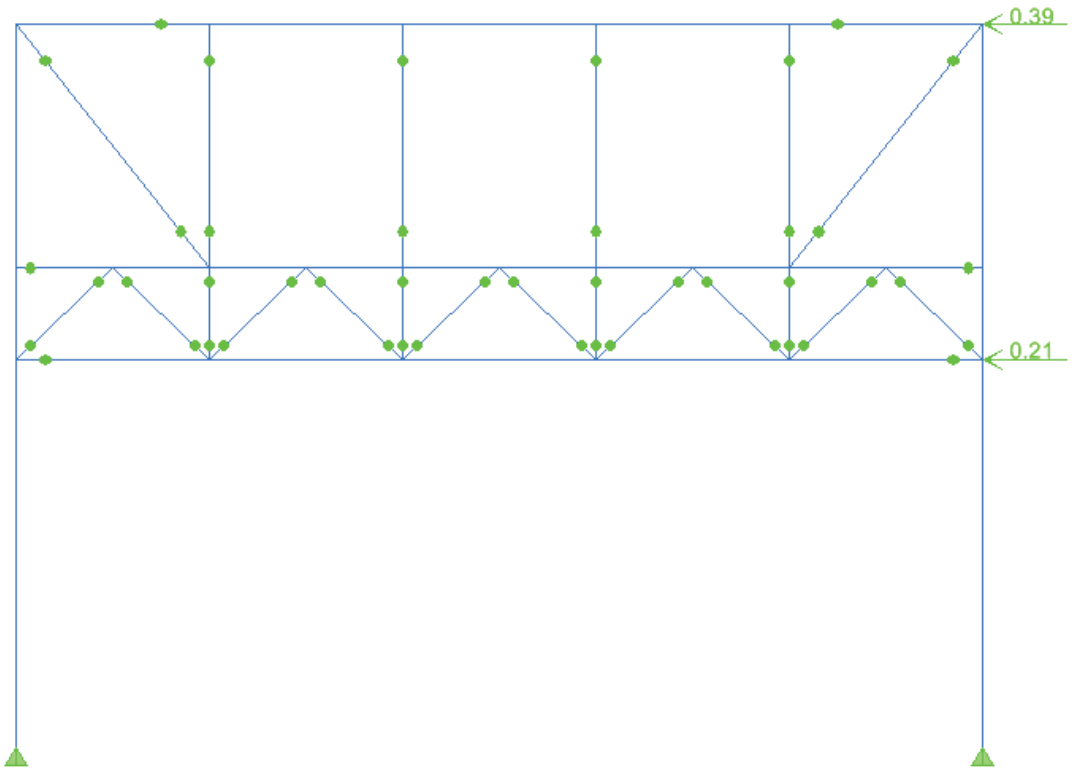
4) Sidewind on façade - W_{side}



4) Upward wind on roof - $W_{up,roof}$



5) Friction - F



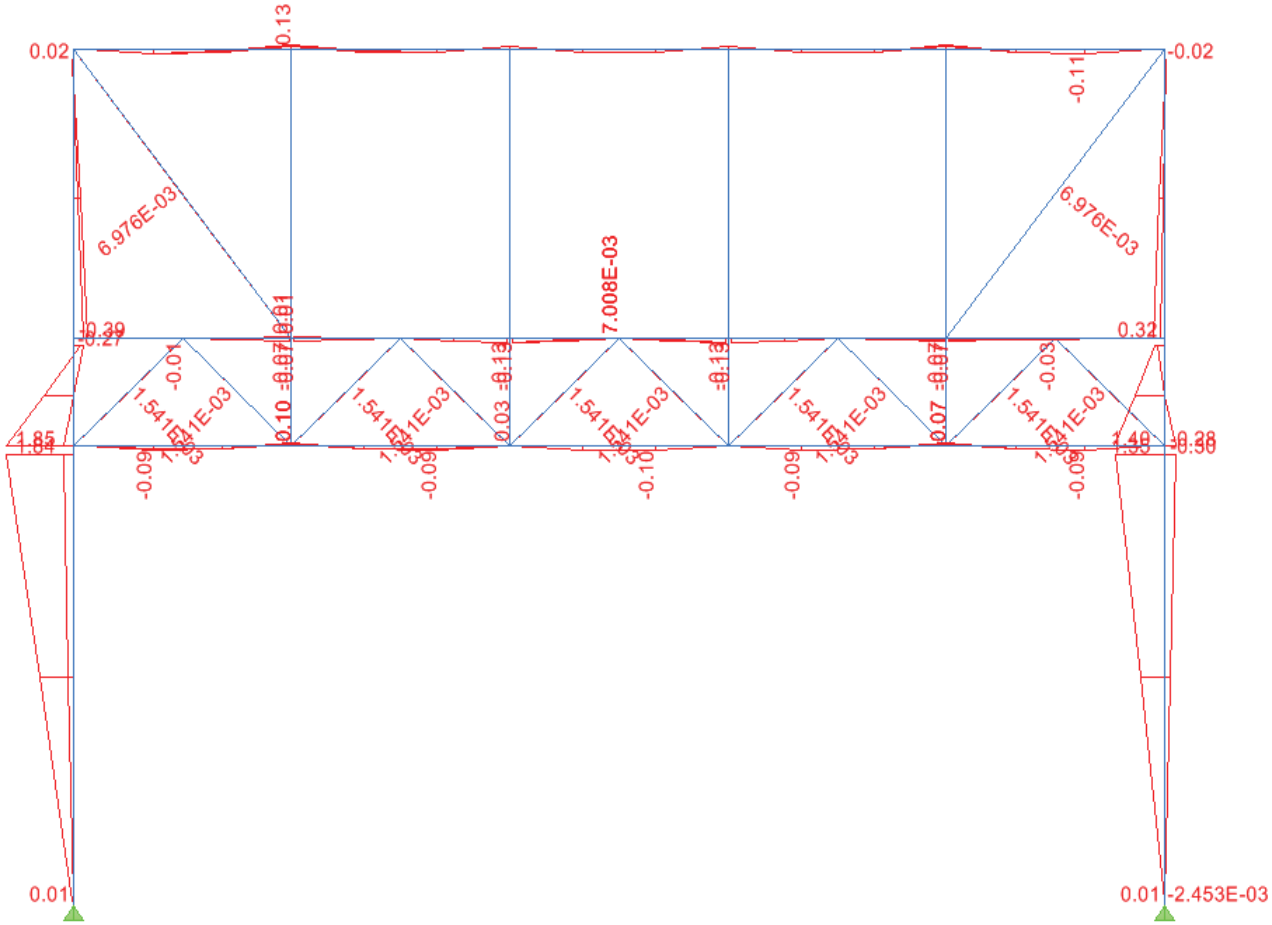
Accidental load combinations

1) $G_{roof}+G_{facade}+G_{self-weight}$

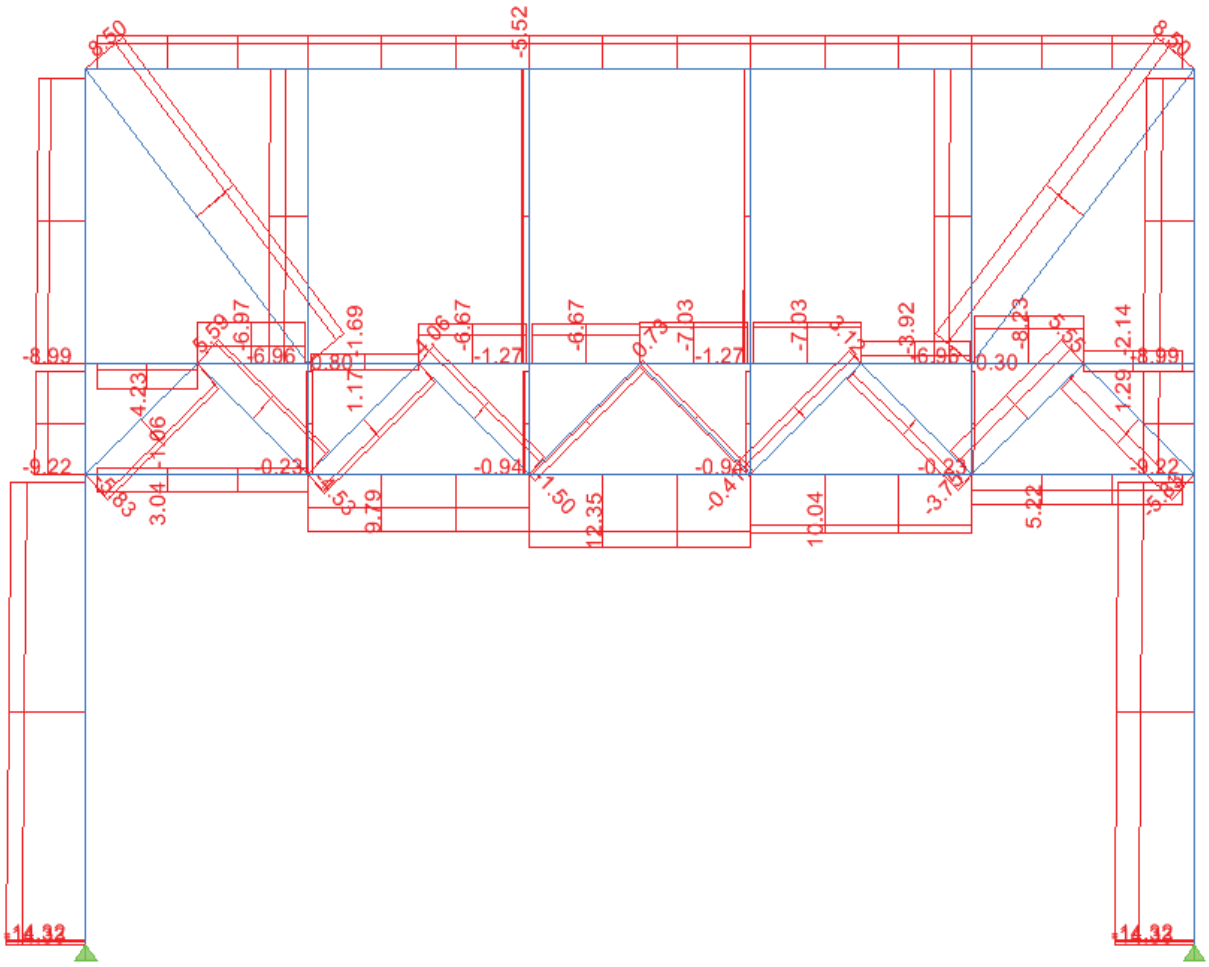
1) $G_{roof}+G_{facade}+G_{self-weight}+0.2S$

1) $G_{roof}+G_{facade}+G_{self-weight}+0.2W_{side}+0.2W_{up,roof}+0.2F$

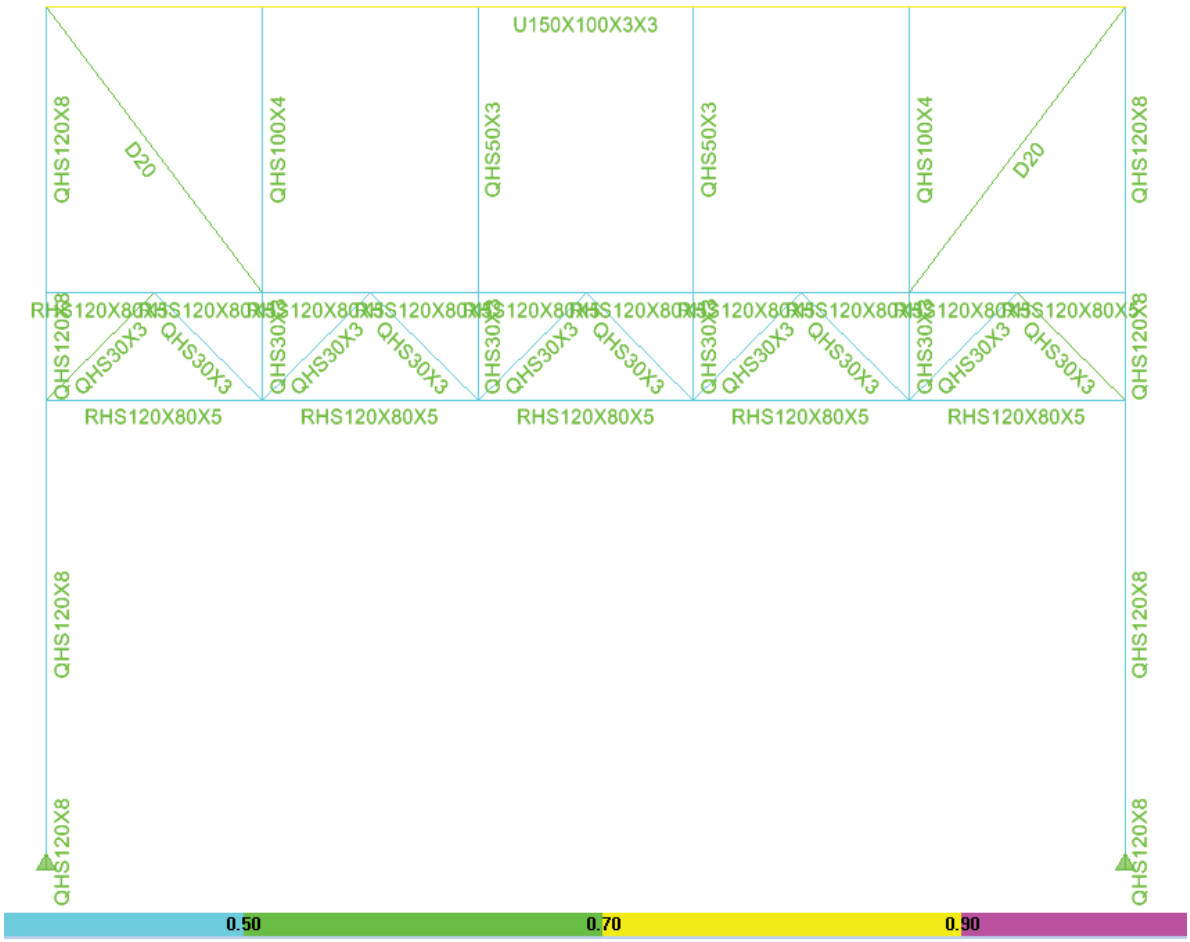
Max bending moment (envelope)



Max axial load (envelope)



Element capacities -> max UC = 0.782



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F + 31 317 467399
www.shr.nl

1. Introductie

Opdrachtgever:	Groothuis Bouwelementen B.V. Ootmarsumseweg 12 7615 PL HARBRINKHOEK
Datum opdracht:	27 maart 2014
Behandeld door:	ir. W.H. de Groot
Onderwerp	30 minuten brandwerendheid op scheiden (BOS) van een wandelement

2. Inleiding

Berekenen van 30 minuten Brandwerendheid op Scheiden (BOS = 30 min) volgens NEN-EN 1995-1-2 bijlage E van het wandelement beschreven in tabel 1.

3. Uitgangspunten voor de berekeningen

De berekening is gemaakt volgens NEN-EN 1995-1-2 bijlage E 'Berekening van de scheidende functie van wand- en vloerconstructies'. Uitgangspunt bij de berekening is dat de brand aan de binnenzijde zal optreden: brandwerendheid op scheiden van binnen naar buiten. De brandwerendheid op scheiden (BOS) van een wand- en vloerconstructie wordt berekend met:

$$t_{ins} = \sum_i t_{ins,0,i} \cdot k_{pos} \cdot k_j$$

Waarin:

t_{ins} tijd van de temperatuurstijging aan de niet-blootgestelde zijde van de constructie.

$t_{ins,0,i}$ basisisolatiewaarde van laag i, in min.

k_{pos} positiecoëfficiënt

k_j voegcoëfficiënt = 1,0 voor voegen bevestigd aan een regel.

Summary of Comments on Timber frame panel - fire resistance report_translated.pdf

Page: 1

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:18:47

1. Introduction

Client
Task date
Handled by
Subject: 30 minutes fire resistance on separation (BOS) of a wall element

2. Preface

Calculation of 30 minutes fire resistance on separation (BOS = 30 min) according to NEN-EN 1995-1-2 appendix E of a wall element described in table 1.

3. Guidelines for the calculations

The calculation has been done according to NEN-EN 1995-1-2 appendix E. Starting point of the calculation is that the fire will appear on the inner side: fire resistance on separation from inside to outside. Fire resistance on separation (BOS) of a wall and floor construction can be calculated with:

---

with:

- time of the temperature increase at the not-exposed side of the construction
- standard insulation value of layer i, in minutes
- position coefficient
- joint coefficient - 1,0 for joints connected to a rail

De basisisolatiewaarden van panelen kunnen als volgt bepaald worden:

- Triplex ρ ≥ 450 kg/m^3.

$$t_{ins,0,triplex} = 0,95 \cdot h_p$$

- Spaanplaat ρ ≥ 600 kg/m3.

$$t_{ins,0,spaanplaat} = 1,1 \cdot h_p$$

- Gipskartonplaat type A, F, R en H

$$t_{ins,0,gipskartonplaat} = 1,4 \cdot h_p$$

Waarin:

h_p is de plaatdikte, in mm.

De binnenbeplating, bestaande uit 12 mm gipsvezelplaat (Fermacell) en 9 mm OSB/3, wordt met extra lange nagels door de tussenlaag bestaande uit 90 mm PIR bevestigd op het regelwerk. De PIR-isolatie fungeert als een tussenlaag. PIR, in tegenstelling tot PUR, heeft brandwerende eigenschappen. Op basis hiervan, en op basis van praktijkervaring mag worden aangenomen dat de 'PIR-laag' voldoende ondersteuning biedt aan de beplating aan de binnenzijde gedurende de brandbelasting. PIR heeft de Europese brandklasse: B, S2, d0, zie bijlage 3 voor de indeling. Rekenkundig is de PIR-laag verwaarloosd (geen eigenschappen aan toegekend).

De berekeningen zijn uitgaande dat de brandwerendheid op bezwijken (BOB) niet maatgevend is. Uitgaande van het vuren regelwerk van 38 x 140 mm toegepast in de wand, is dit aannemelijk te veronderstellen.

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:11:31
The standard insulation values can be determined as following:

triplex
chipboard plate
plasterboard type A, F, R and H

with h as the plate thickness in mm

The inner plates, consisting 12 mm gypsum fiber plate (Fermacall) and 9 mm OSB/3, are connected to the frame with extra long nails through the interlayer of 90 mm PIR. The PIR-insulation is the interlayer. PIR, in contrast to PUR, has fire resisting characteristics. Because of this, and because of practice experience it can be said that the PIR-layer gives enough support to the plates at the inner side during fire. PIR has the European fire class B, S2, d0, see appendix 3. Mathematically the PIR-layer has been ignored (no characteristics).

The calculations are made with the idea that fire resistance on failure (BOB) is not normative. This is plausible because of the pinewood rails of 38x140 in the wall.

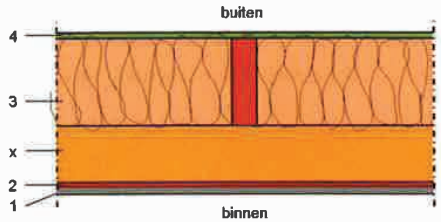
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4. Wandopbouw

In de hierna volgende berekening wordt de rekenkundige brandwerendheid op scheiden bepaald van de wandopbouw gegeven in tabel 1.

Tabel 1. Wandopbouw Groothuis bouwelementen.

wandopbouw	
buiten	
4	12 mm spaanplaat of vezelplaat (ρ ≥ 600 kg/m^3) o.g. bijvoorbeeld: cementgebonden houtvezelplaat
3	140 mm glaswol min 15 kg/m^3 bijvoorbeeld: Isover systeemrol 400 + vuren regels 38 x 140 mm, C18
x	90 mm PIR ('tussenlaag')
2	9 mm spaanplaat of vezelplaat (ρ ≥ 600 kg/m^3) o.g. bijvoorbeeld: OSB/3
1	12 mm gipskartonplaat type A o.g. (bijvoorbeeld: gipsvezelplaat)
binnen	



5. Rekenmethode 1: dubbellaags bekleding

In deze methode wordt laag 1 t/m 4 in beschouwing genomen. Er wordt gebruik gemaakt van tabel E.5 'positiecoëfficiënten k_{pos} voor wanden met dubbellaags panelen'.

1: $t_{ins,0,gipskartonplaat} = 1,4 \cdot h_p = 1,4 \cdot 12,0 = 16,8$ min. $k_{pos} = 1,0$, zie tabel E.5 regel 3, laag 1

2: $t_{ins,0,vezelplaat} = 1,1 \cdot h_p = 1,1 \cdot 9,0 = 9,9$ min. $k_{pos} = 0,8$, zie tabel E.5 regel 3, laag 2

3: $t_{ins,0,isolatie} = 5,0$ min. (beschouwd als holle ruimte)

4: $t_{ins,0,spaanplaat} = 1,1 \cdot h_p = 1,1 \cdot 12,0 = 13,2$ min. $k_{pos} = 0,8$, zie tabel E.5 regel 3, laag 4

$$t_{ins} = \sum_i \begin{matrix} t_{ins,0,i} \cdot k_{pos} \cdot k_j \\ t_{ins,0,i} \cdot k_{pos} \cdot k_j \\ t_{ins,0,i} \cdot k_{pos} \cdot k_j \end{matrix} = \sum_i \begin{matrix} 16,8 \cdot 1,0 \cdot 1,0 \\ 9,9 \cdot 0,8 \cdot 1,0 \\ 5,0 \cdot 1,0 \cdot 1,0 \\ 13,2 \cdot 0,8 \cdot 1,0 \end{matrix} = \sum_i \begin{matrix} 16,8 \\ 7,92 \\ 5,0 \\ 10,56 \end{matrix} = 40,28 \text{ min.} \quad \geq \quad t_{req} = 30,0 \text{ min.}$$

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:12:03
4. Wall structure

Outside

4 - 12 mm chipboard plate or fiber plate, for example cementitous wood fiber plate
3- 140 mm glass wool, for example isover systemrole 400 + pinewood rails
x - 90 mm PIR interlayer
2 - 9 mm chipboard plate or fiber plate, for example OSB/3
1 - 12 mm plasterboard type A (for example gypsum fiber plate)

Inside

Number: 2 Author: Translation Subject: Notitie Date: 30/05/2014 18:12:20
5. Calculation method 1: double layered cladding

In this method layer 1-4 are used. Table E.5 'position coefficients Kpos for walls with double layered panels' is used.

Number: 3 Author: Translation Subject: Notitie Date: 30/05/2014 18:12:38
considered as hollow space

6. Rekenmethode 2: enkellaags bekleding

In deze methode worden laag 1,3 en 4 in beschouwing genomen. Er wordt gebruik gemaakt van tabel E.3 'positiecoëfficiënten k_{pos} voor enkellaags panelen aan de aan brand blootgestelde zijde' en tabel E.4 'positiecoëfficiënten k_{pos} voor enkellaags panelen aan de niet-blootgestelde zijde'.

1: $t_{ins,0,gipskartonplaat} = 1,4 \cdot h_p = 1,4 \cdot 12,0 = 16,8$ min.

$$k_{pos} = \min\begin{Bmatrix} 0,02 \cdot h_p + 0,54 \\ 1,0 \end{Bmatrix} = \min\begin{Bmatrix} 0,02 \cdot 12,0 + 0,54 \\ 1,0 \end{Bmatrix} = \min\begin{Bmatrix} 0,78 \\ 1,0 \end{Bmatrix} = 0,78$$

zie tabel E.3 + uitdrukking E.9

3: $t_{ins,0,isolatie} = 0,1 \cdot h_{ins} \cdot k_{dens} = 0,1 \cdot 140 \cdot 0,9 = 12,6$ min. $k_{pos} = 1,0$, zie E.2.3 2e alinea.

4: $t_{ins,0,spaanplaat} = 1,1 \cdot h_p = 1,1 \cdot 12,0 = 13,2$ min.

$$k_{pos} = 0,07 \cdot h_p - 0,17 = 0,07 \cdot 12 - 0,17 = 0,67$$

zie tabel E.4 + uitdrukking E.10

$$t_{ins} = \sum_i \begin{matrix} t_{ins,0,i} \cdot k_{pos} \cdot k_j \\ t_{ins,0,i} \cdot k_{pos} \cdot k_j \end{matrix} = \sum_i \begin{matrix} 16,8 \cdot 0,78 \cdot 1,0 \\ 13,2 \cdot 0,67 \cdot 1,0 \end{matrix} = \sum_i \begin{matrix} 13,1 \\ 8,84 \end{matrix} = 34,5 \text{ min.} \quad \geq \quad t_{req} = 30,0 \text{ min.}$$

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:12:51

6. Calculation method 2: single layered cladding

In this method layer 1, 3 and 4 are used. Table E.3 'position coefficients Kpos for single layered panels at the fire side' and table E.4 'position coefficients Kpos for single layered panels at the non-fire side' are used.

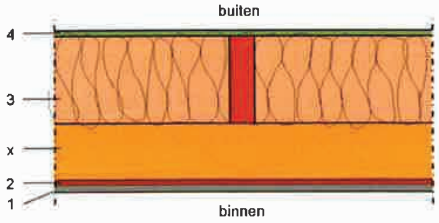
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7. Conclusie

De wandopbouw weergegeven in tabel 2 heeft een rekenkundige brandwerendheid op scheiden volgens NEN-EN 1995-1-2 van minimaal 30 minuten (BOS = 30 min). Mogelijk kan er met dezelfde opbouw een hogere brandwerendheid worden aangetoond indien er brandtesten in het laboratorium worden uitgevoerd.

Tabel 2. Wandopbouw Groothuis bouwelementen.

wandopbouw	
buiten	
4	12 mm spaanplaat of vezelplaat (ρ ≥ 600 kg/m^3) o.g. bijvoorbeeld: cementgebonden houtvezelplaat
3	140 mm glaswol min 15 kg/m^3 bijvoorbeeld: Isover systeemrol 400 + vuren regels 38 x 140 mm, C18
x	90 mm PIR ('tussenlaag')
2	9 mm spaanplaat of vezelplaat (ρ ≥ 600 kg/m^3) o.g. bijvoorbeeld: OSB/3
1	12 mm gipskartonplaat type A o.g. (bijvoorbeeld: gipsvezelplaat)
binnen	



Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:13:04

7. Conclusion

The wall structure as in table 2 has a mathematical fire resistance on separation according to NEN-EN 1995-1-2 of at least 30 minutes (BOS = 30 min). Possibly with the same structure a higher fire resistance can be reached, with the help of lab fire tests.

Number: 2 Author: Translation Subject: Notitie Date: 30/05/2014 18:13:18

4. Wall structure

Outside

4 - 12 mm chipboard plate or fiber plate, for example cementitous wood fiber plate
3- 140 mm glass wool, for example isover systemrole 400 + pinewood rails
x - 90 mm PIR interlayer
2 - 9 mm chipboard plate or fiber plate, for example OSB/3
1 - 12 mm plasterboard type A (for example gypsum fiber plate)

Inside

Literatuur

NEN-EN 520:2004+A1:2009 Gipsplaten – Definities, eisen en beproevingsmethoden

BRL 1009:2012 Nationale beoordelingsrichtlijn voor het KOMO® productcertificaat voor 'Gipskartonplaat'

NEN-EN 1995-1-2+C2:2011 Ontwerp en berekening van houtconstructies – Deel 1-2: Algemeen – Ontwerp en berekening van constructies bij brand (inclusief C1:2006 en C2:2009)

NEN-EN 1995-1-2:2005/NB:2011 Nationale bijlage bij Eurocode 5: Ontwerp en berekening van houtconstructies – Deel 1-2: Algemeen – Ontwerp en berekening van constructies bij brand (inclusief C1:2006 en C2:2009)

NEN-EN 13501-1:2007+A1:2009 Brandclassificatie van bouwproducten en bouwdelen – deel 1: classificatie op grond van resultaten van beproeving van het brandgedrag

Bijlage(n):

1. Typen gipsplaten volgens EN 520
2. Positiecoëfficiënten (k_{pos}) uit NEN-EN 1995-1-2: Tabel E.3, E.4 en E.5
3. Brandclassificatie volgens NEN-EN 13501-1

ir. W.H. de Groot
(projectleider)

prof. dr. ir. A.J.M. Jorissen

Dit rapport heeft 10 bladen. Het is eigendom van de opdrachtgever, die gerechtigd is dit rapport integraal te publiceren. Gedeeltelijke publicatie, ook door de eigenaar, is slechts toegestaan na schriftelijke toestemming van SHR.

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Bijlage 1: Typen gipsplaten volgens EN 520



Verklaring typeaanduiding volgens NEN-EN 520 en BRL 1009:

Type A	=	Standaard gipskartonplaat (voorheen gipskartonplaat GKB)
Type D	=	Gipskartonplaat met vastgestelde dichtheid
Type F	=	Gipskartonplaat met een verhoogde kernsamenhang bij hoge temperaturen (voorheen gipskartonplaat GKF)
Type H	=	Geïmpregneerde gipskartonplaat met vertraagde wateropname
Type I	=	Verhoogde oppervlakte hardheid
Type P	=	Stucplaat
Type R	=	Verhoogde breukweerstand

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:13:30

Appendix 1: types of plasterboards according to EN 520

Type A = standard plasterboard
Type D = plasterboard with set density
Type F = plasterboard with an increased core cohesion at higher temperatures
Type H = impregnated plasterboard with a delayed water absorption
Type I = increased surface hardness
Type P = stucco plate
Type R = increased fracture resistance

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Bijlage 2: Positiecoëfficiënten (k_{pos}) uit NEN-EN 1995-1-2: Tabel E.3, E.4 en E.5

Tabel E.3 — Positiecoëfficiënten k_{pos} voor enkellaags panelen aan de aan brand blootgestelde zijde

Paneel aan de blootgestelde zijde	Dikte mm	Positiecoëfficiënt voor panelen met aan de achterzijde	
		steen- of glaswolisolatie	holle ruimte
Triplex met een karakteristieke volumieke massa ≥ 450 kg/m^3	9 t.m. 25	Uitdrukking (E.9)	0,8
Spaanplaat, vezelplaat met een karakteristieke volumieke massa ≥ 600 kg/m^3	9 t.m. 25		
Houten betimmering met een karakteristieke volumieke massa ≥ 400 kg/m^3	15 t.m. 19		
Gipskartonplaat type A, H, F	9 t.m. 15		

Tabel E.4 — Positiecoëfficiënten k_{pos} voor enkellaags panelen aan de niet-blootgestelde zijde

Paneel aan de blootgestelde zijde	Dikte van het paneel aan de niet-blootgestelde zijde mm	Positiecoëfficiënt voor panelen met aan de voorzijde				
		Glaswol	Steenwol met diktes [a]			Holle ruimte
			45 t.m. 95	145	195	
Triplex met een volumieke massa ≥ 450 kg/m^3	9 t.m. 25	Uitdrukking (E.10)	1,5	3,9	4,9	0,6
Spaanplaat en vezelplaat met een volumieke massa ≥ 600 kg/m^3	9 t.m. 25	Uitdrukking (E.10)				0,6
Houten betimmering met volumieke massa ≥ 400 kg/m^3	15 19	0,45 0,67				0,6
Gipskartonplaat type A, H, F	9 t.m. 15	Uitdrukking (E.10)				0,7

[a] Voor tussenliggende waarden mag lineair zijn geïnterpoleerd.

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:13:40
Table E.3 'position coefficients Kpos for single layered panels at the fire exposed side'

Number: 2 Author: Translation Subject: Notitie Date: 30/05/2014 18:13:51
panel at exposed side - thickness (mm) - position coefficient for panels with at the backside: stone or glass wool insulation | hollow space

Number: 3 Author: Translation Subject: Notitie Date: 30/05/2014 18:14:02
- triplex with a characteristic voluminous mass
- chipboard plate with a characteristic voluminous mass
- wooden boarding with a characteristic voluminous mass
- plasterboard type A, H, F

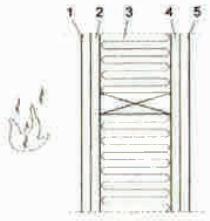
Number: 4 Author: Translation Subject: Notitie Date: 30/05/2014 18:14:09
Table E.4 'position coefficients Kpos for single layered panels at the non fire exposed side'

Number: 5 Author: Translation Subject: Notitie Date: 30/05/2014 18:14:18
panel at exposed side - thickness of the panel at the nonexposed side (mm) - position coefficient for panels with at the backside: glass wool | stone wool | hollow space

Number: 6 Author: Translation Subject: Notitie Date: 30/05/2014 18:14:26
- triplex with a characteristic voluminous mass
- chipboard plate with a characteristic voluminous mass
- wooden boarding with a characteristic voluminous mass
- plasterboard type A, H, F

Tabel E.5 — Positiecoëfficiënten k_{pos} voor wanden met dubbellaags panelen

Constructie: Laagnummer en materiaal		Laagnummer				
		1	2	3	4	5
1, 2, 4, 5 3	Houtachtig plaatmateriaal Holle ruimte	0,7	0,9	1,0	0,5	0,7
1, 2, 4, 5 3	Gipskartonplaat type A of H Holle ruimte	1,0	0,8	1,0	0,8	0,7
1, 5 2, 4 3	Gipskartonplaat type A of H Houtachtig plaatmateriaal Holle ruimte	1,0	0,8	1,0	0,8	0,7
1, 5 2, 4 3	Houtachtig plaatmateriaal Gipskartonplaat type A of H Holle ruimte	1,0	0,8	1,0	0,8	0,7
1, 2, 4, 5 3	Houtachtig plaatmateriaal Steenwol	0,7	0,6	1,0	1,0	1,5
1, 2, 4, 5 3	Gipskartonplaat type A of H Steenwol	1,0	0,6	1,0	0,9	1,5
1, 5 2, 4 3	Gipskartonplaat type A of H Houtachtig plaatmateriaal Steenwol	1,0	0,8	1,0	1,0	1,2
1, 5 2, 4 3	Houtachtig plaatmateriaal Gipskartonplaat type A of H Steenwol	1,0	0,6	1,0	1,0	1,5



Figuur E.2 — Definitie van de laagnummers

Tabel E.2 — Waarden voor k_{dens} voor holle ruimten opgevuld met isolatiematerialen

Vulmateriaal	Volumieke massa kg/m³	k_{dens}*
Glaswol	15	0,9
	20	1,0
	26	1,2
Steenwol	26	1,0
	50	1,1
* Voor tussenliggende waarden van de dichtheid mag lineair zijn geïnterpoleerd.		

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:14:36
Table E.5 'position coefficients Kpos for walls with double layered panels'

Number: 2 Author: Translation Subject: Notitie Date: 30/05/2014 18:14:43
construction: layer number and material | layer number

Number: 3 Author: Translation Subject: Notitie Date: 30/05/2014 18:14:52
plasterboard type A or H
wooden plate material
hollow space

Number: 4 Author: Translation Subject: Notitie Date: 30/05/2014 18:15:01
Figure E.2 - definition of the layer numbers

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Bijlage 3: Brandclassificatie volgens NEN-EN 13501-1

Tabel 2. Euro-brandklassen volgens NEN-EN 13501-1

Europese klassering brandklasse	*materiaalgedrag bij brand*	*in de praktijk*
A1	geen enkele bijdrage	onbrandbaar
A2	nauwelijks bijdrage	praktisch onbrandbaar
B	zeer beperkte bijdrage	zeer moeilijk brandbaar
C	grote bijdrage	brandbaar
D	hoge bijdrage	goed brandbaar
E	zeer hoge bijdrage	zeer brandbaar
F	gevaarlijke bijdrage	uiterst brandbaar

Page: 10

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:15:12
Fire classification

class - material behaviour - in practice

A1 - no contribution - nonflammable
A2 - almost no contribution - practically nonflammable
B - very low contribution - very difficult flammable
C - large contribution - flammable
D - high contribution - well flammable
E - very high contribution - very flammable
F - dangerous contribution - extremely flammable

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Datum
30 november 1995

Ons nummer
95-CVB-B0872/WTJB/GTTB

Uw brief

Onderwerp
Brandproeven
TNO Opdrachtnr. 05.20.6.7095/137

Geachte heer De Bruyne,

In uw opdracht werden bij het Centrum voor Brandveiligheid van TNO Bouw te Rijswijk, Nederland, in de periode van 31-10-'95 tot 13-11-'95 oriënterende proeven uitgevoerd om het gedrag bij brand van houtspaanplaten vast te stellen.

De spaanplaten waren van het type vochtwerend, code V313/KOMO-30850-V-E1.

De spaanplaten werden horizontaal opgesteld en aan de onderzijde enkelzijdig verhit volgens de zogenaamde standaardbrandkromme als vermeld in NEN 6069. Onderzocht werden spaanplaten met afmetingen 1,50 x 1,50 m in verschillende plaatdikten. Zie Tabel 1.

Tabel 1: De onderzochte proefstukken

Proef	Dikte	Gewicht	Volumieke massa [1])	Vocht-gehalte [2])
	[mm]	[kg]	[kg/m³]	[%] (m/m)
1	12	19,6	726	9,2
2	18	30,0	741	9,1
3	22	35,8	723	8,5

[1]) Bepaald vóór droging

[2]) Bepaald na droging bij 105 °C

TNO Bouw verricht onderzoek en geeft advies over bouwvraagstukken, voornamelijk in opdracht van onder meer de overheid, grote en kleine ondernemingen in de bouw, toeleveringsbedrijven en branche-instellingen.

Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek TNO

Op opdrachten aan TNO zijn van toepassing de Algemene Voorwaarden voor onderzoeksopdrachten aan TNO, zoals gedeponeerd bij de Arrondissementsrechtbank en de Kamer van Koophandel te 's-Gravenhage.

3.22

Summary of Comments on chipboard_plywood flooring - fire resistance certificate 1_translated.pdf

Page: 1

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:23:15
Subject: fire tests

Number: 2 Author: Translation Subject: Notitie Date: 30/05/2014 18:23:27
Dear mister De Bruyne,

In your task at the Centre for Fire Safety of TNO Bouw in Rijswijk, in the period of 31-10-95 till 13-11-95, orientating tests have been done to measure the behaviour of chipboard plywood plates during fire.

The plates were from the moist resisting type, code ...

The plates were laid horizontally and were heated one-sided from the bottom, according to the so-called standard-fire-curve as mentioned in NEN 6069. Plates with measurements on 1,5x1,5 meter were tested, with various thicknesses (see table 1).

Number: 3 Author: Translation Subject: Notitie Date: 30/05/2014 18:23:36
test - thickness - weight - voluminous mass - moisture content

Number: 4 Author: Translation Subject: Notitie Date: 30/05/2014 18:23:45
determined before drying

determined after drying at 105 degrees Celsius

Bepaald is de doorbrandtijd in minuten gedefinieerd als de verhittingsduur waarbij niet meer wordt voldaan aan het criterium vlamdichtheid betrokken op de afdichting als gespecificeerd in NEN 6069. Daarnaast zijn oppervlaktetemperaturen van de niet direct verhitte zijde van de plaat gemeten.

Beproevingsresultaten

Een samenvatting van de beproevingsresultaten is gegeven in Tabel 2. Voor gedetailleerde gegevens wordt verwezen naar de appendices A t/m C voor resp. proef 1, proef 2 en proef 3.

Tabel 2: Samenvatting van de beproevingsresultaten

Proef	Beproevings-datum	Verhittingsduur	Tijdsduur voor bereiken van $\Delta T_{gem} \geq 140$ °C	Tijdsduur voor bereiken van $\Delta T_{max} \geq 180$ °C	Vlamdichtheid betr. op afdichting
1	13/11/'95	18 min.	16 min.	17 min.	18 min.
2	31/10/'95	28 min.	25 min.	26 min.	27 min.
3	6/11/'95	33 min.	29 min.	31 min.	33 min.

Conclusie

De doorbrandtijd in minuten van de onderzochte spaanplaten, met een volumieke massa van ten minste 723 kg/m³, bedraagt:
ca. 1,5 x de plaatdikte in mm.

Opmerking

Opgemerkt wordt dat de doorbrandtijd een eigenschap is van bepaalde typen plaatmaterialen bij eenzijdige verhitting volgens de standaardbrandkromme. De doorbrandtijd moet daarom niet worden verward met het begrip brandwerendheid.

ir. J.C.A. van de Weijgert

ing P.W. van de Haar

3.22

mber: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:23:57
termined has been the burning time in minutes, defined as the heating time where the criteria of flame density on the waterproofing (NEN 59) no longer is met. Besides that, surface temperatures of the not-directly heated side of the plate are measured.

mber: 2 Author: Translation Subject: Notitie Date: 30/05/2014 18:24:07
t results.

ummary of the test results is presented in table 2. For detailled statistics, see appendices A to C, for test 1, 2 and 3.

mber: 3 Author: Translation Subject: Notitie Date: 30/05/2014 18:24:17
mmary of the test results.

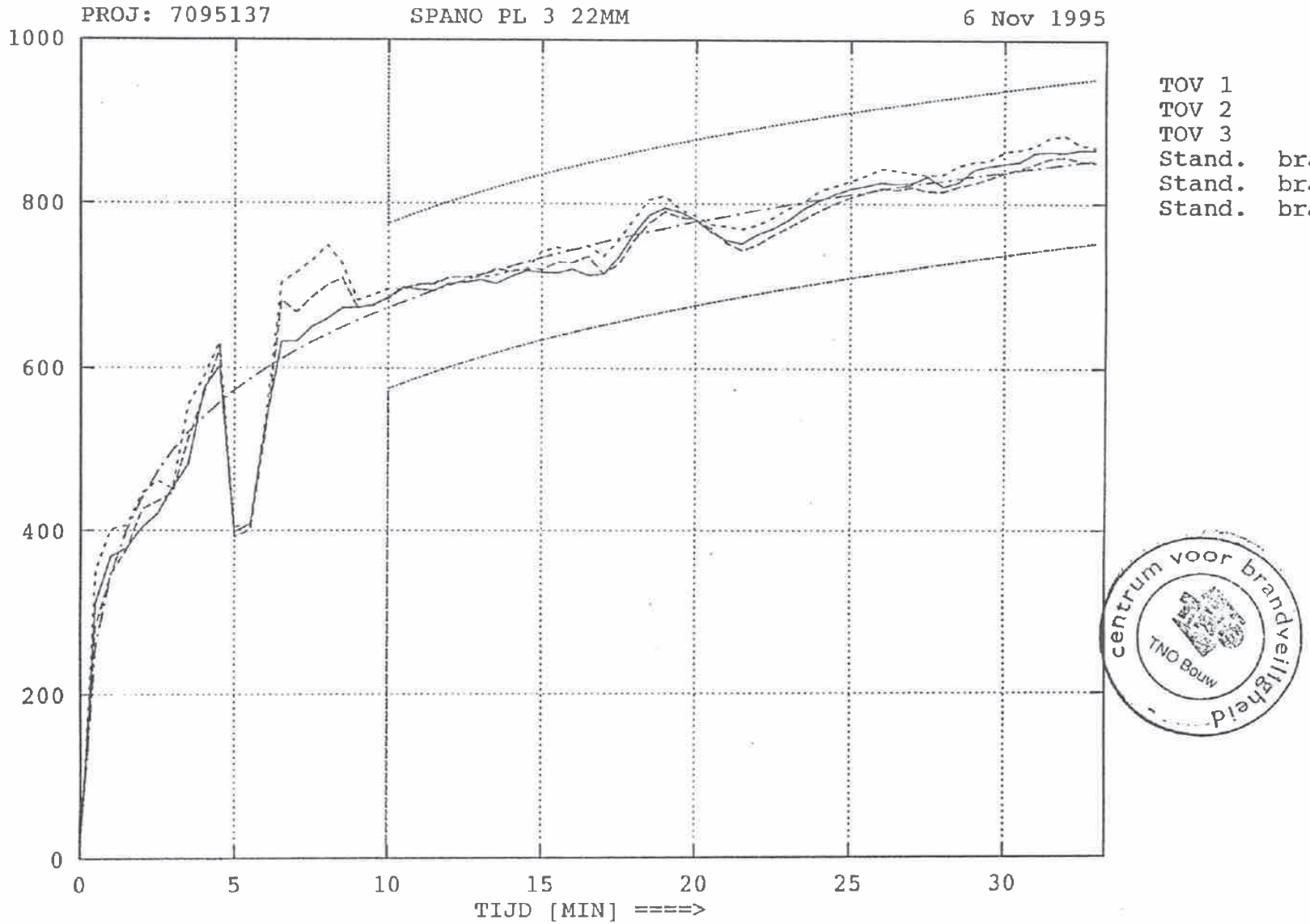
t - test date - heating time - time to reach T (average) > 140 C - time to T (maximum) > 180 C - flame density on waterproofing

mber: 4 Author: Translation Subject: Notitie Date: 30/05/2014 18:24:27
nclusion

e heating time in minutes of the investigated plates, with a voluminous mass of at least 723 kg/m3, is about 1,5 times the plate thickness in n.

mber: 5 Author: Translation Subject: Notitie Date: 30/05/2014 18:24:38
te

ere has to be noted that the heating time is a characteristic of certain types of plate materials during one-sided heating according to the ndard-fire-curve. The heating time therefore should not be confused with the term fire resistance.



centrum voor brandveiligheid
TNO Bouw

Fig. C1: Gemeten gastemperaturen in de oven

mber: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:24:43
asured gas temperatures in the oven

Ons nummer

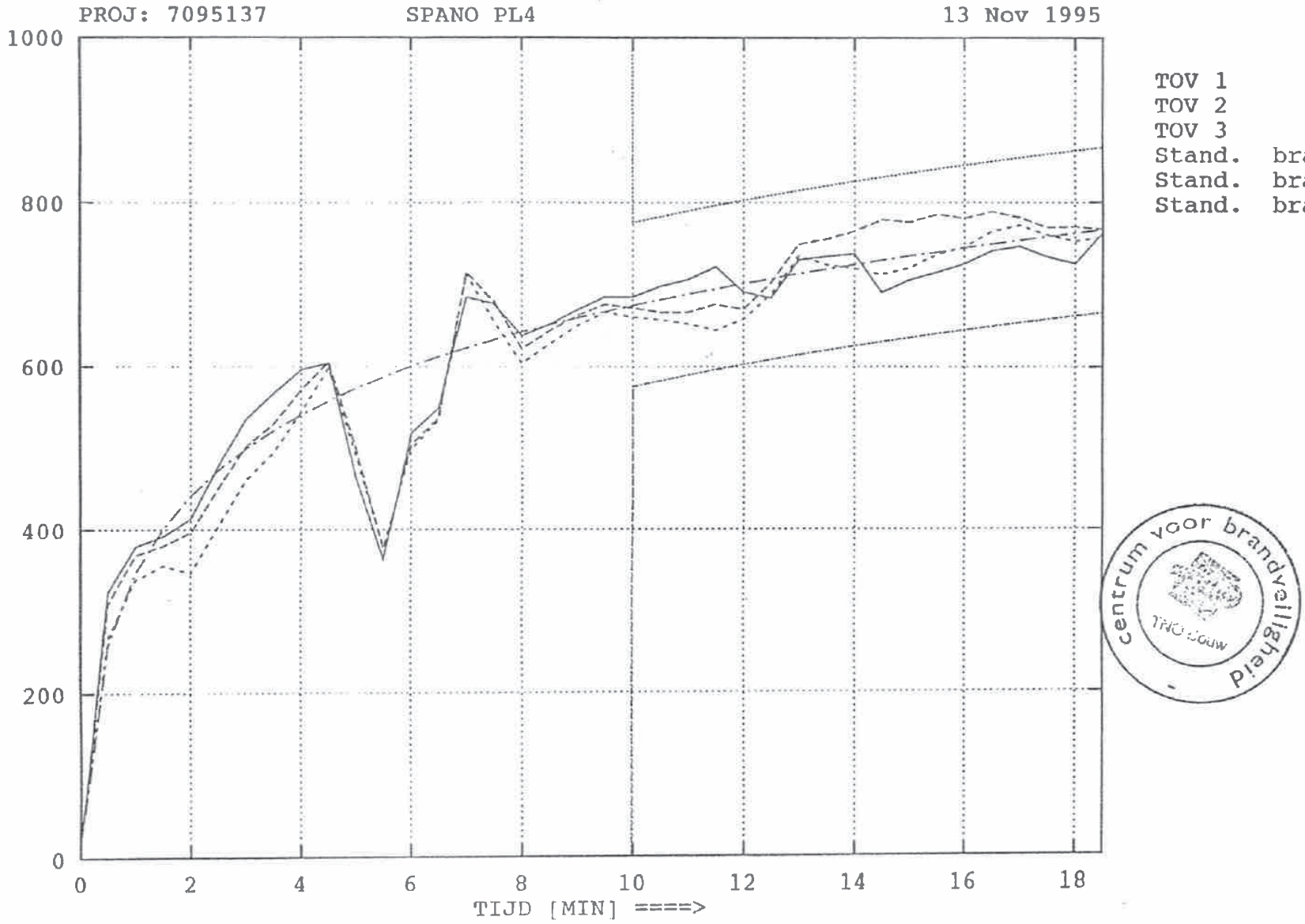
95-CVB-B0872/WTJB/GTTB

Blad

Datum

30 november 1995

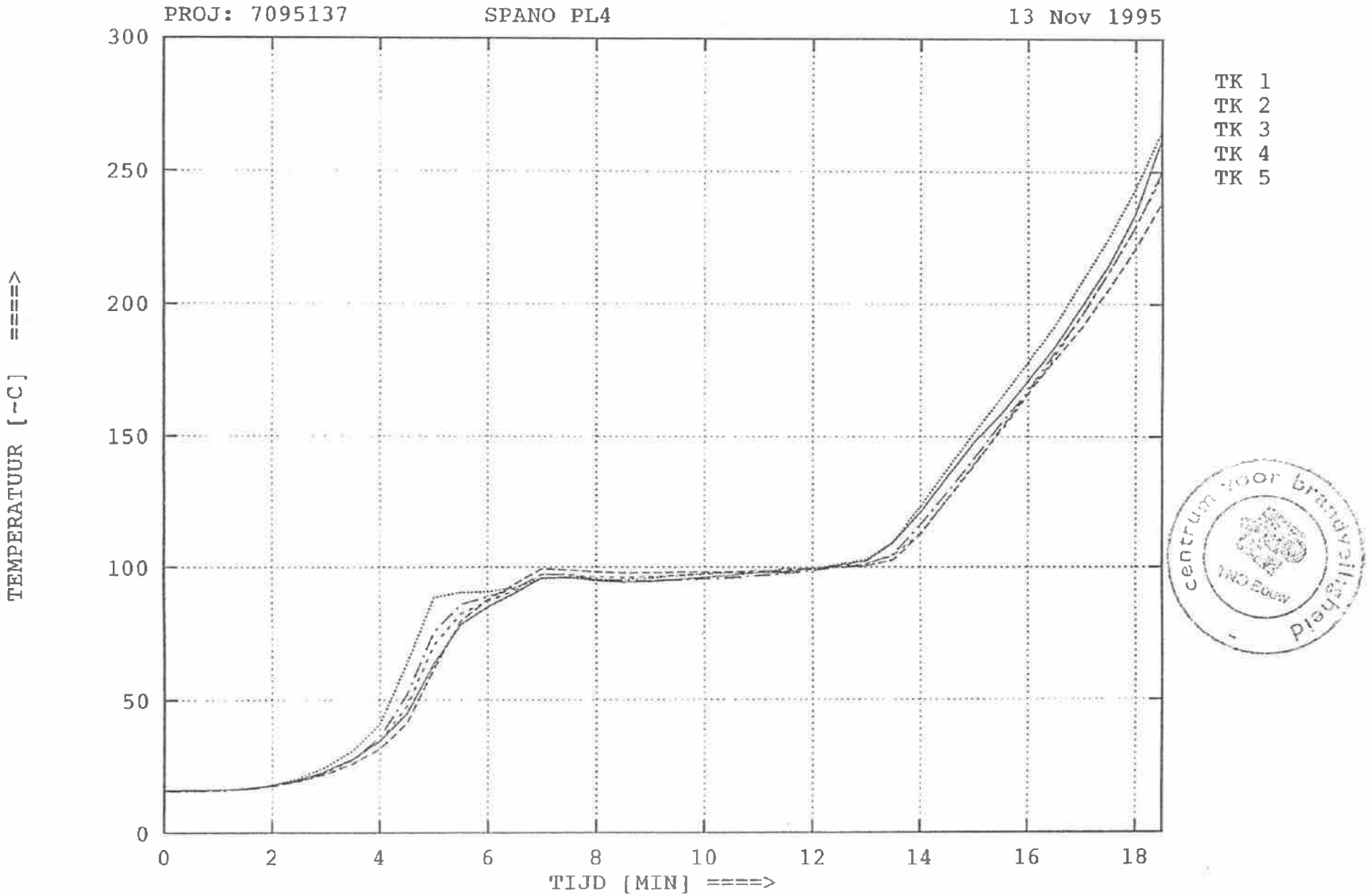
APPENDIX A 12 mm dikke spaanplaat



centrum voor brandveiligheid
TNO-bouw

Fig. A1: Gemeten gastemperaturen in de oven

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:24:49
measured gas temperatures in the oven

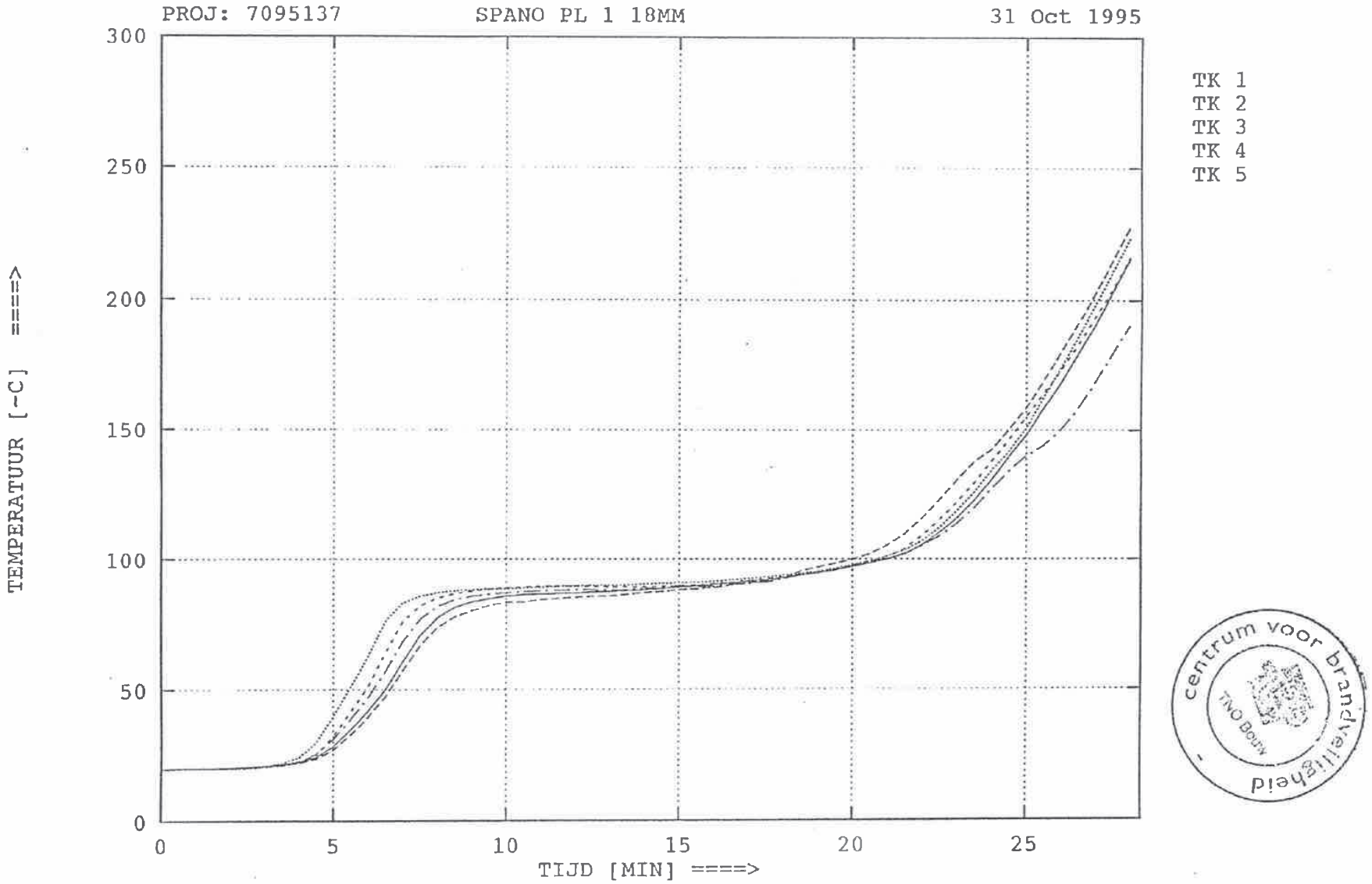


centrum voor brandveiligheid
TNO Bouw

Fig. A2: Gemeten oppervlaktetemperaturen van de niet direct verhitte zijde van de spaanplaat

3.22

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:24:58
measured surface temperatures of the not-directly heated side of the plate



centrum voor brandveiligheid
TNO Bouw

Fig. B2: Gemeten oppervlaktetemperaturen van de niet direct verhitte zijde van de spaanplaat

3.22

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:25:06
measured surface temperatures of the not-directly heated side of the plate

Ons nummer

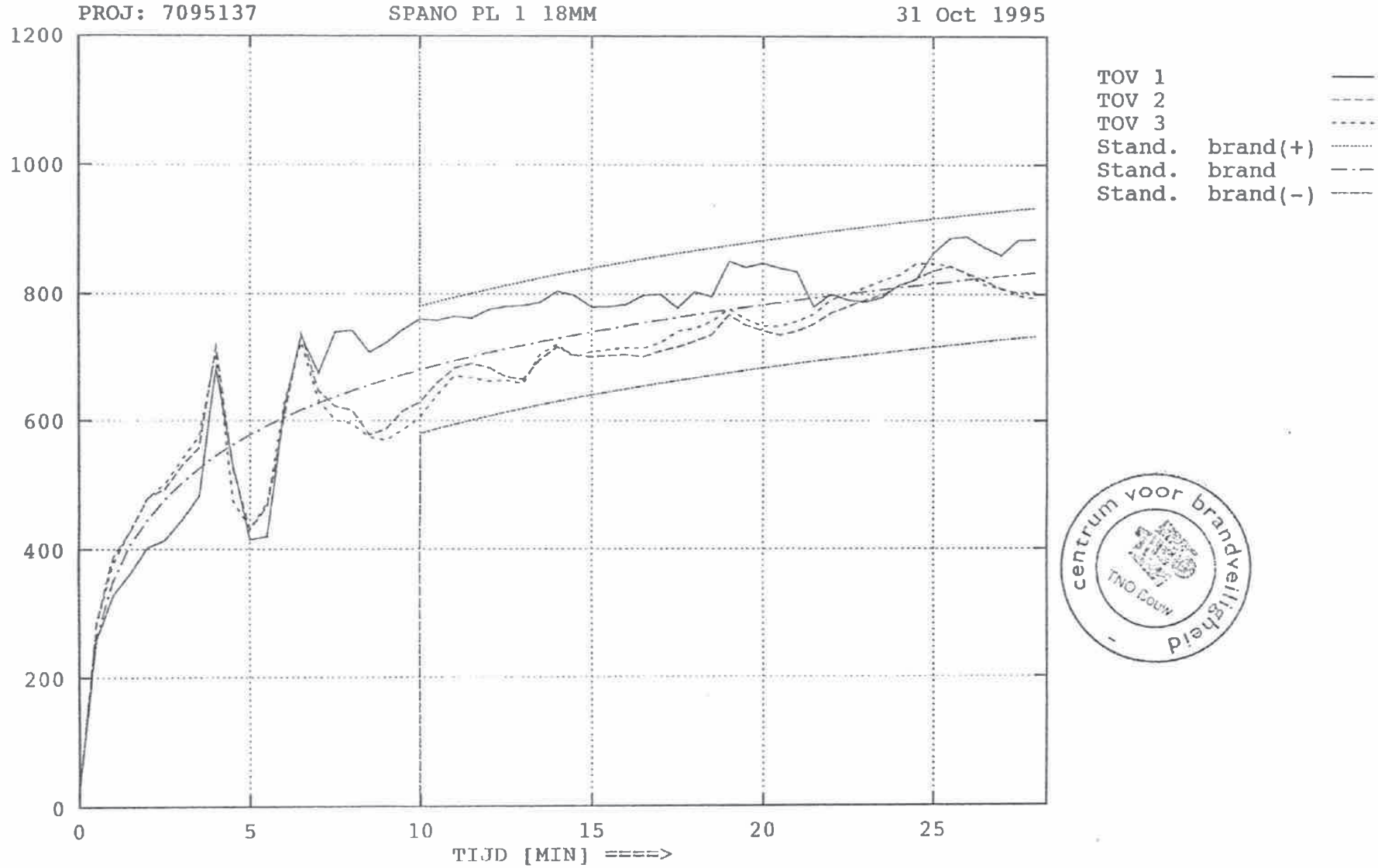
95-CVB-B0872/WTJB/GTTB

Blad

Datum

30 november 1995

APPENDIX B 18 mm dikke spaanplaat



centrum voor brandveiligheid
TNO Bouw

Fig. B1: Gemeten gastemperaturen in de oven

mber: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:25:18
asured gas temperatures in the oven

Ons nummer	Blad	Datum
95-CVB-B0872/WTJB/GTTB		30 november 1995

APPENDIX C 22 mm dikke spaanplaat

3.22

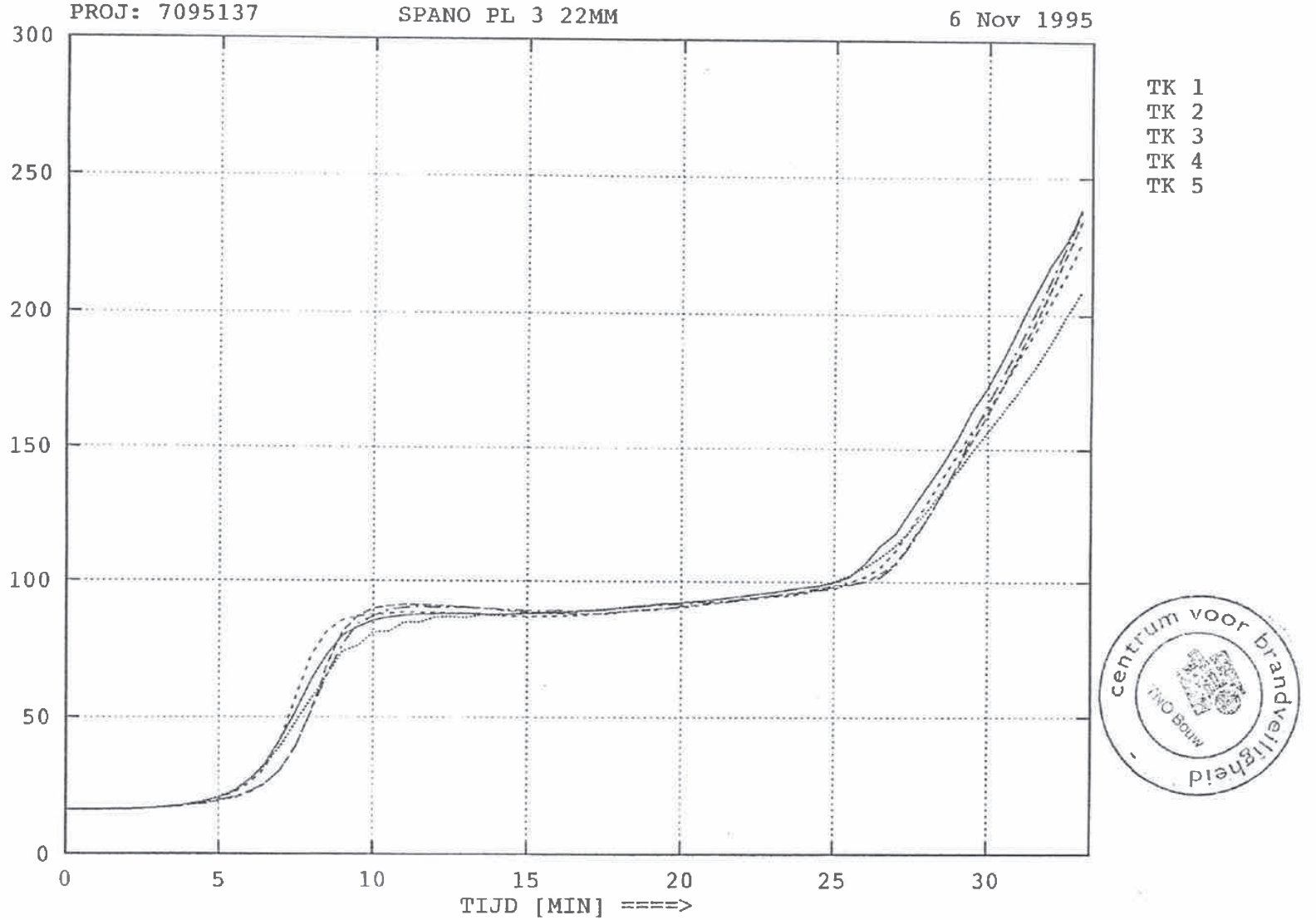


Fig. C2: Gemeten oppervlaktetemperaturen van de niet direct verhitte zijde van de spaanplaat

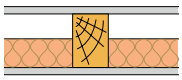
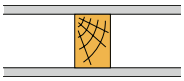
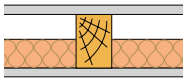
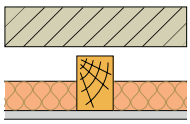
3.22

Number: 1 Author: Translation Subject: Notitie Date: 30/05/2014 18:25:27
measured surface temperatures of the not-directly heated side of the plate

TIMBER FRAMES

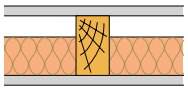
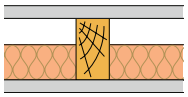
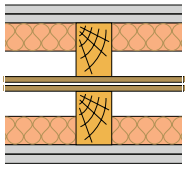
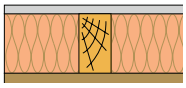
PERFORMANCE DETAILS

FERMACELL TIMBER WALLS WITH INSULATION – NON LOADBEARING

SYSTEM SPECIFICATIONS			Wall Weight kg/m²	Wall Height m	Wall Thickness mm	Fire Rating mins	Sound Insulation R_w	BS 5234/ DIN 4103 Grade
1H12								
	Studs	89 mm x 38 mm @ 500 mm centres	34	4.1	109	30	44	Heavy
	Facings	1 layer 10 mm Fermacell Board each side						
	Insulation	40 mm mineral stone wool density 30 kg/m³						
	Studs	75 mm x 50 mm @ 500 mm centres	35	4.1	95	30	44	Heavy
	Facings	1 layer 10 mm Fermacell Board each side						
	Insulation	40 mm mineral stone wool density 30 kg/m³						
1H13								
	Studs	89 mm x 38 mm @ 600 mm centres	40	4.1	114	30	41	Severe
	Facings	1 layer 12.5 mm Fermacell Board each side						
	Studs	75 mm x 50 mm @ 600 mm centres	40	4.1	100	30	41	Severe
	Facings	1 layer 12.5 mm Fermacell Board each side						
	Studs	75 mm x 50 mm @ 600 mm centres	46	4.1	105	60	41	Severe
	Facings	1 layer 15 mm Fermacell Board each side						
1H22								
	Studs	89 mm x 38 @ 600 mm centres	41	4.1	114	60	44	Severe
	Facings	1 layer 12.5 mm Fermacell Board each side						
	Insulation	40 mm mineral stone wool density 45 kg/m³ or 60 mm mineral stone wool density 30 kg/m³						
	Insulation	70 mm x 30 kg/m³					47	
	Studs	75 mm x 50 mm @ 600 mm centres	40	4.1	100	60	44	Severe
	Facings	1 layer 12.5 mm Fermacell Board each side						
	Insulation	40 mm mineral stone wool density 45 kg/m³ or 60 mm mineral stone wool density 30 kg/m³						
	Insulation	70 mm x 30 kg/m³					47	
3H11 – Independent Lining								
	Studs	75 mm x 50 mm @ 600 mm centres	26	3	87.5	n/a*	**	Severe
	Facings	1 layer 12.5 mm Fermacell Board one side						
	Insulation	70 mm mineral stone wool density 30 kg/m³						
	Studs	89 mm x 38 mm @ 600 mm centres	26	3	101.5	n/a*	**	Severe
	Facings	1 layer 12.5 mm Fermacell Board one side						
	Insulation	40 mm mineral stone wool density 30 kg/m³						

* For a Fire Performance of a complete wall, please contact the Fermacell Technical Department.
** Up to ΔRw 20dB Sound Improvement as an independant lining.

FERMACELL TIMBER WALLS WITH INSULATION – LOADBEARING

SYSTEM SPECIFICATIONS			Applied Load kN/stud	Wall Weight kg/m²	Wall Height m	Wall Thickness mm	Fire Rating mins	Sound Insulation R_w	BS 5234/ DIN 4103 Grade
1HT11									
	Studs	89 mm x 38 mm @ 600 mm centres	5.56	41	2.6	114	30	44	Severe
	Facings	1 layer 12.5 mm Fermacell Board each side							
	Insulation	90 mm mineral stone wool density 10 kg/m³ or 40 mm mineral stone wool density 30 kg/m³							
	Studs	75 mm x 50 mm @ 600 mm centres	9.3	40	3	100	30	44	Severe
	Facings	1 layer 12.5 mm Fermacell Board each side							
	Insulation	40 mm mineral stone wool density 30 kg/m³							
1HT22									
	Studs	89 mm x 38 mm @ 600 mm centres	A	58	3	125	60	≥46	Severe
	Facings	1 layer 18 mm Fermacell Board each side							
	Insulation	90 mm mineral stone wool density 30 kg/m³							
	Studs	120 mm x 45 mm @ 600 mm centres	10.8	48	3	150	60	≥46	Severe
	Facings	1 layer 15 mm Fermacell Board each side							
	Insulation	120 mm mineral stone wool density 30 kg/m³							
	Studs	140 mm x 38 mm @ 600 mm centres	10	48	3	150	60	≥46	Severe
	Facings	1 layer 15 mm Fermacell Board each side							
	Insulation	140 mm mineral stone wool density 30 kg/m³							
1HT23 – Twin Wall									
* 	Studs	2 x 89 mm x 38 mm @ 600 mm centres	5.56	112	2.6	270	60	≥66	Severe
	Facings	2 layers 12.5 mm Fermacell Board inner side plus 2 layers 12.5 mm Fermacell Board outer side. Inner cavity single layer may be timber based product. Refer to Fermacell technical information							
	Insulation	2 x 90 mm mineral stone wool density 10 kg/m³							
3HT22									
	Studs	89 mm x 38 mm @ 600 mm centres	A	≈31	3	116	60†	≈43	Severe
	Facings	1 layer 18 mm Fermacell Board inner side plus Timber Sheathing board to 9mm OSB, ply or similar outer side							
	Insulation	90 mm mineral stone wool density 35 kg/m³							
	Studs	75 mm x 50 mm or 70 mm x 44 mm @ 600 mm centres	A	≈31	3	102	60†	≈43	Severe
	Facings	1 layer 18 mm Fermacell Board inner side plus Timber Sheathing board to 9mm OSB, ply or similar outer side							
	Insulation	75 mm mineral stone wool density 35 kg/m³							

* 9 mm Sheathing Board or 10 mm Fermacell Board

A – Loading up to maximum for timber grade stress in accordance with EN 1995-1-1 and EN 1995-1-2

† Fire rating from Fermacell side only

Deutsches Institut für Bautechnik
Zulassungsstelle für Bauprodukte und Bauarten
Bautechnisches Prüfamt
Eine vom Bund und den Ländern gemeinsam getragene Anstalt des öffentlichen Rechts

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www.dibt.de

Authorised and notified according to Article 10 of the Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (89/106/EEC)

Deutsches Institut für Bautechnik

Mitglied der EOTA
Member of EOTA

European Technical Approval ETA-03/0050

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung *Trade name*		FERMACELL - Gipsfaserplatten - "FERMACELL Gipsfaser-Platte", "FERMACELL Vapor", FERMACELL Gipsfaserplatte-greenline"- *FERMACELL Fibre gypsum boards*
Zulassungsinhaber *Holder of approval*		Xella Trockenbau-Systeme GmbH Dammstraße 25 47119 Duisburg
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*		Gipsfaserplatten für die Beplankung und Bekleidung von Bauteilen *Fibre gypsum boards for planking and lining of building components*
Geltungsdauer: *Validity:*	vom *from* bis *to*	17 June 2013 28 June 2018
Herstellwerk *Manufacturing plant*		Werk 1, Werk 2, Werk 3, Werk 4, Werk 5 Plant 1, plant 2, plant 3, plant 4, plant 5

Diese Zulassung umfasst *This Approval contains*	11 Seiten einschließlich 2 Anhänge *11 pages including 2 annexes*
Diese Zulassung ersetzt *This Approval replaces*	ETA-03/0050 mit Geltungsdauer vom 23.02.2009 bis 22.02.2014 *ETA-03/0050 with validity from 23.02.2009 to 22.02.2014*

EOTA
Europäische Organisation für Technische Zulassungen
European Organisation for Technical Approvals

I LEGAL BASES AND GENERAL CONDITIONS

1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1], modified by Council Directive 93/68/EEC[2] and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council[3];
- *Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998[4], as amended by Article 2 of the law of 8 November 2011[5];*
- Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC[6].

2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.

3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.

4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.

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6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

1 Official Journal of the European Communities L 40, 11 February 1989, p. 12
2 Official Journal of the European Communities L 220, 30 August 1993, p. 1
3 Official Journal of the European Union L 284, 31 October 2003, p. 25
4 *Bundesgesetzblatt Teil I 1998*, p. 812
5 *Bundesgesetzblatt Teil I 2011*, p. 2178
6 Official Journal of the European Communities L 17, 20 January 1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of the construction product and intended use

1.1 Definition of the construction product

"FERMACELL Gipsfaser-Platten", "FERMACELL Vapor" and "FERMACELL Gipsfaserplatte greenline" are special building boards made of gypsum and cellulose fibres. The "FERMACELL Vapor" additionally have a paper-faced functional layer. In contrast, "FERMACELL Gipsfaserplatten greenline" are coated. If individual characteristics concerned all previously mentioned building products at the same time, the plates are hereinafter referred as gypsum fibre boards.

They will be produced for the intended use after section 1.2 with a range of thickness between 10 mm and 25 mm.

Length and width of the boards are at least 500 mm.

The edges of the gypsum boards with fibrous reinforcement may be sharp edged or formed, e.g. "FERMACELL Trockenbau-Kante" (TB-Kante). The "FERMACELL TB"- edge consists of a 40 mm broad, to the edge of the board running flattening, whereby the largest reduction of the nominal thickness of the board is 2,5 mm. At the edge is additionally one chamfer.

The "FERMACELL Gypsum-Fibreboard" and "FERMACELL Gipsfaser-Platte greenline" meets the class A2-s1, d0 according to EN 13501-1[7]. At the "FERMACELL Vapor" has been no performance determined.

"FERMACELL Gipsfaser-Platten" correspond to type GF-W2 and type GF-I (see section 2.7.5).

1.2 Intended use

1.2.1 "FERMACELL Gipsfaser-Platten", "FERMACELL Vapor", "FERMACELL Gipsfaser-Platten greenline" are used for the planking (structural) and lining (non-structural) of building components. They may be used both as loadbearing and as stiffening boards.

The "FERMACELL Gipsfaser-Platten", "FERMACELL Vapor", "FERMACELL Gipsfaser-Platten greenline" may be used in the service classes 1 and 2 according to EN 1995-1-1[8].

1.2.2 The provisions made in this European technical approval are based on an assumed intended working life of the Gypsum-Fibreboard of at least 50 years, provided that the conditions laid down in sections 4 and 5 for the packaging, transport, storage, installation, use, maintenance and repair are met. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

7 EN 13501-1:2002 Fire classification of construction products and building elements; part 1

8 EN 1995-1-1:2010-12 Eurocode 5; Design of timber structures; Part 1-1: General - Common rules and rules for building

2 Characteristics of the construction product and methods of verification

2.1 Mechanical resistance and stability

The characteristic values for strength and stiffness of the "FERMACELL- Gipsfaser- Platten" are indicated in Annex 1, table 1.

For bending strength perpendicular to the board plane, tested according to section 3.2.1.2, the following minimum value is required:

$$f_{m,90} \geq 5{,}8 \text{ N/mm}^2.$$

This value must not be used for the calculation according to EN 1995-1-1[8].

The density of the gypsum fibre boards, tested according section 3.2.1.2, shall be at least 1000 kg/m³ and must not exceed 1250 kg/m³.

2.2 Behaviour against fire

2.2.1 Reaction to fire

Based on tests carried out according to EN 13823[9] (SBI) in combination with EN ISO 1716 the "FERMACELL Gipsfaser- Platten" and the" FERMACELL Gipsfaserplatten greenline" meet the class A2-s1, d0 according to EN 13501-1[7]. For the "FERMACELL Vapor" no performance has been determined.

Fire protection clothing out "FERMACELL-Gipsfaser-Platten" with a thickness at least 10mm fulfills the requirements of the class K 10 according to EN 13501-2[10].

2.3 Hygiene, health and environment

The Eeuropean technical approval is issued for the product with the chemical composition and other characteristics as deposited with the issuing Approval Body. Changes of materials, of composition or characteristics, should be immediately notified to the Approval Body, which will decide whether a new assessment will be necessary.

In addition to the specific clauses relating to dangerous substances contained in this European technical approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

2.4 Safety in use

The value of the impact resistance of the "FERMACELL Gypsum-Fibreboard", tested according to EN 1128, is at least IR = 11 mm/ mm thickness of the board.

2.5 Protection against noise

Not relevant.

2.6 Energy economy and heat retention

2.6.1 The value of thermal conductivity λ of the "FERMACELL Gipsfaser-Platten", tested according to EN 12664, is $\lambda \leq 0.32$ W/mK.

For the "FERMACELL Vapor" and the "FERMACELL Gipsfaserplatte-greenline" no performance has been determined.

9 EN 13823:2010-12 Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item

10 EN 13501-2:2003 Fire classification of construction products and building elements; part 2

2.6.2 The "FERMACELL Gipsfaser-Platten" are airtight.

2.6.3 The value of the water vapour diffusion resistance of the "FERMACELL Gipsfaser-Platten", tested according to EN ISO 12572[11], is $\mu = 13$. The s_d-value determined according to EN ISO 12572[11] for the "FERMACELL Vapor" of thicknesses 10 mm / 18 mm is s_d = 3.1 m / 4.5 m.

For the "FERMACELL Gipsfaserplatten greenline" no performance has been determined.

2.7 Aspects of durability, serviceability and identification

2.7.1 The thickness of the "FERMACELL Gipsfaser-Platten", "FERMACELL Vapor" and the "FERMACELL Gipsfaser-Platte greenline" for the intended use after section 1.2 must be between 10 mm and 25 mm.

Length and width of the boards must be at least 500 mm.

Dimensional tolerances of 0/-4 mm for nominal width of boards, 0/-5 mm for nominal length and ± 0.2 mm for nominal thickness are permissible. They correspond to board type C1 in accordance with EN 15283-2[12].

2.7.2 The moisture content of the FERMACELL Gypsum-Fibreboard in normal climate (20 °C/ 65 % humidity), tested according to EN 322, ranges between 1.0 and 1.5 %. In this case the boards are dried up by 40 °C to mass constancy.

2.7.3 The relative change in length during testing according to EN 318 for "FERMACELL Gipsfaser-Platten" of thicknesses 10 mm to 18 mm for swelling is $\delta l_{65,85}$ = 0.33 mm/m. The relative change in length for "FERMACELL Gipsfaser-Platten" for shrinkage is $\delta l_{65,30}$ = -0.31mm/m.

2.7.4 The chemical composition of the fibre gypsum boards shall correspond to the details deposited with the Deutsches Institut für Bautechnik.

2.7.5 The following additional type designations can be specified as a function of water absorption and surface hardness. If the water absorption is less than 1500g/m² according to testing as described in section 5.9 of DIN EN 15283-2[12] the "FERMACELL-Gipsfaser-Platte" can be designated as type GF-W2.

If the diameter of the indentation is less than 15 mm according to testing as described in section 5.11 of EN 15283-2[12] the panel may be designated as a "FERMACELL-Gipsfaser-Platte" of type GF-I with increased surface hardness.

3 Evaluation of conformity and CE marking

3.1 System of attestation of conformity

In its Decision 95/467/EC the European Commission has specified system 3 for the attestation of conformity of gypsum products (in the present case: fibre gypsum boards). The system is described in the Council Directive (89/106/EEC) in Annex III, 2 (ii), second possibility and provides for the following:

System 3: Declaration of conformity of the product by the manufacturer on the basis of:

(a) Tasks of the manufacturer:

(1) factory production control;

(b) Tasks of the approved body:

(2) initial type-testing of the product.

11	EN ISO 12572:2001	Hygrothermal performance of building materials and products - Determination of water vapour transmission properties
12	EN 15283.-2:2009:12,	Gypsum boards with fibrous reinforcement- part 2-Gypsum fibre boards

3.2 Responsibilities

3.2.1 Tasks of the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use raw and constituent materials in consensus to the details deposited by the Deutsches Institut für Bautechnik.

The factory production control shall be in accordance with the "Control Plan", which is part of the technical documentation of this European technical approval. The "Control Plan" is laid down in the context of the factory production control system operated by the manufacturer and deposited at the Deutsches Institut für Bautechnik.[13]

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the "Control Plan".

3.2.1.2 Other tasks of manufacturer

The manufacturer shall control in each manufacturing plant compliance with the requirements given in section 2 of the present European technical approval for the bending strength and the density as well as with the requirements given in section 3.3 of the present European technical approval for the CE marking.

The determinations of the control plan to monitor the values must be observed.

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of gypsum fibre boards in order to undertake the actions laid down in section 3.3. For this purpose, the "control plan" referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer must give an attestation of conformity for his product. So he declares, that the building product is in accordance with this ETA 03/0050.

3.2.2 Tasks of approved bodies

The approved body shall perform the

- initial type-testing of the product

in accordance with the provisions laid down in the "Control Plan" (see section 3.2.1.1)

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

[13] The "control plan" is a confidential part of the European technical approval and only handed over to the approved body/bodies involved in the procedure of attestation of conformity. See section 3.2.2.

3.3 CE marking

The CE marking shall be affixed on the product itself, on the label attached to it, on the packaging or on the accompanying commercial documents.

The letters "CE" shall be followed by the following additional information:

- the name and address of the manufacturer (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,
- the number of the European technical approval,
- the trading name,
- reaction to fire class,
- the thickness of the board,
- the type of the board.

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The manufacturing procedure for the fibre gypsum boards has been deposited by the Deutsches Institut für Bautechnik.

The European technical approval is issued for the product on the basis of tested data and informations, deposited with the Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to the Deutsches Institut für Bautechnik before the changes are introduced. The Deutsches Institut für Bautechnik will decide whether or not such changes affect the European technical approval and consequently the validity of the CE marking on the basis of the European technical approval and if so whether further assessment or alterations to the European technical approval shall be necessary.

4.2 Design, calculation and execution of building components

The design, calculation and execution of building components which are manufactured using the present "FERMACELL Gipsfaser-Platten", "FERMACELL-Vapor", "FERMACELL-greenline" can take place according to Annex 2 or accomplish the standards EN 1995-1-1[8] and EN 1993-1-1[14].

The data of this European technical approval including Annex 1 and if necessary the references in valid additional national regulations are to be considered.

[14] EN 1993-1-1 Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings

4.3 Installation

As connectors for the "FERMACELL Gipsfaser-Platten", "FERMACELL Vapor" and the "FERMACELL Gipsfaser- Platten greenline" with the substructure can be used zinc-coated and/or stainless nails, screws or staples. Following conditions must be considered:

- The nails must have a diameter 2.0 mm ≤ d ≤ 3.0 mm and a diameter of the nail heat at least ≥ 1.8 d.
- The characteristic tensile strength of the nail steel must be at least 600 N/mm².
- The staples must have a wire diameter d ≥ 1.5 mm. The back width b_R of the staples must be 6 d ≤ b_R ≤ 12 mm.
- The screws must have an outside diameter of the screw thread d ≥ 3.5 mm.

Tips for calculation of connecting systems contain Annex 2.

The distances of the connectors from the unstressed edge of the Gypsum fibre boards shall belf an TB-Kante is implemented at the Gypsum-fibre boards, the distances of the connectors from the unstressed edge shall be at least 7·d, from the stressed edge at least 10·d.

5 Indications for the manufacturer and user

5.1 Packaging, transport and storage

During transport and storage the "FERMACELL Gipsfaser-Platten", the "FERMACELL Vapor" and "FERMACELL Gipsfaser-Platten greenline" and the components manufactured by using the present boards shall be protected against damaging and inadequate moisture, e. g. due to precipitation or high construction moisture (all-round covering of the boards or components by means of a foil).

5.2 Use, maintenance and repair

Damaged Gypsum fibre boards or components manufactured by using the present boards must not be used or installed.

Where components are produced on site by using fibre gypsum boards the moisture of the wood substructure must not increase inadequately until installation of the fibre gypsum boards (protection against precipitation or very high construction moisture).

Andreas Kummerow
p. p. Head of Department

beglaubigt:
Wehlan

Deutsches Institut für Bautechnik DIBt

Annex 1:

Characteristic strength and stiffness values of the FERMACELL Gypsum-Fibreboard, which are to be used during design and calculation

Table 1: Characteristic strength and stiffness values of the "FERMACELL Gipsfaser-Platte", "FERMACELL Vapor" and "FERMACELL Gipsfaser-Platten greenline" in N/mm²

Type of stress		Thickness of boards in mm				
		10	**2,5**	**15**	**18**	**25**
Characteristic strength values						
Perpendicular to the plane of the board						
Bending	$f_{m,k}$	**4,6**	**4,3**	**4,0**	**3,6**	**3,0**
Shear	$f_{v,k}$	**1,9**	**1,8**	**1,7**	**1,6**	**1,4**
In plane of the board						
Bending	$f_{m,k}$	**4,3**	**4,2**	**4,1**	**4,0**	**3,8**
Tension	$f_{t,k}$	**2,5**	**2,4**	**2,4**	**2,3**	**2,1**
Compression	$f_{c,0,k}$	**8,5**				
	$f_{c,90,k}$	**7,3**				
Shear	$f_{v,k}$	**3,7**	**3,6**	**3,5**	**3,4**	**3,2**
Stiffness values						
Perpendicular to the plane of the board						
Modulus of elasticity	$E_{m,mean}$	**3800**				
Shear modulus		**1600**				
Compression Modulus of elasticity ⊥ to the plane	$E_{c,perp}$	**800**				
In plane of the board						
Bending, Tension, Compression Modulus of elasticity	$E_{m,t,c,mean}$	**3800**				
Shear modulus	G_{mean}	**1600**				
Value of density (in kg/m³)						
Density	ρ_k	**1150**				

Deutsches Institut für Bautechnik DIBt

Annex 2 (informative)

Describing notes for design and calculation

1. Design, calculation and execution of building components which are manufactured by using the present "FERMACELL Gipsfaser-Platte", "FERMACELL Vapor" and the "FERMACELL Gipsfaser-Platten greenline" can take place considering the table 1 in Annex 1 and the regulations in mark 3 according to EN 1995-1-1[8]. Additional national regulations are to be considered.

2. For this calculation the characteristic strength values and values of stiffness indicated in table 1 and the regulations in mark 3 are relevant.

3. As design data of the modification factor k_{mod} the following values are valid:

Class of load action duration	service class 1	service class 2
permanent	0,20	0,15
long	0,40	0,30
average	0,60	0,45
shortterm	0,80	0,60
verry short	1,10	0,80

As design data of the deformation parameter k_{def} the following values are valid:

Class of load action duration	service class 1	service class 2
permanent	3,0	4,0
long	2,0	2,5
average	1,0	1,25
shortterm	0,35	0,5

As partial safety factor of fibre gypsum boards γ_m = 1,3 is recommended, provided that the regulations applicable at the location of application do not specify another value.

The characteristic embedding strength of the face of the hole can be determined as follows:

$$f_{h,1,k} = 7 \cdot d^{-0,7} \cdot t^{0,9} \quad (N/mm^2)$$

with d = nominal diameter of the connector (mm)
t = thickness of board (mm)
(in the range of the TB-Kante is the reduced board thickness to set)

The characteristic value of the load-bearing capacity of connecting devices for each shear joint R_k can be determined for board thickness t ≥ 7d (within the range of the TB-Kante is the reduced board thickness to set) simplifying as follows:

$$R_k = 0.7 \cdot \sqrt{2 \cdot M_{y,k} \cdot f_{h,1,k} \cdot d} \quad (N)$$

with $M_{y,k}$ = characteristic value of the flow moment of the connecting device (Nmm).

If the board thickness t is smaller than 7d, R_k is to be reduced in the relationship t / 7d.

If the characteristic load-bearing capacity R_k will be determined for boards with TB-Kante, for staples connections with demand perpendicular to edge of the board the characteristic load-bearing capa city R_k is to reduce in the relationship 1.5 : d. For nailed connections the characteristic load-bearing capacity R_k is always to reduce in the relationship 2.5 : d by a thickness of the board $t \leq 12.5$ mm and a nail diameter $d > 2.5$ mm.

By one set connections with predominantly short actions on structures parallel to the edge of the gypsum fiber board the determined characteristic load-bearing capacity R_k can be increased by a share ΔR_k as follows:

$$\Delta R_k = \min\{0{,}5 \cdot R_k; 0{,}25 \cdot R_{ax,k}\}$$

For board thicknesses of 10 mm to 25 mm the characteristic values of head pull-through resistance $R_{ax,head,k}$ shown below apply.

1	2	3	4	5
Board thickness t	10 mm	12.5 mm	15 mm	18 mm - 25 mm
$R_{ax,head,k}$	500 N	900 N	1100 N	1300 N

As design data for the slip modulus of displacement for each shear joint K_{ser} of connecting devices can k_{ser} calculated as a function of the density in according EN 1995-1-1[8].

DECLARATION OF PERFORMANCE
No. 0020-0004-DoP-2013-06
Multilayer 13 mm parquet

1. Unique identification code of the product-type:
Rumba 13 mm, Tango 13 mm, Professional 13 mm, Bravo 13 mm

2. Type number allowing identification of the construction product
Rumba 13 mm, Tango 13 mm, Professional 13 mm, Bravo 13 mm

3. Intended use:
Wood floor covering for indoor application in accordance with the harmonised standard EN 14342:2005+A1 2008

4. Name and contact address of the manufacturer
Tarkett AB, SE-289 89 Hanaskog

5. Name and contact address of the authorised representative
Not applicable

6. Systems of assessment and verification of constancy of performance
System 3

7. Declaration of performance concerning a construction product covered by the harmonised standard EN 717-1:
The initial testing report n° *2713094* performed *2013-04-24* by test institute *Entwicklungs- und Prüflabor Holztechnologie GmbH, Dresden, Germany* according to system 3 regarding formaldehyde emissions.

8. Declaration of performance concerning a construction product for which a European Technical Assessment has been issued:
Not applicable

9. Declared performance:

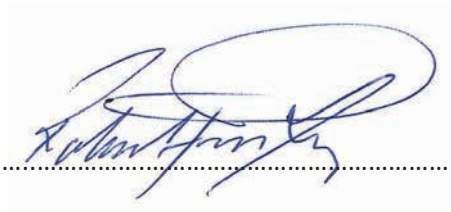
Essential characteristics	Performance	Harmonised technical specification
A – Reaction to fire	Dfl-s1	EN 14342 :2005+A1 2008
B - Formaldehyde emission	E1	
C - Content of pentachlorophenol	< 5ppm	
D – Breaking strength	NPD	
E - Slipperiness	NPD	
G – Thermal conductivity	0,11 W/m K	
H – Durability (Biological)	Class 1	

10. The performance of the product identified in points 1 and 2 is in conformity with the declared performance in point 9.
This declaration of performance is issued under the sole responsibility of the manufacturer identified in point 4.

Signed for and on behalf of the manufacturer by:

Robert Petersson, Director Product Marketing

Hanaskog, Sweden 2013-06-28



.....

BELGIAN CONSTRUCTION CERTIFICATION ASSOCIATION
BCCA
Stichters : WTCB en SECO

Aarlenstraat 53, B – 1040 BRUSSEL
Tel. : + 32 2 238 24 11 Fax. : +32 2 238 24 01

021 PROD

CERTIFICATE OF CONFORMITY

BENOR

BB – 651-673-1401 C1.D1-NL-ENK
BB – 651-673-1401 C2.D1-NL-ENK
BB – 651-673-1401 C3.D1-NL-ENK

BCCA certifies that:

PIPELIFE NEDERLAND B.V.
Flevolaan 7
NL – 1601 AJ ENKHUIZEN

takes the necessary measurements to realize that fittings of:

group of components 1, diameter group: D1
group of components 2, diameter group: D1
group of components 3, diameter group: D1

manufactured at the production site

PIPELIFE NEDERLAND B.V. Flevolaan 7 NL – 1601 AJ ENKHUIZEN

Fulfill the requirements determined by the standard NBN EN 1401

Plastics piping systems for non-pressure underground drainage and sewerage - Unplasticised poly(vinyl chloride) (PVC- U)

and the (PTV 1005)

This certificate is granted on the basis of the evaluation and approval of the initial type-testing (ITT) executed on samples taken at the above mentioned production site, on the basis of an initial inspection of the factory and the factory production control system (FPC).

BCCA confirms that the production is submitted by the manufacturer to a factory production control system and to further testing of samples taken at the factory in accordance with a prescribed test plan.
By means of periodical inspections of the test registers, audit testing and a yearly FPC system audit, BCCA supervises the production and the production control.

On basis of this certificate, the manufacturer is allowed to use the BENOR label to state the conformity of this product.

This authorization is effective from 1 mars 2008 and this certificate is valid until 1 mars 2011.

Done at Brussels, 29 February 2008.

B. De Blaere
Director

BELGIAN CONSTRUCTION CERTIFICATION ASSOCIATION
BCCA
Stichters : WTCB en SECO

Aarlenstraat 53, B – 1040 BRUSSEL
Tel. : + 32 2 238 24 11 Fax. : +32 2 238 24 01

021 PROD

CERTIFICATE OF CONFORMITY

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PIPELIFE NEDERLAND B.V.
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group of components 1, diameter group: D1
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group of components 3, diameter group: D1

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PIPELIFE NEDERLAND B.V. Flevolaan 7 NL – 1601 AJ ENKHUIZEN

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B. De Blaere
Director

NPV Corporation Rental Dwelling (Organizational Value Calculation)

Starting points

Discount Rate	5,25%
Management expenses	1.000
Taxes and insurances	300
Specific levys after 5 years	330
Tennant levy	0,231%

Investment	100.000
Financial gap	-38.435

Indexes	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	**Basis**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Rent	550	6.600	6.732	6.867	7.004	7.144	7.287	7.433	7.581	7.733	7.888	8.045	8.206	8.370	8.538	8.709	8.883
Maintenance costs	800	-800	-824	-849	-874	-900	-927	-955	-984	-1.013	-1.044	-1.075	-1.107	-1.141	-1.175	-1.210	-1.246
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104	-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346
Taxes and insurances	300	-300	-306	-312	-318	-325	-331	-338	-345	-351	-359	-366	-373	-380	-388	-396	-404
Landlord levy	231	-231	-236	-240	-245	-250	-255	-260	-265	-271	-276	-282	-287	-293	-299	-305	-311
Specific levys after 5 years	330	-330	330	-330	330	-330	330										
Rest value	5.000																
NPV 20 year 0,0%	**€ 61.565,39**		**4.676**	**4.095**	**4.835**	**4.256**	**4.999**	**4.753**	**4.839**	**4.926**	**5.014**	**5.104**	**5.195**	**5.288**	**5.382**	**5.478**	**5.576**
NPV 50 year	**€ 102.028,01**																

Total maintenance costs (discounted) 20 years	-12.970
Total maintenance costs (discounted) 50 years	-23.745

2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
9.060	9.242	9.426	9.615	9.807	10.003	10.203	10.408	10.616	10.828	11.045	11.265	11.491	11.721	11.955	12.194	12.438	12.687	12.940
-1.284	-1.322	-1.362	-1.403	-1.445	-1.488	-1.533	-1.579	-1.626	-1.675	-1.725	-1.777	-1.830	-1.885	-1.942	-2.000	-2.060	-2.122	-2.186
-1.373	-1.400	-1.428	-1.457	-1.486	-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961
-412	-420	-428	-437	-446	-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588
-317	-323	-330	-337	-343	-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453
5.675	**5.776**	**5.878**	**5.982**	**6.087**	**6.195**	**6.304**	**6.414**	**6.527**	**6.641**	**6.757**	**6.875**	**6.995**	**7.117**	**7.240**	**7.365**	**7.493**	**7.622**	**7.753**

2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
13.199	13.463	13.733	14.007	14.287	14.573	14.865	15.162	15.465	15.774	16.090	16.412	16.740	17.075	17.416	17.764
-2.251	-2.319	-2.388	-2.460	-2.534	-2.610	-2.688	-2.769	-2.852	-2.937	-3.025	-3.116	-3.210	-3.306	-3.405	-3.507
-2.000	-2.040	-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-600	-612	-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-462	-471	-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
7.886	**8.022**	**8.159**	**8.298**	**8.439**	**8.583**	**8.728**	**8.876**	**9.026**	**9.178**	**9.332**	**9.489**	**9.647**	**9.808**	**9.971**	**10.137**

Needed investment	€ 66.723,00	
Rent before refurbishment	€ 450,00	p/mnd
Energy before refurbishment	€ 200,00	p/mnd
% energy savings interference	80%	
% passing on to the tennant	100%	
Lifespan increase option 1	20	jaar
Lifespan increase option 2	50	jaar
Discount rate	4,00%	
Annual inflation	2,00%	
Current Market Value RE Object	€ 120.000,00	
Future Market Value RE Object	€ 138.000,00	

Resident	Before	After
Rent	450	610
Energy	200	40
Living costs	650	650

Corporation
Investment
Lifespan exter
Financial gap

F
F

Fi
Fi

Calculations

Indexes	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Price increase energy	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Corporation	**Basis**	**0**	**1**	**2**	**3**	**4**	**5**	**6**
NPV option 1	**30.896**	66.723-	1920,00	1958,40	1997,57	2037,52	2078,27	2119,84
NPV option 2	**59.641**	66.723-	1920,00	1958,40	1997,57	2037,52	2078,27	2119,84

Resident	**With sustainable refurbishment**	**Basis**	**0**	**1**	**2**	**3**	**4**	**5**	**6**

				450	610	622	635	647	660	673
				200	40	42	44	46	49	51
				650	650	664	679	694	709	725
Resident	**Without sustainable refurbishment**		**Basis**	**0**	**1**	**2**	**3**	**4**	**5**	**6**
				450	459	468	478	487	497	507
				200	210	221	232	243	255	268
				650	669	689	709	730	752	775
Difference in residents with or without sutainable refurbishment				**0**	**1**	**2**	**3**	**4**	**5**	**6**
				0,00	19,00	24,48	30,32	36,55	43,19	50,25
Annual production cost decrease				**0**	**1**	**2**	**3**	**4**	**5**	**6**
	Total NPV	13000			3000	4000	3000	2000	1000	500
Construction cost decrease				66723	63723	59723	56723	54723	53723	53223

Maintenance DCF Normal Situation

Discount Rate 4,00%

Indexes	2014	2015	2016	2017	2018	2019	2020
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	Basis	0	1	2	3	4	5	6
Rent	450	5.400	5.508	5.618	5.731	5.845	5.962	6.081
Maintenance costs	1.200	-1.200	-1.236	-1.273	-1.311	-1.351	-1.391	-1.433
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104	-1.126
Taxes and insurances	300	-300	-306	-312	-318	-325	-331	-338
Landlord levy	231	-231	-236	-240	-245	-250	-255	-260
Specific levys after 5 years	330	-330	330	-330	330	-330	330	
Rest value								
NPV 20 years	**€ 42.080,19**		**3.040**	**2.422**	**3.125**	**2.507**	**3.211**	**2.924**
NPV 50 years	**€ 75.526,29**							

Total maintenance costs 20 years			-22.037
Total maintenance costs 50 years			-46.687

Maintenance situation after upgrading to level 1

Discount Rate 4,00%

Indexes	2014	2015	2016	2017	2018	2019	2020
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	Basis	0	1	2	3	4	5	6
Rent	610	7.320	7.466	7.616	7.768	7.923	8.082	8.244
Maintenance costs	1.200	-300	-309	-318	-328	-338	-1.391	-358
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104	-1.126
Taxes and insurances	300	-300	-306	-312	-318	-325	-331	-338
Landlord levy	231	-231	-236	-240	-245	-250	-255	-260
Specific levys after 5 years	330	-330	330	-330	330	-330	330	
Rest value								
NPV 20 years	**€ 83.573,40**		**5.926**	**5.375**	**6.146**	**5.599**	**5.330**	**6.161**
NPV 50 years	**€ 152.680,26**							

Difference NPV after upgrade and before upgrade - 20 years	€ 41.493,21
Difference NPV after upgrade and before upgrade - 50 years	€ 77.153,98

Total maintenance costs 20 years		-11.576
Total maintenance costs 50 years		-30.129

Difference maintenance costs 20 years		-10.461
Difference maintenance costs 50 years		-16.558

Standard Maintenance, but with upgrade to level 1

Indexes		2014	2015	2016	2017	2018	2019	2020
Price inflation		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase		3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase		0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Organizational value	**Basis**	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Rent	610	7.320	7.466	7.616	7.768	7.923	8.082	8.244
Maintenance costs	1.200	-1.200	-1.236	-1.273	-1.311	-1.351	-1.391	-1.433
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104	-1.126
Taxes and insurances	300	-300	-306	-312	-318	-325	-331	-338
Landlord levy	231	-231	-236	-240	-245	-250	-255	-260
Specific levys after 5 years	330	-330	330	-330	330	-330	330	
Rest value								
NPV 20 years	**€ 73.594,08**		**4.999**	**4.420**	**5.162**	**4.586**	**5.330**	**5.086**
NPV 50 years	**€ 136.360,03**							

66.723

nsion	20	Lifespan extension 2	50
option 1	**-€ 35.827,03**	**Financial gap option 2**	**-€ 7.082,08**

inancial gap option 1 with maintenance included	**-€ 25.229,79**
inancial gap option 2 with maintenance included	**€ 10.430,98**

inancial gap option 2 with maintenance and value increase included	**-€ 7.229,79**
inancial gap option 2 with maintenance and value increase included	**€ 28.430,98**

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

7	8	9	10	11	12	13	14	15	16	17	18	19	20
2162,23	2205,48	2249,59	2294,58	2340,47	2387,28	2435,02	2483,72	2533,40	2584,07	2635,75	2688,46	2742,23	2797,08
2162,23	2205,48	2249,59	2294,58	2340,47	2387,28	2435,02	2483,72	2533,40	2584,07	2635,75	2688,46	2742,23	2797,08

7	8	9	10	11	12	13	14	15	16	17	18	19	20

687	701	715	729	744	758	774	789	805	821	837	854	871	889
54	56	59	62	65	68	72	75	79	83	87	92	96	101
741	757	774	791	809	827	845	865	884	904	925	946	967	990

7	8	9	10	11	12	13	14	15	16	17	18	19	20
517	527	538	549	560	571	582	594	606	618	630	643	656	669
281	295	310	326	342	359	377	396	416	437	458	481	505	531
798	823	848	874	902	930	959	990	1021	1054	1089	1124	1161	1199

7	8	9	10	11	12	13	14	15	16	17	18	19	20
57,77	65,76	74,25	83,27	92,84	103,01	113,79	125,23	137,35	150,19	163,80	178,21	193,46	209,60

7	8	9	10	11	12	13	14	15	16	17	18	19	20
0	-200	-500	-700	-1000	-1250								
53223	53423	53923	54623	55623	56873	58010,46	59170,67	60354,08	61561,16	62792,39	64048,24	65329,2	66635,78

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

7	8	9	10	11	12	13	14	15	16	17	18	19	20
6.203	6.327	6.453	6.583	6.714	6.849	6.985	7.125	7.268	7.413	7.561	7.713	7.867	8.024
-1.476	-1.520	-1.566	-1.613	-1.661	-1.711	-1.762	-1.815	-1.870	-1.926	-1.983	-2.043	-2.104	-2.167
-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486
-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437	-446
-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337	-343
2.968	**3.013**	**3.058**	**3.104**	**3.150**	**3.196**	**3.243**	**3.290**	**3.338**	**3.386**	**3.434**	**3.483**	**3.532**	**3.582**

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
7	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
8.408	8.577	8.748	8.923	9.101	9.284	9.469	9.659	9.852	10.049	10.250	10.455	10.664	10.877
-369	-380	-391	-1.613	-415	-428	-441	-454	-7.478	-481	-496	-511	-526	-2.167
-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486
-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437	-446
-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337	-343
6.281	**6.403**	**6.527**	**5.444**	**6.783**	**6.914**	**7.048**	**7.185**	**313**	**7.466**	**7.610**	**7.757**	**7.907**	**6.435**

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
7	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
8.408	8.577	8.748	8.923	9.101	9.284	9.469	9.659	9.852	10.049	10.250	10.455	10.664	10.877
-1.476	-1.520	-1.566	-1.613	-1.661	-1.711	-1.762	-1.815	-1.870	-1.926	-1.983	-2.043	-2.104	-2.167
-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486
-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437	-446
-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337	-343
5.174	**5.263**	**5.353**	**5.444**	**5.537**	**5.631**	**5.726**	**5.823**	**5.922**	**6.021**	**6.123**	**6.225**	**6.329**	**6.435**

2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**
2853,02	2910,08	2968,28	3027,65	3088,20	3149,96	3212,96	3277,22	3342,77	3409,62	3477,81	3547,37	3618,32	3690,68	3764,50
2853,02	2910,08	2968,28	3027,65	3088,20	3149,96	3212,96	3277,22	3342,77	3409,62	3477,81	3547,37	3618,32	3690,68	3764,50
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**

906	925	943	962	981	1001	1021	1041	1062	1083	1105	1127	1150	1173	1196
106	111	117	123	129	135	142	149	157	165	173	182	191	200	210
1013	1036	1060	1085	1110	1136	1163	1191	1219	1248	1278	1309	1340	1373	1406

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
682	696	710	724	738	753	768	783	799	815	831	848	865	882	900
557	585	614	645	677	711	747	784	823	864	908	953	1001	1051	1103
1239	1281	1324	1369	1416	1464	1515	1567	1622	1680	1739	1801	1866	1933	2003

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
226,68	244,75	263,85	284,05	305,39	327,95	351,78	376,95	403,53	431,59	461,21	492,48	525,47	560,29	597,01

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
67968,5	69327,87	70714,43	72128,72	73571,29	75042,72	76543,57	78074,44	79635,93	81228,65	82853,22	84510,29	86200,49	87924,5	89682,99

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2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
8.185	8.348	8.515	8.686	8.859	9.036	9.217	9.402	9.590	9.781	9.977	10.177	10.380	10.588	10.799
-2.232	-2.299	-2.368	-2.439	-2.513	-2.588	-2.666	-2.746	-2.828	-2.913	-3.000	-3.090	-3.183	-3.278	-3.377
-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000
-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600
-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462
3.632	**3.682**	**3.733**	**3.784**	**3.835**	**3.887**	**3.938**	**3.991**	**4.043**	**4.095**	**4.148**	**4.201**	**4.254**	**4.308**	**4.361**

2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
11.095	11.317	11.543	11.774	12.009	12.249	12.494	12.744	12.999	13.259	13.524	13.795	14.071	14.352	14.639
-558	-575	-592	-610	-12.513	-647	-666	-686	-707	-11.651	-750	-773	-796	-820	-6.753
-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000
-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600
-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462
8.216	**8.375**	**8.537**	**8.701**	**-3.015**	**9.040**	**9.215**	**9.392**	**9.573**	**-1.165**	**9.946**	**10.137**	**10.332**	**10.531**	**4.824**

2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
11.095	11.317	11.543	11.774	12.009	12.249	12.494	12.744	12.999	13.259	13.524	13.795	14.071	14.352	14.639
-2.232	-2.299	-2.368	-2.439	-2.513	-2.588	-2.666	-2.746	-2.828	-2.913	-3.000	-3.090	-3.183	-3.278	-3.377
-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000
-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600
-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462
6.542	**6.650**	**6.760**	**6.872**	**6.985**	**7.100**	**7.216**	**7.333**	**7.452**	**7.573**	**7.696**	**7.820**	**7.945**	**8.072**	**8.201**



2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
3839,79	3916,58	3994,92	4074,81	4156,31	4239,44	4324,22	4410,71	4498,92	4588,90	4680,68	4774,29	4869,78	4967,18	5066,52
3839,79	3916,58	3994,92	4074,81	4156,31	4239,44	4324,22	4410,71	4498,92	4588,90	4680,68	4774,29	4869,78	4967,18	5066,52

36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

1220	1244	1269	1295	1320	1347	1374	1401	1429	1458	1487	1517	1547	1578	1610
221	232	243	255	268	282	296	310	326	342	359	377	396	416	437
1441	1476	1512	1550	1589	1629	1670	1712	1755	1800	1846	1894	1943	1994	2047

36	37	38	39	40	41	42	43	4	45	46	47	48	49	50
918	936	955	974	994	1013	1034	1054	1076	1097	1119	1141	1164	1187	1211
1158	1216	1277	1341	1408	1478	1552	1630	1711	1797	1887	1981	2080	2184	2293
2076	2153	2232	2315	2402	2492	2586	2684	2787	2894	3006	3123	3244	3372	3505

36	37	38	39	40	41	42	43	4	45	46	47	48	49	50
635,74	676,59	719,66	765,06	812,93	863,38	916,56	972,59	1031,62	1093,82	1159,34	1228,35	1301,03	1377,57	1458,17

36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
91476,65	93306,18	95172,31	97075,75	99017,27	100997,6	103017,6	105077,9	107179,5	109323,1	111509,5	113739,7	116014,5	118334,8	120701,5

2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

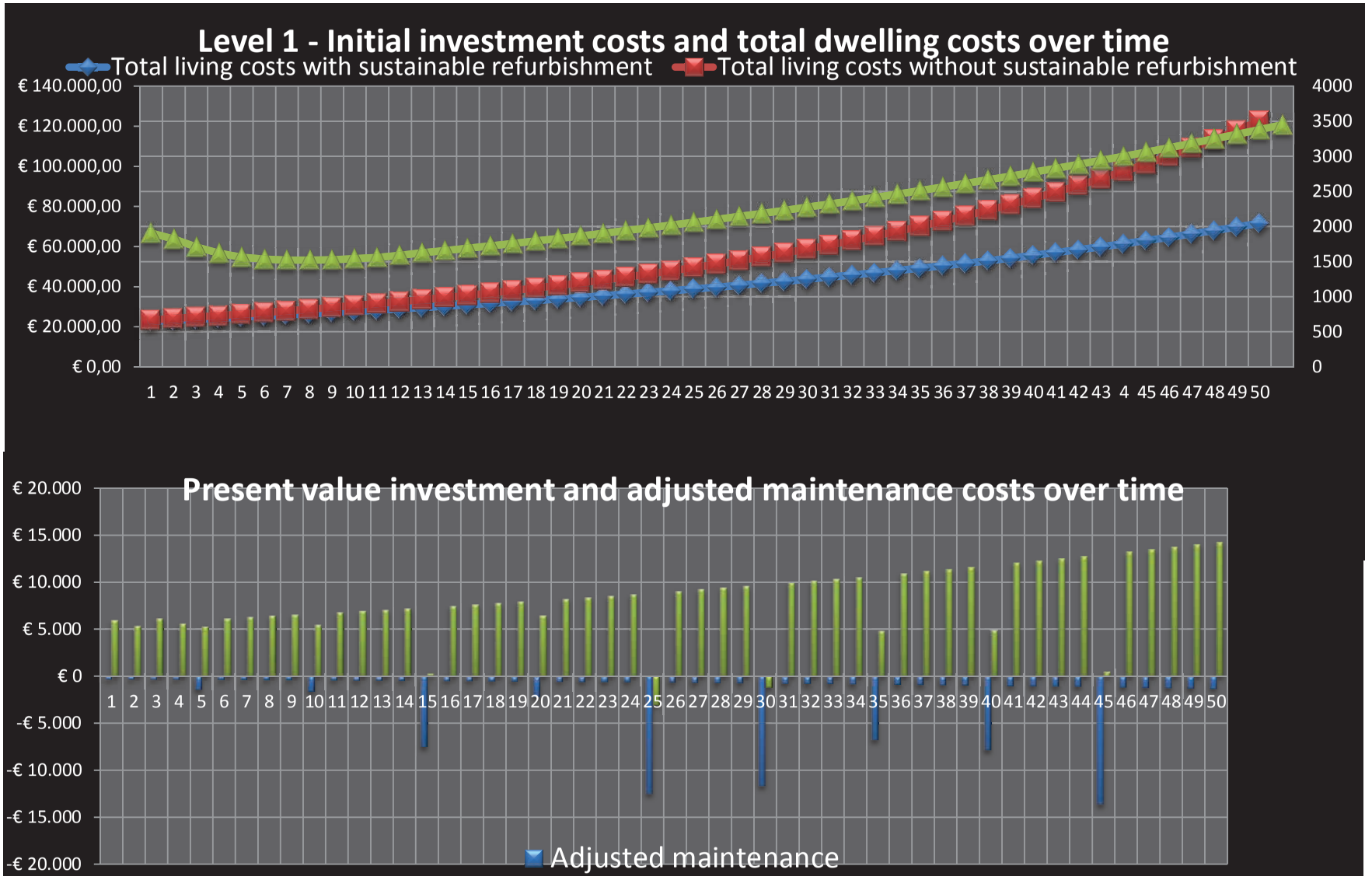
36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
11.015	11.236	11.460	11.690	11.923	12.162	12.405	12.653	12.906	13.164	13.428	13.696	13.970	14.250	14.535
-3.478	-3.582	-3.690	-3.800	-3.914	-4.032	-4.153	-4.277	-4.406	-4.538	-4.674	-4.814	-4.959	-5.107	-5.261
-2.040	-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-612	-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-471	-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
4.414	**4.468**	**4.521**	**4.575**	**4.628**	**4.682**	**4.735**	**4.788**	**4.841**	**4.894**	**4.947**	**4.999**	**5.051**	**5.102**	**5.153**

2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
14.932	15.231	15.535	15.846	16.163	16.486	16.816	17.152	17.495	17.845	18.202	18.566	18.937	19.316	19.702
-869	-896	-922	-950	-7.829	-1.008	-1.038	-1.069	-1.101	-13.614	-1.169	-1.204	-1.240	-1.277	-1.315
-2.040	-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-612	-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-471	-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
10.939	**11.150**	**11.364**	**11.582**	**4.953**	**12.030**	**12.261**	**12.495**	**12.735**	**499**	**13.226**	**13.479**	**13.737**	**13.999**	**14.266**

2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
14.932	15.231	15.535	15.846	16.163	16.486	16.816	17.152	17.495	17.845	18.202	18.566	18.937	19.316	19.702
-3.478	-3.582	-3.690	-3.800	-3.914	-4.032	-4.153	-4.277	-4.406	-4.538	-4.674	-4.814	-4.959	-5.107	-5.261
-2.040	-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-612	-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-471	-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
8.331	**8.463**	**8.596**	**8.731**	**8.868**	**9.006**	**9.146**	**9.287**	**9.430**	**9.575**	**9.721**	**9.869**	**10.018**	**10.169**	**10.321**


Level 1 - Initial investment costs and total dwelling costs over time
Total living costs with sustainable refurbishment
Total living costs without sustainable refurbishment
€ 140.000,00
€ 120.000,00
€ 100.000,00
€ 80.000,00
€ 60.000,00
€ 40.000,00
€ 20.000,00
€ 0,00
4000
3500
3000
2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 4 45 46 47 48 49 50
Present value investment and adjusted maintenance costs over time
€ 20.000
€ 15.000
€ 10.000
€ 5.000
€ 0
-€ 5.000
-€ 10.000
-€ 15.000
-€ 20.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Adjusted maintenance

Needed investment	€ 66.723,00	
Rent before refurbishment	€ 450,00	p/mnd
Energy before refurbishment	€ 200,00	p/mnd
% energy savings interference	80%	
% passing on to the tennant	100%	
Lifespan increase option 1	20	jaar
Lifespan increase option 2	50	jaar
Discount rate	4,00%	
Annual inflation	2,00%	
Current Market Value RE Object	€ 120.000,00	
Future Market Value RE Object	€ 138.000,00	

Resident	Before	After
Rent	450	610
Energy	200	40
Living costs	650	650

Calculations

Indexes	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Price increase energy	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Corporation	**Basis**	**0**	**1**	**2**	**3**	**4**	**5**
NPV option 1	**30.896**	66.723-	1920,00	1958,40	1997,57	2037,52	2078,27
NPV option 2	**59.641**	66.723-	1920,00	1958,40	1997,57	2037,52	2078,27

Resident	**With sustainable refurbishment**	**Basis**	**0**	**1**	**2**	**3**	**4**	**5**
			450	610	622	635	647	660
			200	40	42	44	46	49

				650	650	664	679	694	709
Resident	**Without sustainable refurbishment**		**Basis**	**0**	**1**	**2**	**3**	**4**	**5**
				450	459	468	478	487	497
				200	210	221	232	243	255
				650	669	689	709	730	752
Difference in residents with or without sutainable refurbishment				**0**	**1**	**2**	**3**	**4**	**5**
				0,00	19,00	24,48	30,32	36,55	43,19
Annual production cost decrease				**0**	**1**	**2**	**3**	**4**	**5**
	Total NPV	13000			3000	4000	3000	2000	1000
Construction cost decrease				66723	63723	59723	56723	54723	53723

Discount Rate	4,00%

Indexes	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	**Basis**	**0**	**1**	**2**	**3**	**4**	**5**
Rent	450	5.400	5.508	5.618	5.731	5.845	5.962
Maintenance costs	1.200	-1.200	-1.236	-1.273	-1.311	-1.351	-1.391
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104
Taxes and insurances	300	-300	-306	-312	-318	-325	-331
Landlord levy	231	-231	-236	-240	-245	-250	-255
Specific levys after 5 years	330	-330	330	-330	330	-330	330
Rest value							
NPV 20 years	**€ 42.080,19**		**3.040**	**2.422**	**3.125**	**2.507**	**3.211**
NPV 50 years	**€ 75.526,29**						

Total maintenance costs 20 years			-22.037
Total maintenance costs 50 years			-46.687

Maintenance situation after upgrading to level 1

Discount Rate 4,00%

Indexes	2014	2015	2016	2017	2018	2019
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	Basis	0	1	2	3	4	5
Rent	610	7.320	7.466	7.616	7.768	7.923	8.082
Maintenance costs	1.200	-300	-309	-318	-328	-338	-1.391
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104
Taxes and insurances	300	-300	-306	-312	-318	-325	-331
Landlord levy	231	-231	-236	-240	-245	-250	-255
Specific levys after 5 years	330	-330	330	-330	330	-330	330
Rest value							
NPV 20 years	**€ 83.573,40**		**5.926**	**5.375**	**6.146**	**5.599**	**5.330**
NPV 50 years	**€ 152.680,26**						

Difference NPV after upgrade and before upgrade - 20 years	€ 41.493,21
Difference NPV after upgrade and before upgrade - 50 years	€ 77.153,98

Total maintenance costs 20 years		-11.576
Total maintenance costs 50 years		-30.129

Difference maintenance costs 20 years		-10.461
Difference maintenance costs 50 years		-16.558

Standard Maintenance, but with upgrade to level 1

Indexes		2014	2015	2016	2017	2018	2019
Price inflation		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase		3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase		0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase		2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Organizational value	**Basis**	**0**	**1**	**2**	**3**	**4**	**5**
Rent	610	7.320	7.466	7.616	7.768	7.923	8.082
Maintenance costs	1.200	-1.200	-1.236	-1.273	-1.311	-1.351	-1.391
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104
Taxes and insurances	300	-300	-306	-312	-318	-325	-331
Landlord levy	231	-231	-236	-240	-245	-250	-255
Specific levys after 5 years	330	-330	330	-330	330	-330	330
Rest value							
NPV 20 years	**€ 73.594,08**		**4.999**	**4.420**	**5.162**	**4.586**	**5.330**
NPV 50 years	**€ 136.360,03**						

Corporation				
Investment	66.723			
Lifespan extension		20	Lifespan extension 2	50
Financial gap option 1		**-€ 35.827,03**	**Financial gap option 2**	**-€ 7.082,08**

Financial gap option 1 with maintenance included	**-€ 25.229,79**
Financial gap option 2 with maintenance included	**€ 10.430,98**

Financial gap option 2 with maintenance and value increase included	**-€ 7.229,79**
Financial gap option 2 with maintenance and value increase included	**€ 28.430,98**

2020	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
2119,84	2162,23	2205,48	2249,59	2294,58	2340,47	2387,28	2435,02	2483,72	2533,40	2584,07	2635,75	2688,46	2742,23	2797,08
2119,84	2162,23	2205,48	2249,59	2294,58	2340,47	2387,28	2435,02	2483,72	2533,40	2584,07	2635,75	2688,46	2742,23	2797,08

6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
673	687	701	715	729	744	758	774	789	805	821	837	854	871	889
51	54	56	59	62	65	68	72	75	79	83	87	92	96	101

725	741	757	774	791	809	827	845	865	884	904	925	946	967	990

6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
507	517	527	538	549	560	571	582	594	606	618	630	643	656	669
268	281	295	310	326	342	359	377	396	416	437	458	481	505	531
775	798	823	848	874	902	930	959	990	1021	1054	1089	1124	1161	1199

6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
50,25	57,77	65,76	74,25	83,27	92,84	103,01	113,79	125,23	137,35	150,19	163,80	178,21	193,46	209,60

6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
500	0	-200	-500	-700	-1000	-1250								
53223	53223	53423	53923	54623	55623	56873	58010,46	59170,67	60354,08	61561,16	62792,39	64048,24	65329,2	66635,78

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
6.081	6.203	6.327	6.453	6.583	6.714	6.849	6.985	7.125	7.268	7.413	7.561	7.713	7.867	8.024
-1.433	-1.476	-1.520	-1.566	-1.613	-1.661	-1.711	-1.762	-1.815	-1.870	-1.926	-1.983	-2.043	-2.104	-2.167
-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486
-338	-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437	-446
-260	-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337	-343
2.924	**2.968**	**3.013**	**3.058**	**3.104**	**3.150**	**3.196**	**3.243**	**3.290**	**3.338**	**3.386**	**3.434**	**3.483**	**3.532**	**3.582**

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
8.244	8.408	8.577	8.748	8.923	9.101	9.284	9.469	9.659	9.852	10.049	10.250	10.455	10.664	10.877
-358	-369	-380	-391	-1.613	-415	-428	-441	-454	-7.478	-481	-496	-511	-526	-2.167
-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486
-338	-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437	-446
-260	-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337	-343
6.161	**6.281**	**6.403**	**6.527**	**5.444**	**6.783**	**6.914**	**7.048**	**7.185**	**313**	**7.466**	**7.610**	**7.757**	**7.907**	**6.435**

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
8.244	8.408	8.577	8.748	8.923	9.101	9.284	9.469	9.659	9.852	10.049	10.250	10.455	10.664	10.877
-1.433	-1.476	-1.520	-1.566	-1.613	-1.661	-1.711	-1.762	-1.815	-1.870	-1.926	-1.983	-2.043	-2.104	-2.167
-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486
-338	-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437	-446
-260	-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337	-343
5.086	**5.174**	**5.263**	**5.353**	**5.444**	**5.537**	**5.631**	**5.726**	**5.823**	**5.922**	**6.021**	**6.123**	**6.225**	**6.329**	**6.435**

2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
2853,02	2910,08	2968,28	3027,65	3088,20	3149,96	3212,96	3277,22	3342,77	3409,62	3477,81	3547,37	3618,32	3690,68	3764,50	3839,79
2853,02	2910,08	2968,28	3027,65	3088,20	3149,96	3212,96	3277,22	3342,77	3409,62	3477,81	3547,37	3618,32	3690,68	3764,50	3839,79

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
906	925	943	962	981	1001	1021	1041	1062	1083	1105	1127	1150	1173	1196	1220
106	111	117	123	129	135	142	149	157	165	173	182	191	200	210	221

1013	1036	1060	1085	1110	1136	1163	1191	1219	1248	1278	1309	1340	1373	1406	1441

21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**
682	696	710	724	738	753	768	783	799	815	831	848	865	882	900	918
557	585	614	645	677	711	747	784	823	864	908	953	1001	1051	1103	1158
1239	1281	1324	1369	1416	1464	1515	1567	1622	1680	1739	1801	1866	1933	2003	2076

21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**
226,68	244,75	263,85	284,05	305,39	327,95	351,78	376,95	403,53	431,59	461,21	492,48	525,47	560,29	597,01	635,74

21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**
67968,5	69327,87	70714,43	72128,72	73571,29	75042,72	76543,57	78074,44	79635,93	81228,65	82853,22	84510,29	86200,49	87924,5	89682,99	91476,65

2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
8.185	8.348	8.515	8.686	8.859	9.036	9.217	9.402	9.590	9.781	9.977	10.177	10.380	10.588	10.799	11.015
-2.232	-2.299	-2.368	-2.439	-2.513	-2.588	-2.666	-2.746	-2.828	-2.913	-3.000	-3.090	-3.183	-3.278	-3.377	-3.478
-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000	-2.040
-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600	-612
-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462	-471
3.632	**3.682**	**3.733**	**3.784**	**3.835**	**3.887**	**3.938**	**3.991**	**4.043**	**4.095**	**4.148**	**4.201**	**4.254**	**4.308**	**4.361**	**4.414**

2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
11.095	11.317	11.543	11.774	12.009	12.249	12.494	12.744	12.999	13.259	13.524	13.795	14.071	14.352	14.639	14.932
-558	-575	-592	-610	-12.513	-647	-666	-686	-707	-11.651	-750	-773	-796	-820	-6.753	-869
-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000	-2.040
-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600	-612
-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462	-471
8.216	**8.375**	**8.537**	**8.701**	**-3.015**	**9.040**	**9.215**	**9.392**	**9.573**	**-1.165**	**9.946**	**10.137**	**10.332**	**10.531**	**4.824**	**10.939**

2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
11.095	11.317	11.543	11.774	12.009	12.249	12.494	12.744	12.999	13.259	13.524	13.795	14.071	14.352	14.639	14.932
-2.232	-2.299	-2.368	-2.439	-2.513	-2.588	-2.666	-2.746	-2.828	-2.913	-3.000	-3.090	-3.183	-3.278	-3.377	-3.478
-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000	-2.040
-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600	-612
-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462	-471
6.542	**6.650**	**6.760**	**6.872**	**6.985**	**7.100**	**7.216**	**7.333**	**7.452**	**7.573**	**7.696**	**7.820**	**7.945**	**8.072**	**8.201**	**8.331**

2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

37	38	39	40	41	42	43	44	45	46	47	48	49	50
3916,58	3994,92	4074,81	4156,31	4239,44	4324,22	4410,71	4498,92	4588,90	4680,68	4774,29	4869,78	4967,18	5066,52
3916,58	3994,92	4074,81	4156,31	4239,44	4324,22	4410,71	4498,92	4588,90	4680,68	4774,29	4869,78	4967,18	5066,52

37	38	39	40	41	42	43	44	45	46	47	48	49	50

1476	1512	1550	1589	1629	1670	1712	1755	1800	1846	1894	1943	1994	2047

37	**38**	**39**	**40**	**41**	**42**	**43**	**4**	**45**	**46**	**47**	**48**	**49**	**50**
936	955	974	994	1013	1034	1054	1076	1097	1119	1141	1164	1187	1211
1216	1277	1341	1408	1478	1552	1630	1711	1797	1887	1981	2080	2184	2293
2153	2232	2315	2402	2492	2586	2684	2787	2894	3006	3123	3244	3372	3505

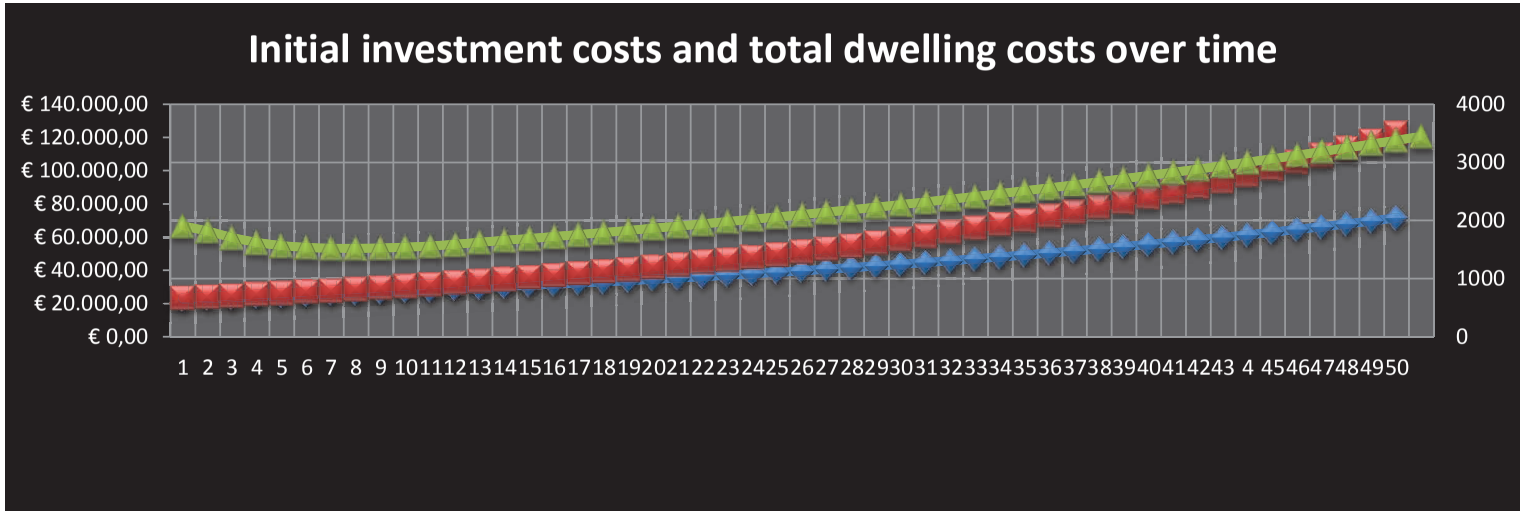
37	**38**	**39**	**40**	**41**	**42**	**43**	**4**	**45**	**46**	**47**	**48**	**49**	**50**
676,59	719,66	765,06	812,93	863,38	916,56	972,59	1031,62	1093,82	1159,34	1228,35	1301,03	1377,57	1458,17

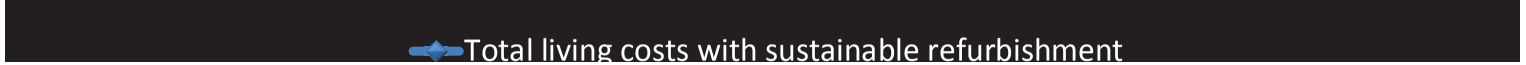
37	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
93306,18	95172,31	97075,75	99017,27	100997,6	103017,6	105077,9	107179,5	109323,1	111509,5	113739,7	116014,5	118334,8	120701,5

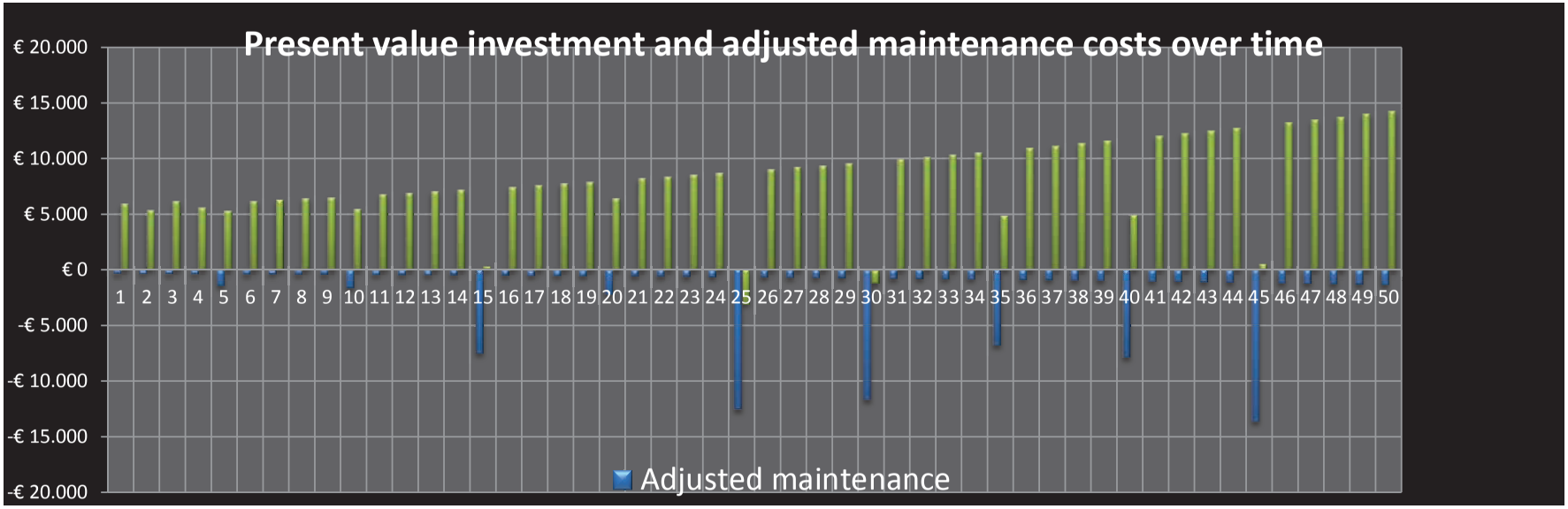
2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
37	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
11.236	11.460	11.690	11.923	12.162	12.405	12.653	12.906	13.164	13.428	13.696	13.970	14.250	14.535
-3.582	-3.690	-3.800	-3.914	-4.032	-4.153	-4.277	-4.406	-4.538	-4.674	-4.814	-4.959	-5.107	-5.261
-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
4.468	**4.521**	**4.575**	**4.628**	**4.682**	**4.735**	**4.788**	**4.841**	**4.894**	**4.947**	**4.999**	**5.051**	**5.102**	**5.153**

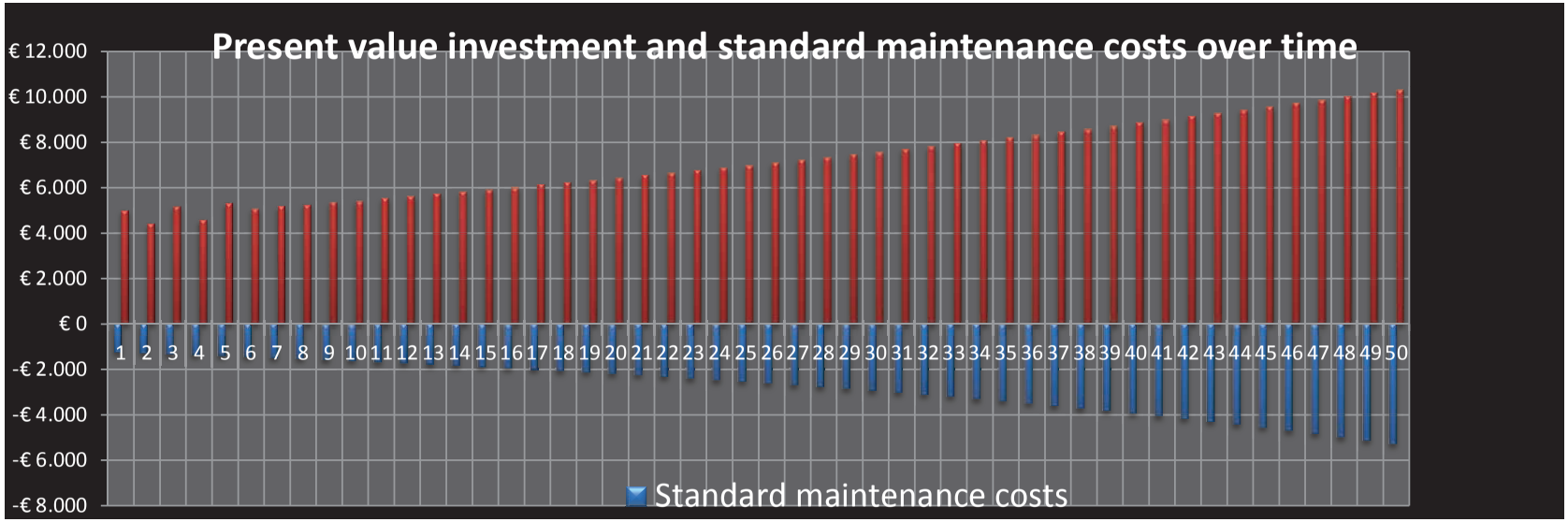
2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
37	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
15.231	15.535	15.846	16.163	16.486	16.816	17.152	17.495	17.845	18.202	18.566	18.937	19.316	19.702
-896	-922	-950	-7.829	-1.008	-1.038	-1.069	-1.101	-13.614	-1.169	-1.204	-1.240	-1.277	-1.315
-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
11.150	**11.364**	**11.582**	**4.953**	**12.030**	**12.261**	**12.495**	**12.735**	**499**	**13.226**	**13.479**	**13.737**	**13.999**	**14.266**

2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
37	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
15.231	15.535	15.846	16.163	16.486	16.816	17.152	17.495	17.845	18.202	18.566	18.937	19.316	19.702
-3.582	-3.690	-3.800	-3.914	-4.032	-4.153	-4.277	-4.406	-4.538	-4.674	-4.814	-4.959	-5.107	-5.261
-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
8.463	**8.596**	**8.731**	**8.868**	**9.006**	**9.146**	**9.287**	**9.430**	**9.575**	**9.721**	**9.869**	**10.018**	**10.169**	**10.321**


Initial investment costs and total dwelling costs over time
€ 140.000,00
€ 120.000,00
€ 100.000,00
€ 80.000,00
€ 60.000,00
€ 40.000,00
€ 20.000,00
€ 0,00
4000
3000
2000
1000
0
1 2 3 4 5 6 7 8 9 10111213141516171819202122232425262728293031323334353637383940414243 4 454647484950


Total living costs with sustainable refurbishment


Present value investment and adjusted maintenance costs over time
€ 20.000
€ 15.000
€ 10.000
€ 5.000
€ 0
-€ 5.000
-€ 10.000
-€ 15.000
-€ 20.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Adjusted maintenance


Present value investment and standard maintenance costs over time
€ 12.000
€ 10.000
€ 8.000
€ 6.000
€ 4.000
€ 2.000
€ 0
-€ 2.000
-€ 4.000
-€ 6.000
-€ 8.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Standard maintenance costs

Needed investment	€ 146.000,00	
Rent before refurbishment	€ 450,00	p/mnd
Energy before refurbishment	€ 200,00	p/mnd
% energy savings interference	111%	
% passing on to the tennant	100%	
Lifespan increase option 1	20	year
Lifespan increase option 2	50	year
Discount rate	4,00%	
Annual inflation	2,00%	
Current Market Value RE Object	€ 120.000,00	
Future Market Value RE Object	€ 150.000,00	

Resident	Before	After
Rent	450	672
Energy	200	-22
Living costs	650	650

Corporation
Investment
Lifespan exte
Financial gap

Fin
Fin

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Finar

Calculations

Indexes	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Price increase energy	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Corporation	**Basis**	**0**	**1**	**2**	**3**	**4**	**5**	**6**
NPV option 1	**42.868**	146.000-	2664	2.717	2.772	2.827	2.884	2.941
NPV option 2	**82.752**	146.000-	2.664	2.717	2.772	2.827	2.884	2.941

Resident	With sustainable refurbishment		Basis	0	1	2	3	4	5	6
				450	672	685	699	713	727	742
				200	-22	-23,1	-24	-25	-27	-28
				650	650	662	675	688	701	714

Resident	Without sustainable refurbishment		Basis	0	1	2	3	4	5	6
				450	459	468	478	487	497	507
				200	210	221	232	243	255	268
				650	669	689	709	730	752	775

Difference in residents with or without sutainable refurbishment			0	1	2	3	4	5	6
			0,00	19,00	26,34	34,17	42,53	51,44	60,93

Annual production cost decrease		0	1	2	3	4	5	6
Total NPV	28000		6000	8000	6000	5000	3000	1500
Construction cost decrease		146000	140000	132000	126000	121000	118000	116500

Maintenance DCF Normal Situation

Discount Rate 4,00%

Indexes	2014	2015	2016	2017	2018	2019	2020
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	Basis	0	1	2	3	4	5	6
Rent	450	5.400	5.508	5.618	5.731	5.845	5.962	6.081
Maintenance costs	1.200	-1.200	-1.236	-1.273	-1.311	-1.351	-1.391	-1.433
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104	-1.126
Taxes and insurances	300	-300	-306	-312	-318	-325	-331	-338
Landlord levy	231	-231	-236	-240	-245	-250	-255	-260
Specific levys after 5 years	330	-330	330	-330	330	-330	330	
Rest value								
NPV 20 years	**€ 42.080,19**		**3.040**	**2.422**	**3.125**	**2.507**	**3.211**	**2.924**
NPV 50 years	**€ 75.526,29**							

Total maintenance costs 20 years			-22.037
Total maintenance costs 50 years			-46.687

Maintenance situation after upgrading to level 2

Discount Rate 4,00%

Indexes	2014	2015	2016	2017	2018	2019	2020
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	Basis	0	1	2	3	4	5	6
Rent	672	8.064	8.225	8.390	8.558	8.729	8.903	9.081
Maintenance costs	1.200	-200	-206	-212	-219	-225	-1.391	-358
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104	-1.126
Taxes and insurances	300	-300	-306	-312	-318	-325	-331	-338
Landlord levy	231	-231	-236	-240	-245	-250	-255	-260
Specific levys after 5 years	330	-330	330	-330	330	-330	330	
Rest value								
NPV 20 years	**€ 96.175,51**		**6.788**	**6.255**	**7.044**	**6.516**	**6.152**	**6.999**
NPV 50 years	**€ 176.643,82**							

Difference NPV after upgrade and before upgrade - 20 years	€ 54.095,32
Difference NPV after upgrade and before upgrade - 50 years	€ 101.117,53

Total maintenance costs 20 years	-11.104
Total maintenance costs 50 years	-29.658

Difference maintenance costs 20 years	-10.933
Difference maintenance costs 50 years	-17.030

Standard maintenance after upgrading to level 2

Discount Rate 4,00%

Indexes	2014	2015	2016	2017	2018	2019	2020
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	Basis	0	1	2	3	4	5	6
Rent	672	8.064	8.225	8.390	8.558	8.729	8.903	9.081
Maintenance costs	1.200	-1.200	-1.236	-1.273	-1.311	-1.351	-1.391	-1.433
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104	-1.126
Taxes and insurances	300	-300	-306	-312	-318	-325	-331	-338
Landlord levy	231	-231	-236	-240	-245	-250	-255	-260
Specific levys after 5 years	330	-330	330	-330	330	-330	330	
Rest value								
NPV 20 years	**€ 85.805,71**		**5.758**	**5.194**	**5.952**	**5.391**	**6.152**	**5.924**
NPV 50 years	**€ 159.933,10**							

146.000	

nsion	20	Lifespan extension 2	50
option 1	**-€ 103.131,84**	**Financial gap option 2**	**-€ 63.248,22**

ancial gap option 1 with maintenance included	**-€ 91.904,68**
ancial gap option 2 with maintenance included	**-€ 44.882,47**

ncial gap option 1 with maintenance and value increase included	**-€ 61.904,68**
ncial gap option 2 with maintenance and value increase included	**-€ 14.882,47**

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
3.000	3.060	3.121	3.184	3.247	3.312	3.379	3.446	3.515	3.585	3.657	3.730	3.805	3.881	3.959
3.000	3.060	3.121	3.184	3.247	3.312	3.379	3.446	3.515	3.585	3.657	3.730	3.805	3.881	3.959

103292,606

7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
757	772	787	803	819	836	852	869	887	904	923	941	960	979	999
-29	-31	-33	-34	-36	-38	-40	-41	-44	-46	-48	-50	-53	-56	-58
727	741	755	769	783	798	813	828	843	859	874	891	907	923	940

7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
517	527	538	549	560	571	582	594	606	618	630	643	656	669	682
281	295	310	326	342	359	377	396	416	437	458	481	505	531	557
798	823	848	874	902	930	959	990	1021	1054	1089	1124	1161	1199	1239

7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
71,03	81,78	93,21	105,35	118,26	131,96	146,50	161,93	178,30	195,64	214,02	233,50	254,12	275,95	299,06

7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
500	-400	-1000	-1400	-2000	-2500									
116000	116400	117400	118800	120800	123300	125766	128281,3	130846,9	133463,9	136133,2	138855,8	141632,9	144465,6	147354,9

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
7	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
6.203	6.327	6.453	6.583	6.714	6.849	6.985	7.125	7.268	7.413	7.561	7.713	7.867	8.024	8.185
-1.476	-1.520	-1.566	-1.613	-1.661	-1.711	-1.762	-1.815	-1.870	-1.926	-1.983	-2.043	-2.104	-2.167	-2.232
-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486	-1.516
-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437	-446	-455
-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337	-343	-350
2.968	**3.013**	**3.058**	**3.104**	**3.150**	**3.196**	**3.243**	**3.290**	**3.338**	**3.386**	**3.434**	**3.483**	**3.532**	**3.582**	**3.632**

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
7	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
9.263	9.448	9.637	9.830	10.027	10.227	10.432	10.640	10.853	11.070	11.292	11.517	11.748	11.983	12.222
-369	-380	-391	-1.613	-415	-428	-441	-454	-7.478	-481	-496	-511	-526	-2.167	-558
-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486	-1.516
-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437	-446	-455
-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337	-343	-350
7.135	**7.274**	**7.416**	**6.351**	**7.708**	**7.858**	**8.011**	**8.166**	**1.314**	**8.487**	**8.652**	**8.820**	**8.991**	**7.540**	**9.344**

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
9.263	9.448	9.637	9.830	10.027	10.227	10.432	10.640	10.853	11.070	11.292	11.517	11.748	11.983	12.222
-1.476	-1.520	-1.566	-1.613	-1.661	-1.711	-1.762	-1.815	-1.870	-1.926	-1.983	-2.043	-2.104	-2.167	-2.232
-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486	-1.516
-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437	-446	-455
-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337	-343	-350
6.029	**6.134**	**6.242**	**6.351**	**6.462**	**6.575**	**6.689**	**6.805**	**6.923**	**7.043**	**7.164**	**7.288**	**7.413**	**7.540**	**7.669**

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
4.038	4.118	4.201	4.285	4.371	4.458	4.547	4.638	4.731	4.825	4.922	5.020	5.121	5.223	5.328	5.434
4.038	4.118	4.201	4.285	4.371	4.458	4.547	4.638	4.731	4.825	4.922	5.020	5.121	5.223	5.328	5.434

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
1019	1039	1060	1081	1102	1125	1147	1170	1193	1217	1242	1266	1292	1318	1344	1371
-61	-64	-68	-71	-74	-78	-82	-86	-91	-95	-100	-105	-110	-116	-121	-127
957	975	992	1010	1028	1046	1065	1084	1103	1122	1142	1162	1182	1202	1223	1243

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
696	710	724	738	753	768	783,4609	799	815	831	848	865	882	900	918	936
585	614	645	677	711	747	784,0258	823	864	908	953	1001	1051	1103	1158	1216
1281	1324	1369	1416	1464	1515	1567	1622	1680	1739	1801	1866	1933	2003	2076	2153

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
323,51	349,37	376,71	405,63	436,19	468,48	502,60	538,63	576,69	616,87	659,29	704,06	751,30	801,15	853,74	909,21

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
150302	153308,1	156374,2	159501,7	162691,7	165945,6	169264,5	172649,8	176102,8	179624,8	183217,3	186881,7	190619,3	194431,7	198320,3	202286,7

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
8.348	8.515	8.686	8.859	9.036	9.217	9.402	9.590	9.781	9.977	10.177	10.380	10.588	10.799	11.015	11.236
-2.299	-2.368	-2.439	-2.513	-2.588	-2.666	-2.746	-2.828	-2.913	-3.000	-3.090	-3.183	-3.278	-3.377	-3.478	-3.582
-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000	-2.040	-2.081
-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600	-612	-624
-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462	-471	-481
3.682	**3.733**	**3.784**	**3.835**	**3.887**	**3.938**	**3.991**	**4.043**	**4.095**	**4.148**	**4.201**	**4.254**	**4.308**	**4.361**	**4.414**	**4.468**

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
12.467	12.716	12.970	13.230	13.494	13.764	14.040	14.320	14.607	14.899	15.197	15.501	15.811	16.127	16.450	16.779
-575	-592	-610	-12.513	-647	-666	-686	-707	-11.651	-750	-773	-796	-820	-6.753	-869	-896
-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000	-2.040	-2.081
-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600	-612	-624
-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462	-471	-481
9.525	**9.710**	**9.898**	**-1.794**	**10.285**	**10.485**	**10.688**	**10.895**	**183**	**11.320**	**11.539**	**11.762**	**11.990**	**6.312**	**12.457**	**12.698**

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
12.467	12.716	12.970	13.230	13.494	13.764	14.040	14.320	14.607	14.899	15.197	15.501	15.811	16.127	16.450	16.779
-2.299	-2.368	-2.439	-2.513	-2.588	-2.666	-2.746	-2.828	-2.913	-3.000	-3.090	-3.183	-3.278	-3.377	-3.478	-3.582
-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000	-2.040	-2.081
-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600	-612	-624
-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462	-471	-481
7.801	**7.934**	**8.069**	**8.206**	**8.345**	**8.486**	**8.629**	**8.774**	**8.921**	**9.070**	**9.222**	**9.375**	**9.531**	**9.689**	**9.849**	**10.011**

2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

38	39	40	41	42	43	44	45	46	47	48	49	50
5.543	5.654	5.767	5.882	6.000	6.120	6.242	6.367	6.494	6.624	6.757	6.892	7.030
5.543	5.654	5.767	5.882	6.000	6.120	6.242	6.367	6.494	6.624	6.757	6.892	7.030

38	39	40	41	42	43	44	45	46	47	48	49	50
1398	1426	1455	1484	1513	1544	1575	1606	1638	1671	1704	1739	1773
-134	-140	-148	-155	-163	-171	-179	-188	-198	-208	-218	-229	-240
1264	1286	1307	1329	1351	1373	1395	1418	1441	1463	1486	1510	1533

38	39	40	41	42	43	4	45	46	47	48	49	50
955	974	994	1013	1034	1054	1076	1097	1119	1141	1164	1187	1211
1277	1341	1408	1478	1552	1630	1711	1797	1887	1981	2080	2184	2293
2232	2315	2402	2492	2586	2684	2787	2894	3006	3123	3244	3372	3505

38	39	40	41	42	43	4	45	46	47	48	49	50
967,70	1029,38	1094,41	1162,96	1235,22	1311,38	1391,62	1476,18	1565,26	1659,10	1757,94	1862,05	1971,68

38	39	40	41	42	43	44	45	46	47	48	49	50
206332,5	210459,1	214668,3	218961,7	223340,9	227807,7	232363,9	237011,1	241751,4	246586,4	251518,1	256548,5	261679,4

2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

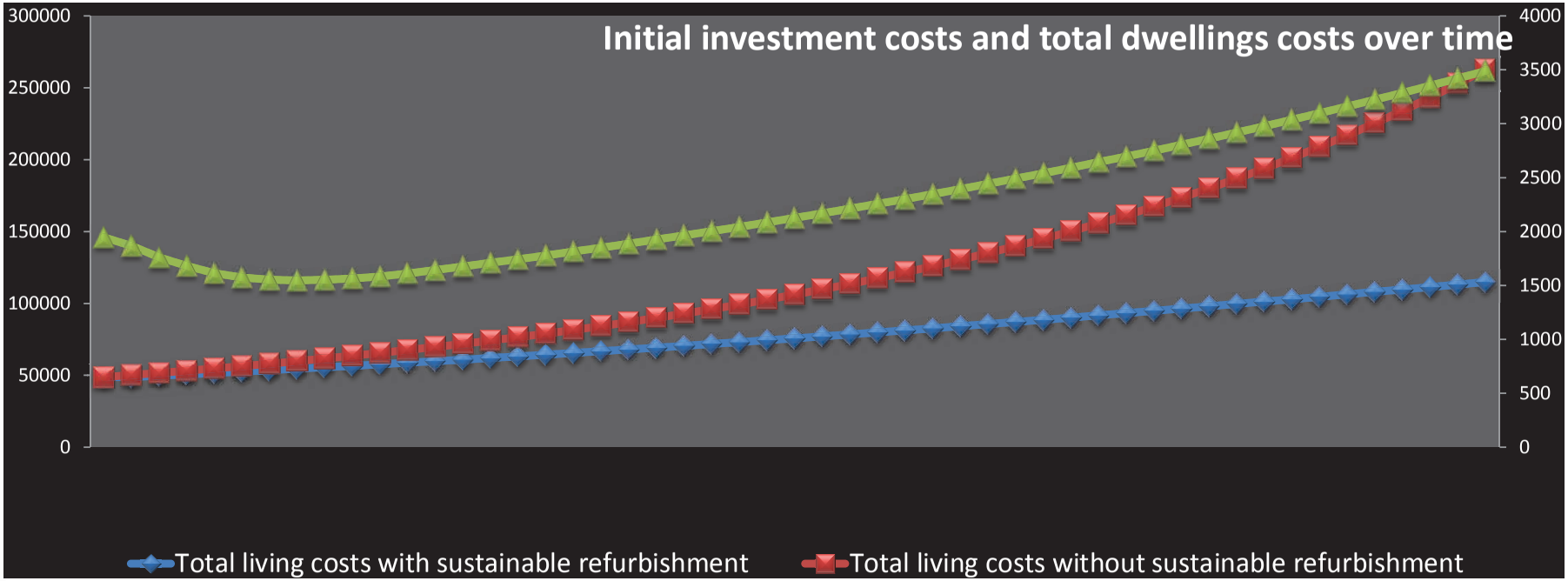
38	39	40	41	42	43	44	45	46	47	48	49	50
11.460	11.690	11.923	12.162	12.405	12.653	12.906	13.164	13.428	13.696	13.970	14.250	14.535
-3.690	-3.800	-3.914	-4.032	-4.153	-4.277	-4.406	-4.538	-4.674	-4.814	-4.959	-5.107	-5.261
-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
4.521	**4.575**	**4.628**	**4.682**	**4.735**	**4.788**	**4.841**	**4.894**	**4.947**	**4.999**	**5.051**	**5.102**	**5.153**

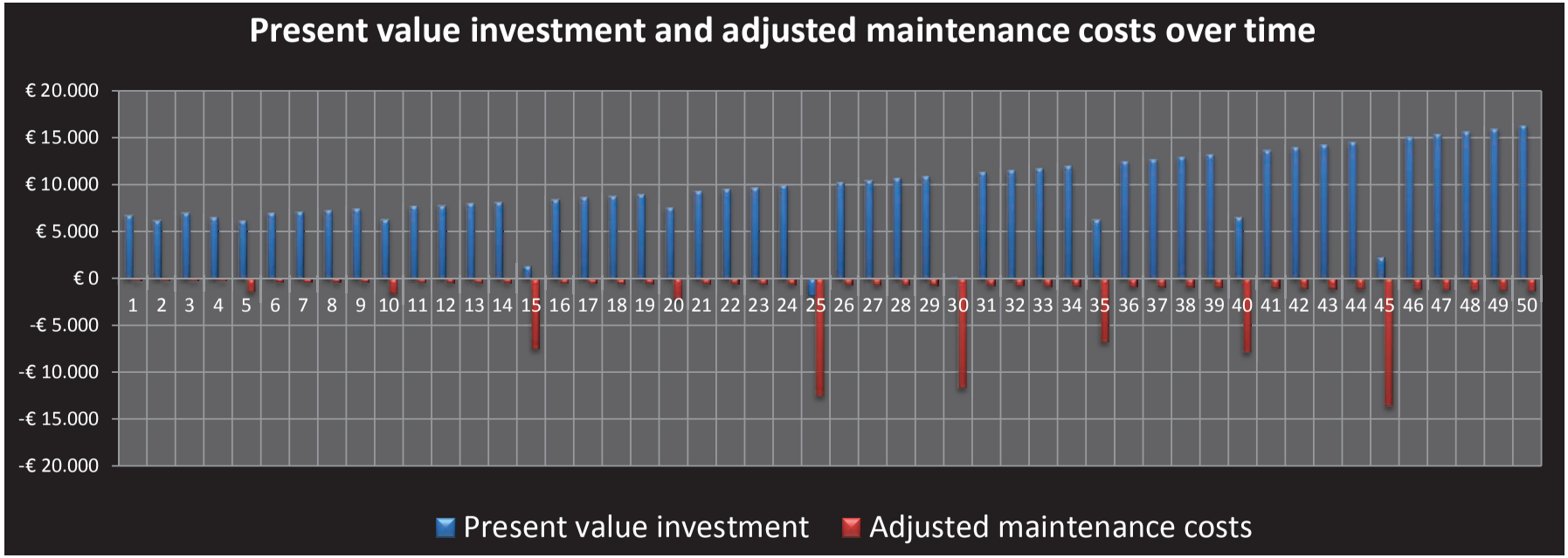
2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

38	39	40	41	42	43	44	45	46	47	48	49	50
17.114	17.457	17.806	18.162	18.525	18.895	19.273	19.659	20.052	20.453	20.862	21.279	21.705
-922	-950	-7.829	-1.008	-1.038	-1.069	-1.101	-13.614	-1.169	-1.204	-1.240	-1.277	-1.315
-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
12.943	**13.192**	**6.596**	**13.706**	**13.970**	**14.239**	**14.513**	**2.313**	**15.077**	**15.366**	**15.662**	**15.962**	**16.269**

2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

38	39	40	41	42	43	44	45	46	47	48	49	50
17.114	17.457	17.806	18.162	18.525	18.895	19.273	19.659	20.052	20.453	20.862	21.279	21.705
-3.690	-3.800	-3.914	-4.032	-4.153	-4.277	-4.406	-4.538	-4.674	-4.814	-4.959	-5.107	-5.261
-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
10.175	**10.342**	**10.511**	**10.682**	**10.855**	**11.031**	**11.208**	**11.389**	**11.571**	**11.756**	**11.943**	**12.132**	**12.323**


Initial investment costs and total dwellings costs over time
300000
250000
200000
150000
100000
50000
0
4000
3500
3000
2500
2000
1500
1000
500
0
Total living costs with sustainable refurbishment
Total living costs without sustainable refurbishment


Present value investment and adjusted maintenance costs over time
€ 20.000
€ 15.000
€ 10.000
€ 5.000
€ 0
-€ 5.000
-€ 10.000
-€ 15.000
-€ 20.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Present value investment
Adjusted maintenance costs

Needed investment	€ 146.000,00	
Rent before refurbishment	€ 450,00	p/mnd
Energy before refurbishment	€ 200,00	p/mnd
% energy savings interference	111%	
% passing on to the tennant	100%	
Lifespan increase option 1	20	year
Lifespan increase option 2	50	year
Discount rate	4,00%	
Annual inflation	2,00%	
Current Market Value RE Object	€ 120.000,00	
Future Market Value RE Object	€ 150.000,00	

Resident	Before	After
Rent	450	672
Energy	200	-22
Living costs	650	650

Calculations

Indexes	**2014**	**2015**	**2016**	**2017**	**2018**
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%
Price increase energy	5,0%	5,0%	5,0%	5,0%	5,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%

Corporation	**Basis**	**0**	**1**	**2**	**3**	**4**
NPV option 1	**42.868**	146.000-	2664	2.717	2.772	2.827
NPV option 2	**82.752**	146.000-	2.664	2.717	2.772	2.827



Resident	With sustainable refurbishment		Basis	0	1	2	3	4
				450	672	685	699	713
				200	-22	-23,1	-24	-25
				650	650	662	675	688

Resident	Without sustainable refurbishment		Basis	0	1	2	3	4
				450	459	468	478	487
				200	210	221	232	243
				650	669	689	709	730

Difference in residents with or without sutainable refurbishment			0	1	2	3	4
			0,00	19,00	26,34	34,17	42,53

Annual production cost decrease		0	1	2	3	4
Total NPV	28000		6000	8000	6000	5000
Construction cost decrease		146000	140000	132000	126000	121000

Maintenance DCF Normal Situation

Discount Rate	4,00%

Indexes	**2014**	**2015**	**2016**	**2017**	**2018**
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	**Basis**	**0**	**1**	**2**	**3**	**4**
Rent	450	5.400	5.508	5.618	5.731	5.845
Maintenance costs	1.200	-1.200	-1.236	-1.273	-1.311	-1.351
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082
Taxes and insurances	300	-300	-306	-312	-318	-325
Landlord levy	231	-231	-236	-240	-245	-250
Specific levys after 5 years	330	-330	330	-330	330	-330
Rest value						
NPV 20 years	**€ 42.080,19**		**3.040**	**2.422**	**3.125**	**2.507**
NPV 50 years	**€ 75.526,29**					

Total maintenance costs 20 years			-22.037
Total maintenance costs 50 years			-46.687

Maintenance situation after upgrading to level 2

Discount Rate 4,00%

Indexes	2014	2015	2016	2017	2018
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	Basis	0	1	2	3	4
Rent	672	8.064	8.225	8.390	8.558	8.729
Maintenance costs	1.200	-200	-206	-212	-219	-225
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082
Taxes and insurances	300	-300	-306	-312	-318	-325
Landlord levy	231	-231	-236	-240	-245	-250
Specific levys after 5 years	330	-330	330	-330	330	-330
Rest value						
NPV 20 years	**€ 96.175,51**		**6.788**	**6.255**	**7.044**	**6.516**
NPV 50 years	**€ 176.643,82**					

Difference NPV after upgrade and before upgrade - 20 years	€ 54.095,32
Difference NPV after upgrade and before upgrade - 50 years	€ 101.117,53

Total maintenance costs 20 years	-11.104
Total maintenance costs 50 years	-29.658

Difference maintenance costs 20 years	-10.933
Difference maintenance costs 50 years	-17.030

Standard maintenance after upgrading to level 2

Discount Rate	4,00%

Indexes		**2014**	**2015**	**2016**	**2017**	**2018**
Price inflation		2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase		2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase		3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase		2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase		0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs		2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold		2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs		2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase		2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	**Basis**	**0**	**1**	**2**	**3**	**4**
Rent	672	8.064	8.225	8.390	8.558	8.729
Maintenance costs	1.200	-1.200	-1.236	-1.273	-1.311	-1.351
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082
Taxes and insurances	300	-300	-306	-312	-318	-325
Landlord levy	231	-231	-236	-240	-245	-250
Specific levys after 5 years	330	-330	330	-330	330	-330
Rest value						
NPV 20 years	**€ 85.805,71**		**5.758**	**5.194**	**5.952**	**5.391**
NPV 50 years	**€ 159.933,10**					

Corporation				
Investment	146.000			
Lifespan extension		20	Lifespan extension 2	50
Financial gap option 1		**-€ 103.131,84**	**Financial gap option 2**	**-€ 63.248,22**

Financial gap option 1 with maintenance included	**-€ 91.904,68**
Financial gap option 2 with maintenance included	**-€ 44.882,47**

Financial gap option 1 with maintenance and value increase included	**-€ 61.904,68**
Financial gap option 2 with maintenance and value increase included	**-€ 14.882,47**

2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

5	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
2.884	2.941	3.000	3.060	3.121	3.184	3.247	3.312	3.379	3.446	3.515	3.585	3.657	3.730	3.805	3.881	3.959	4.038	4.118	4.201
2.884	2.941	3.000	3.060	3.121	3.184	3.247	3.312	3.379	3.446	3.515	3.585	3.657	3.730	3.805	3.881	3.959	4.038	4.118	4.201

103292,606

5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
727	742	757	772	787	803	819	836	852	869	887	904	923	941	960	979	999	1019	1039	1060
-27	-28	-29	-31	-33	-34	-36	-38	-40	-41	-44	-46	-48	-50	-53	-56	-58	-61	-64	-68
701	714	727	741	755	769	783	798	813	828	843	859	874	891	907	923	940	957	975	992

5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
497	507	517	527	538	549	560	571	582	594	606	618	630	643	656	669	682	696	710	724
255	268	281	295	310	326	342	359	377	396	416	437	458	481	505	531	557	585	614	645
752	775	798	823	848	874	902	930	959	990	1021	1054	1089	1124	1161	1199	1239	1281	1324	1369

5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
51,44	60,93	71,03	81,78	93,21	105,35	118,26	131,96	146,50	161,93	178,30	195,64	214,02	233,50	254,12	275,95	299,06	323,51	349,37	376,71

5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
3000	1500	500	-400	-1000	-1400	-2000	-2500												
118000	116500	116000	116400	117400	118800	120800	123300	125766	1E+05	130847	133464	136133	1E+05	141633	144466	147355	150302	153308	156374



2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
5.962	6.081	6.203	6.327	6.453	6.583	6.714	6.849	6.985	7.125	7.268	7.413	7.561	7.713	7.867	8.024	8.185	8.348	8.515	8.686
-1.391	-1.433	-1.476	-1.520	-1.566	-1.613	-1.661	-1.711	-1.762	-1.815	-1.870	-1.926	-1.983	-2.043	-2.104	-2.167	-2.232	-2.299	-2.368	-2.439
-1.104	-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486	-1.516	-1.546	-1.577	-1.608
-331	-338	-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437	-446	-455	-464	-473	-483
-255	-260	-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337	-343	-350	-357	-364	-372
330																			
3.211	**2.924**	**2.968**	**3.013**	**3.058**	**3.104**	**3.150**	**3.196**	**3.243**	**3.290**	**3.338**	**3.386**	**3.434**	**3.483**	**3.532**	**3.582**	**3.632**	**3.682**	**3.733**	**3.784**

2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
8.903	9.081	9.263	9.448	9.637	9.830	10.027	10.227	10.432	10.640	10.853	11.070	11.292	11.517	11.748	11.983	12.222	12.467	12.716	12.970
-1.391	-358	-369	-380	-391	-1.613	-415	-428	-441	-454	-7.478	-481	-496	-511	-526	-2.167	-558	-575	-592	-610
-1.104	-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486	-1.516	-1.546	-1.577	-1.608
-331	-338	-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437	-446	-455	-464	-473	-483
-255	-260	-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337	-343	-350	-357	-364	-372
330																			
6.152	**6.999**	**7.135**	**7.274**	**7.416**	**6.351**	**7.708**	**7.858**	**8.011**	**8.166**	**1.314**	**8.487**	**8.652**	**8.820**	**8.991**	**7.540**	**9.344**	**9.525**	**9.710**	**9.898**

2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
8.903	9.081	9.263	9.448	9.637	9.830	10.027	10.227	10.432	10.640	10.853	11.070	11.292	11.517	11.748	11.983	12.222	12.467	12.716	12.970
-1.391	-1.433	-1.476	-1.520	-1.566	-1.613	-1.661	-1.711	-1.762	-1.815	-1.870	-1.926	-1.983	-2.043	-2.104	-2.167	-2.232	-2.299	-2.368	-2.439
-1.104	-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486	-1.516	-1.546	-1.577	-1.608
-331	-338	-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437	-446	-455	-464	-473	-483
-255	-260	-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337	-343	-350	-357	-364	-372
330																			
6.152	**5.924**	**6.029**	**6.134**	**6.242**	**6.351**	**6.462**	**6.575**	**6.689**	**6.805**	**6.923**	**7.043**	**7.164**	**7.288**	**7.413**	**7.540**	**7.669**	**7.801**	**7.934**	**8.069**

2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
4.285	4.371	4.458	4.547	4.638	4.731	4.825	4.922	5.020	5.121	5.223	5.328	5.434	5.543	5.654
4.285	4.371	4.458	4.547	4.638	4.731	4.825	4.922	5.020	5.121	5.223	5.328	5.434	5.543	5.654

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
1081	1102	1125	1147	1170	1193	1217	1242	1266	1292	1318	1344	1371	1398	1426
-71	-74	-78	-82	-86	-91	-95	-100	-105	-110	-116	-121	-127	-134	-140
1010	1028	1046	1065	1084	1103	1122	1142	1162	1182	1202	1223	1243	1264	1286

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
738	753	768	783,46	799	815	831	848	865	882	900	918	936	955	974
677	711	747	784,03	823	864	908	953	1001	1051	1103	1158	1216	1277	1341
1416	1464	1515	1567	1622	1680	1739	1801	1866	1933	2003	2076	2153	2232	2315

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
405,63	436,19	468,48	502,60	538,63	576,69	616,87	659,29	704,06	751,30	801,15	853,74	909,21	967,70	1029,38

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
159502	162692	165946	169264	172649,77	176102,762	179624,8176	183217,3139	186881,6602	190619,2934	194431,6793	198320,3129	202286,7191	206332,4535	210459,1026

2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
8.859	9.036	9.217	9.402	9.590	9.781	9.977	10.177	10.380	10.588	10.799	11.015	11.236	11.460	11.690
-2.513	-2.588	-2.666	-2.746	-2.828	-2.913	-3.000	-3.090	-3.183	-3.278	-3.377	-3.478	-3.582	-3.690	-3.800
-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000	-2.040	-2.081	-2.122	-2.165
-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600	-612	-624	-637	-649
-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462	-471	-481	-490	-500
3.835	**3.887**	**3.938**	**3.991**	**4.043**	**4.095**	**4.148**	**4.201**	**4.254**	**4.308**	**4.361**	**4.414**	**4.468**	**4.521**	**4.575**

2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
13.230	13.494	13.764	14.040	14.320	14.607	14.899	15.197	15.501	15.811	16.127	16.450	16.779	17.114	17.457
-12.513	-647	-666	-686	-707	-11.651	-750	-773	-796	-820	-6.753	-869	-896	-922	-950
-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000	-2.040	-2.081	-2.122	-2.165
-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600	-612	-624	-637	-649
-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462	-471	-481	-490	-500
-1.794	**10.285**	**10.485**	**10.688**	**10.895**	**183**	**11.320**	**11.539**	**11.762**	**11.990**	**6.312**	**12.457**	**12.698**	**12.943**	**13.192**

2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
13.230	13.494	13.764	14.040	14.320	14.607	14.899	15.197	15.501	15.811	16.127	16.450	16.779	17.114	17.457
-2.513	-2.588	-2.666	-2.746	-2.828	-2.913	-3.000	-3.090	-3.183	-3.278	-3.377	-3.478	-3.582	-3.690	-3.800
-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000	-2.040	-2.081	-2.122	-2.165
-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600	-612	-624	-637	-649
-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462	-471	-481	-490	-500
8.206	**8.345**	**8.486**	**8.629**	**8.774**	**8.921**	**9.070**	**9.222**	**9.375**	**9.531**	**9.689**	**9.849**	**10.011**	**10.175**	**10.342**

2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

40	41	42	43	44	45	46	47	48	49	50
5.767	5.882	6.000	6.120	6.242	6.367	6.494	6.624	6.757	6.892	7.030
5.767	5.882	6.000	6.120	6.242	6.367	6.494	6.624	6.757	6.892	7.030

40	41	42	43	44	45	46	47	48	49	50
1455	1484	1513	1544	1575	1606	1638	1671	1704	1739	1773
-148	-155	-163	-171	-179	-188	-198	-208	-218	-229	-240
1307	1329	1351	1373	1395	1418	1441	1463	1486	1510	1533

40	41	42	43	4	45	46	47	48	49	50
994	1013	1034	1054	1076	1097	1119	1141	1164	1187	1211
1408	1478	1552	1630	1711	1797	1887	1981	2080	2184	2293
2402	2492	2586	2684	2787	2894	3006	3123	3244	3372	3505

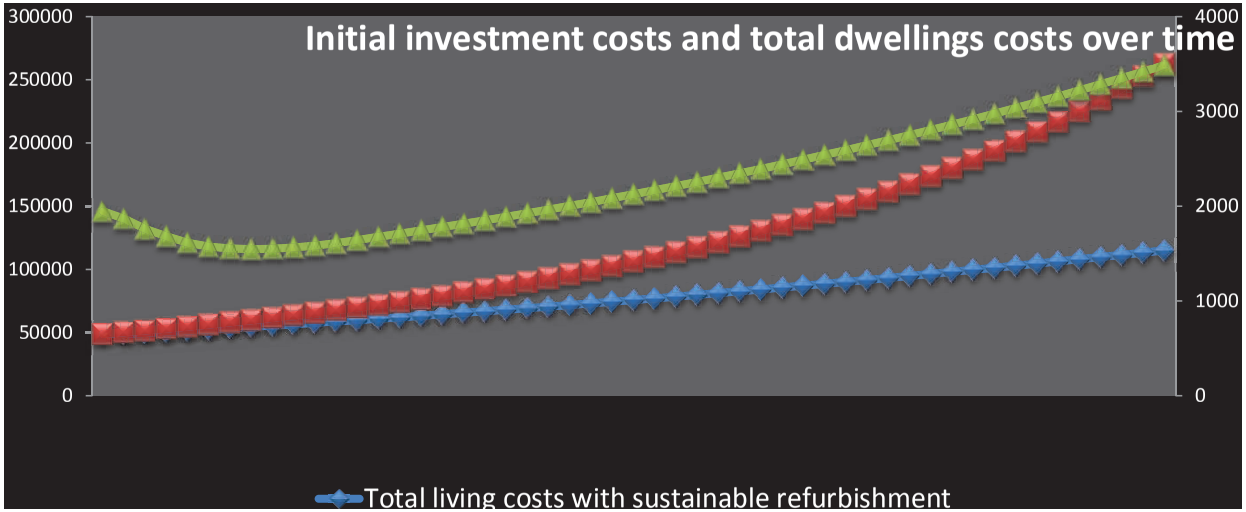
40	41	42	43	4	45	46	47	48	49	50
1094,41	1162,96	1235,22	1311,38	1391,62	1476,18	1565,26	1659,10	1757,94	1862,05	1971,68

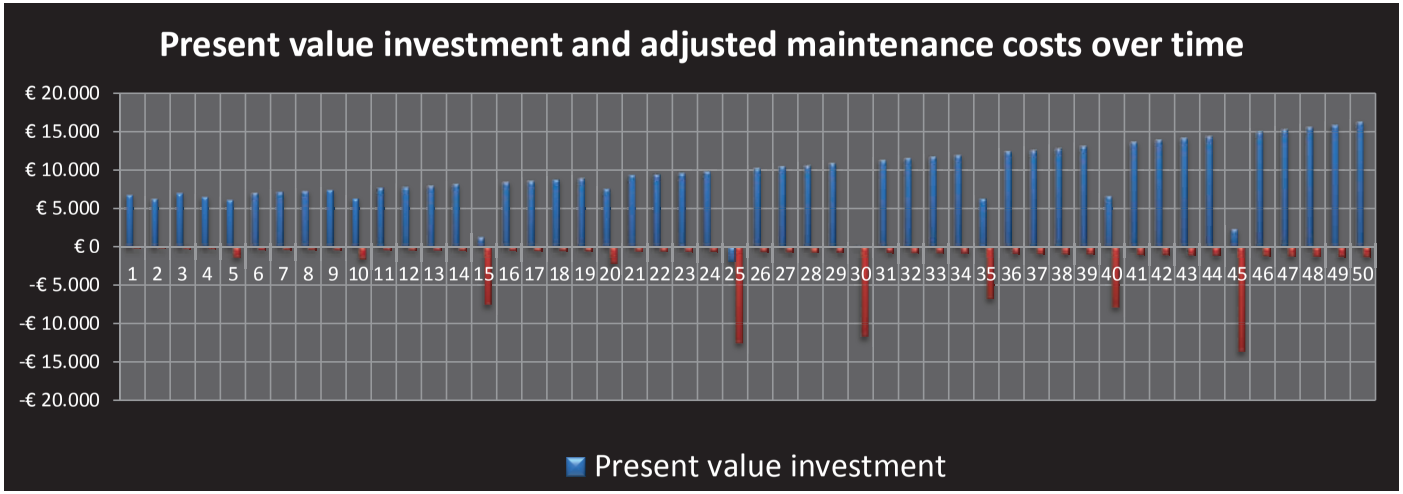
40	41	42	43	44	45	46	47	48	49	50
214668,2846	218961,6503	223340,8833	227807,701	232363,855	237011,132	241751,3547	246586,382	251518,1095	256548,4717	261679,4411

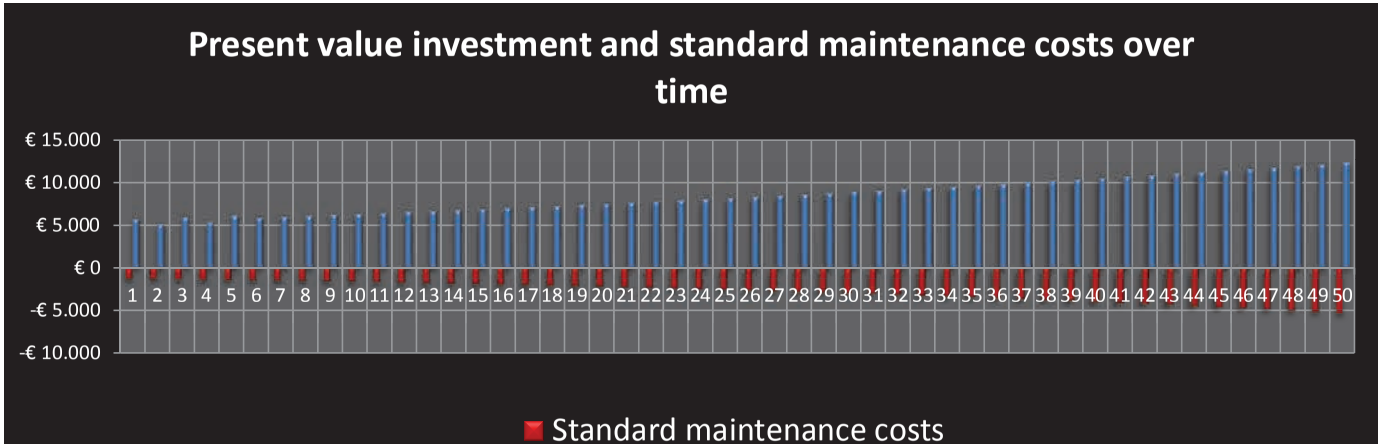
2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
11.923	12.162	12.405	12.653	12.906	13.164	13.428	13.696	13.970	14.250	14.535
-3.914	-4.032	-4.153	-4.277	-4.406	-4.538	-4.674	-4.814	-4.959	-5.107	-5.261
-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
4.628	**4.682**	**4.735**	**4.788**	**4.841**	**4.894**	**4.947**	**4.999**	**5.051**	**5.102**	**5.153**

2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
17.806	18.162	18.525	18.895	19.273	19.659	20.052	20.453	20.862	21.279	21.705
-7.829	-1.008	-1.038	-1.069	-1.101	-13.614	-1.169	-1.204	-1.240	-1.277	-1.315
-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
6.596	**13.706**	**13.970**	**14.239**	**14.513**	**2.313**	**15.077**	**15.366**	**15.662**	**15.962**	**16.269**

2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
17.806	18.162	18.525	18.895	19.273	19.659	20.052	20.453	20.862	21.279	21.705
-3.914	-4.032	-4.153	-4.277	-4.406	-4.538	-4.674	-4.814	-4.959	-5.107	-5.261
-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
10.511	**10.682**	**10.855**	**11.031**	**11.208**	**11.389**	**11.571**	**11.756**	**11.943**	**12.132**	**12.323**


Initial investment costs and total dwellings costs over time
300000
250000
200000
150000
100000
50000
0
4000
3000
2000
1000
0
Total living costs with sustainable refurbishment


Present value investment and adjusted maintenance costs over time
€ 20.000
€ 15.000
€ 10.000
€ 5.000
€ 0
-€ 5.000
-€ 10.000
-€ 15.000
-€ 20.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Present value investment


Present value investment and standard maintenance costs over time
€ 15.000
€ 10.000
€ 5.000
€ 0
-€ 5.000
-€ 10.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Standard maintenance costs

Needed investment	€ 86.413,00	
Rent before refurbishment	€ 450,00	p/mnd
Energy before refurbishment	€ 200,00	p/mnd
% energy savings interference	92%	
% passing on to the tennant	100%	
Lifespan increase option 1	20	jaar
Lifespan increase option 2	50	jaar
Discount rate	4,00%	
Annual inflation	2,00%	
Current Market Value RE Object	€ 120.000,00	
Future Market Value RE Object	€ 144.000,00	

Resident	Before	After
Rent	450	634
Energy	200	16
Living costs	650	650

Calculations

Indexes	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Price increase energy	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Corporation	**Basis**	**0**	**1**	**2**	**3**	**4**	**5**
NPV option 1	**35.530**	86.413-	2208	2.252	2.297	2.343	2.390
NPV option 2	**68.587**	86.413-	2.208	2.252	2.297	2.343	2.390

Resident	met energie renovatie	Basis	0	1	2	3	4	5
			450	634	647	660	673	686
			200	16	16,8	18	19	19
			650	650	663	677	691	706

Resident	zonder energie renovatie	Basis	0	1	2	3	4	5
			450	459	468	478	487	497
			200	210	221	232	243	255
			650	669	689	709	730	752

Difference in residents with or without sutainable refurbishment	0	1	2	3	4	5
	0,00	19,00	25,20	31,81	38,87	46,38

Annual production cost decrease		0	1	2	3	4	5	6
Total NPV	0							
			3900	5200	3900	3250	1950	975
Construction cost decrease		86413	82513	77313	73413	70163	68213	67238

Maintenance DCF Normal Situation

Discount Rate 4,00%

Indexes	2014	2015	2016	2017	2018	2019
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	Index	Basis	0	1	2	3	4	5
Rent	Huurstijging regulier	450	5.400	5.508	5.618	5.731	5.845	5.962
Maintenance costs	Onderhoudkostenstijging	1.200	-1.200	-1.236	-1.273	-1.311	-1.351	-1.391
Management expenses	Beheerkostenstijging	1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104
Taxes and insurances	Index overige lasten	300	-300	-306	-312	-318	-325	-331
Landlord levy	Index overige lasten	231	-231	-236	-240	-245	-250	-255
Specific levys after 5 years	Index overige lasten	330	-330	330	-330	330	-330	330
Rest value	Prijsinflatie							
NPV 20 years		**€ 42.080,19**		**3.040**	**2.422**	**3.125**	**2.507**	**3.211**
NPV 50 years		**€ 75.526,29**						

Total maintenance costs 20 years			-22.037
Total maintenance costs 50 years			-46.687

Maintenance situation after upgrading to level 'Honselersdijk'

Discount Rate 4,00%

Indexes	2014	2015	2016	2017	2018	2019
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	Index	Basis	0	1	2	3	4	5
Rent		634	7.608	7.760	7.915	8.074	8.235	8.400
Maintenance costs		1.200	-300	-309	-318	-328	-338	-1.391
Management expenses		1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104
Taxes and insurances		300	-300	-306	-312	-318	-325	-331
Landlord levy		231	-231	-236	-240	-245	-250	-255
Specific levys after 5 years		330	-330	330	-330	330	-330	330
Rest value								
NPV 20 years		**€ 88.300,48**		**6.220**	**5.674**	**6.451**	**5.910**	**5.648**
NPV 50 years		**€ 161.805,33**						

Difference NPV after upgrade and before upgrade - 20 years	€ 46.220,30
Difference NPV after upgrade and before upgrade - 50 years	€ 86.279,04

Total maintenance costs 20 years		-11.576
Total maintenance costs 50 years		-30.129

Difference maintenance costs 20 years		-10.461
Difference maintenance costs 50 years		-16.558

Maintenance situation after upgrading to level 'Honselersdijk'

Discount Rate 4,00%

Indexes	2014	2015	2016	2017	2018	2019
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	Index	Basis	0	1	2	3	4	5
Rent		634	7.608	7.760	7.915	8.074	8.235	8.400
Maintenance costs		1.200	-1.200	-1.236	-1.273	-1.311	-1.351	-1.391
Management expenses		1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104
Taxes and insurances		300	-300	-306	-312	-318	-325	-331
Landlord levy		231	-231	-236	-240	-245	-250	-255
Specific levys after 5 years		330	-330	330	-330	330	-330	330
Rest value								
NPV 20 years		**€ 78.321,16**		**5.293**	**4.719**	**5.468**	**4.897**	**5.648**
NPV 50 years		**€ 145.485,09**						

Corporation			
Investment	86.413		
Lifespan extension	20	Lifespan extension 2	50
Financial gap option 1	**-€ 50.882,64**	**Financial gap option 2**	**-€ 17.825,94**

Financial gap option 1 with maintenance included	**-€ 40.192,70**
Financial gap option 2 with maintenance included	**-€ 133,96**

Financial gap option 2 with maintenance and value increase included	**-€ 16.192,70**
Financial gap option 2 with maintenance and value increase included	**€ 23.866,04**

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
2.438	2.487	2.536	2.587	2.639	2.692	2.745	2.800	2.856	2.913	2.972	3.031	3.092	3.154
2.438	2.487	2.536	2.587	2.639	2.692	2.745	2.800	2.856	2.913	2.972	3.031	3.092	3.154



6	7	8	9	10	11	12	13	14	15	16	17	18	19
700	714	728	743	758	773	788	804	820	837	853	870	888	906
20	21	23	24	25	26	27	29	30	32	33	35	37	39
720	735	751	766	783	799	816	833	850	868	887	905	924	944

6	7	8	9	10	11	12	13	14	15	16	17	18	19
507	517	527	538	549	560	571	582	594	606	618	630	643	656
268	281	295	310	326	342	359	377	396	416	437	458	481	505
775	798	823	848	874	902	930	959	990	1021	1054	1089	1124	1161

6	7	8	9	10	11	12	13	14	15	16	17	18	19
54,38	62,90	71,96	81,59	91,82	102,68	114,22	126,45	139,43	153,20	167,79	183,24	199,61	216,94

7	8	9	10	11	12	13	14	15	16	17	18	19	20
325	-260	-650	-910	-1300	-1625								
66913	67173	67823	68733	70033	71658	73091,16	74552,9832	76044,0429	77564,9237	79116,2222	80698,5466	82312,5176	83958,77

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

6	7	8	9	10	11	12	13	14	15	16	17	18	19
6.081	6.203	6.327	6.453	6.583	6.714	6.849	6.985	7.125	7.268	7.413	7.561	7.713	7.867
-1.433	-1.476	-1.520	-1.566	-1.613	-1.661	-1.711	-1.762	-1.815	-1.870	-1.926	-1.983	-2.043	-2.104
-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457
-338	-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437
-260	-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337
2.924	**2.968**	**3.013**	**3.058**	**3.104**	**3.150**	**3.196**	**3.243**	**3.290**	**3.338**	**3.386**	**3.434**	**3.483**	**3.532**



2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
8.568	8.739	8.914	9.092	9.274	9.460	9.649	9.842	10.039	10.239	10.444	10.653	10.866	11.083
-358	-369	-380	-391	-1.613	-415	-428	-441	-454	-7.478	-481	-496	-511	-526
-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457
-338	-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437
-260	-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337
6.485	**6.612**	**6.740**	**6.871**	**5.795**	**7.141**	**7.279**	**7.421**	**7.565**	**701**	**7.861**	**8.013**	**8.169**	**8.327**

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

6	7	8	9	10	11	12	13	14	15	16	17	18	19
8.568	8.739	8.914	9.092	9.274	9.460	9.649	9.842	10.039	10.239	10.444	10.653	10.866	11.083
-1.433	-1.476	-1.520	-1.566	-1.613	-1.661	-1.711	-1.762	-1.815	-1.870	-1.926	-1.983	-2.043	-2.104
-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268	-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457
-338	-345	-351	-359	-366	-373	-380	-388	-396	-404	-412	-420	-428	-437
-260	-265	-271	-276	-282	-287	-293	-299	-305	-311	-317	-323	-330	-337
5.411	**5.505**	**5.600**	**5.697**	**5.795**	**5.895**	**5.996**	**6.099**	**6.203**	**6.309**	**6.417**	**6.526**	**6.637**	**6.749**



2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
3.217	3.281	3.347	3.414	3.482	3.551	3.622	3.695	3.769	3.844	3.921	3.999	4.079	4.161	4.244	4.329
3.217	3.281	3.347	3.414	3.482	3.551	3.622	3.695	3.769	3.844	3.921	3.999	4.079	4.161	4.244	4.329

20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
924	942	961	980	1000	1020	1040	1061	1082	1104	1126	1148	1171	1195	1219	1243
40	42	45	47	49	52	54	57	60	63	66	69	73	76	80	84
964	985	1006	1027	1049	1071	1094	1118	1142	1167	1192	1218	1244	1271	1299	1327

20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
669	682	696	710	724	738	753	768	783	799	815	831	848	865	882	900
531	557	585	614	645	677	711	747	784	823	864	908	953	1001	1051	1103
1199	1239	1281	1324	1369	1416	1464	1515	1567	1622	1680	1739	1801	1866	1933	2003

20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
235,29	254,70	275,24	296,95	319,92	344,19	369,85	396,95	425,59	455,83	487,76	521,47	557,05	594,60	634,23	676,03

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
85637,94	87350,7	89097,72	90879,67	92697,26	94551,21	96442,23	98371,08	100338,5	102345,3	104392,2	106480	108609,6	110781,8	112997,4	115257,4

2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
20	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**
8.024	8.185	8.348	8.515	8.686	8.859	9.036	9.217	9.402	9.590	9.781	9.977	10.177	10.380	10.588	10.799
-2.167	-2.232	-2.299	-2.368	-2.439	-2.513	-2.588	-2.666	-2.746	-2.828	-2.913	-3.000	-3.090	-3.183	-3.278	-3.377
-1.486	-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000
-446	-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600
-343	-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462
3.582	**3.632**	**3.682**	**3.733**	**3.784**	**3.835**	**3.887**	**3.938**	**3.991**	**4.043**	**4.095**	**4.148**	**4.201**	**4.254**	**4.308**	**4.361**

2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
20	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**
11.305	11.531	11.762	11.997	12.237	12.482	12.731	12.986	13.246	13.511	13.781	14.056	14.338	14.624	14.917	15.215
-2.167	-558	-575	-592	-610	-12.513	-647	-666	-686	-707	-11.651	-750	-773	-796	-820	-6.753
-1.486	-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000
-446	-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600
-343	-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462
6.863	**8.653**	**8.820**	**8.991**	**9.165**	**-2.543**	**9.522**	**9.706**	**9.894**	**10.085**	**-643**	**10.478**	**10.680**	**10.886**	**11.095**	**5.400**

2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
20	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**
11.305	11.531	11.762	11.997	12.237	12.482	12.731	12.986	13.246	13.511	13.781	14.056	14.338	14.624	14.917	15.215
-2.167	-2.232	-2.299	-2.368	-2.439	-2.513	-2.588	-2.666	-2.746	-2.828	-2.913	-3.000	-3.090	-3.183	-3.278	-3.377
-1.486	-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885	-1.922	-1.961	-2.000
-446	-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565	-577	-588	-600
-343	-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435	-444	-453	-462
6.863	**6.978**	**7.096**	**7.215**	**7.335**	**7.457**	**7.581**	**7.707**	**7.835**	**7.964**	**8.095**	**8.228**	**8.362**	**8.499**	**8.637**	**8.777**

2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
4.416	4.504	4.594	4.686	4.780	4.875	4.973	5.072	5.174	5.277	5.383	5.490	5.600	5.712	5.826
4.416	4.504	4.594	4.686	4.780	4.875	4.973	5.072	5.174	5.277	5.383	5.490	5.600	5.712	5.826

36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
1268	1293	1319	1346	1372	1400	1428	1456	1486	1515	1546	1577	1608	1640	1673
88	93	97	102	107	113	118	124	130	137	144	151	158	166	175
1356	1386	1416	1448	1480	1513	1546	1581	1616	1652	1689	1727	1767	1807	1848

36	37	38	39	40	41	42	43	4	45	46	47	48	49	50
918	936	955	974	994	1013	1034	1054	1076	1097	1119	1141	1164	1187	1211
1158	1216	1277	1341	1408	1478	1552	1630	1711	1797	1887	1981	2080	2184	2293
2076	2153	2232	2315	2402	2492	2586	2684	2787	2894	3006	3123	3244	3372	3505

36	37	38	39	40	41	42	43	4	45	46	47	48	49	50
720,13	766,63	815,67	867,38	921,89	979,35	1039,91	1103,73	1170,98	1241,83	1316,47	1395,09	1477,90	1565,11	1656,95

37	38	39	40	41	42	43	44	45	46	47	48	49	50
117562,5	119913,8	122312,1	124758,3	127253,5	129798,5	132394,5	135042,4	137743,3	140498,1	143308,1	146174,2	149097,7	152079,7

2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

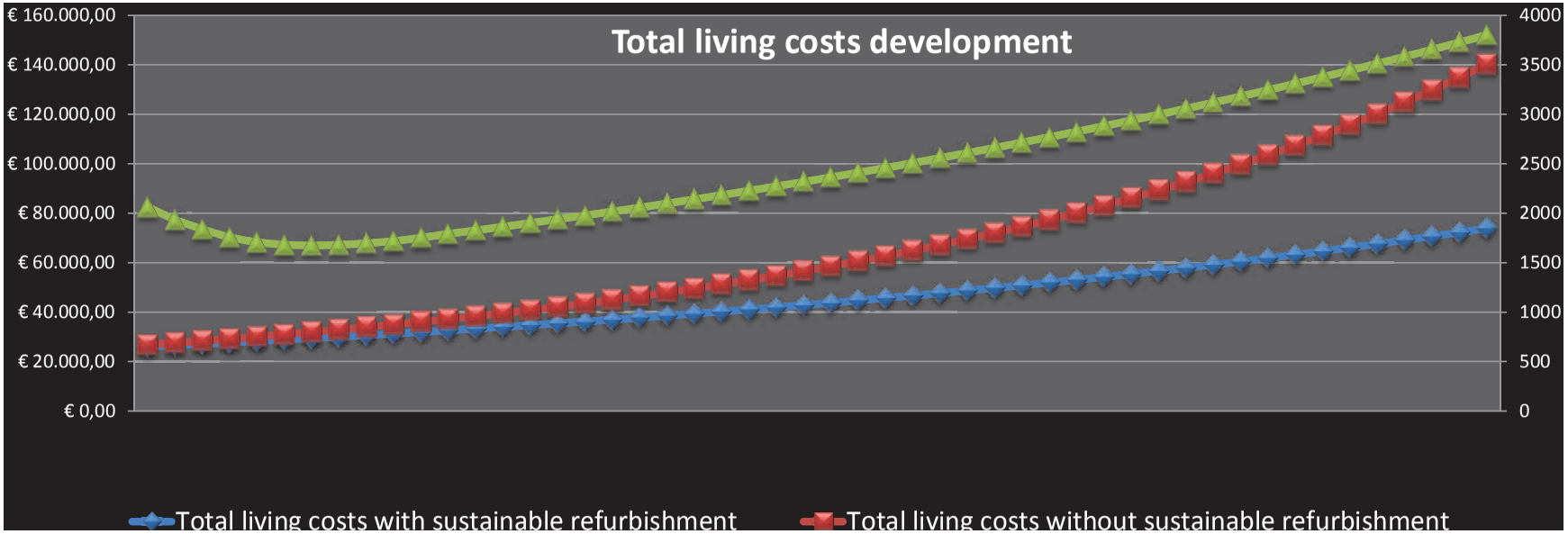
36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
11.015	11.236	11.460	11.690	11.923	12.162	12.405	12.653	12.906	13.164	13.428	13.696	13.970	14.250	14.535
-3.478	-3.582	-3.690	-3.800	-3.914	-4.032	-4.153	-4.277	-4.406	-4.538	-4.674	-4.814	-4.959	-5.107	-5.261
-2.040	-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-612	-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-471	-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
4.414	**4.468**	**4.521**	**4.575**	**4.628**	**4.682**	**4.735**	**4.788**	**4.841**	**4.894**	**4.947**	**4.999**	**5.051**	**5.102**	**5.153**

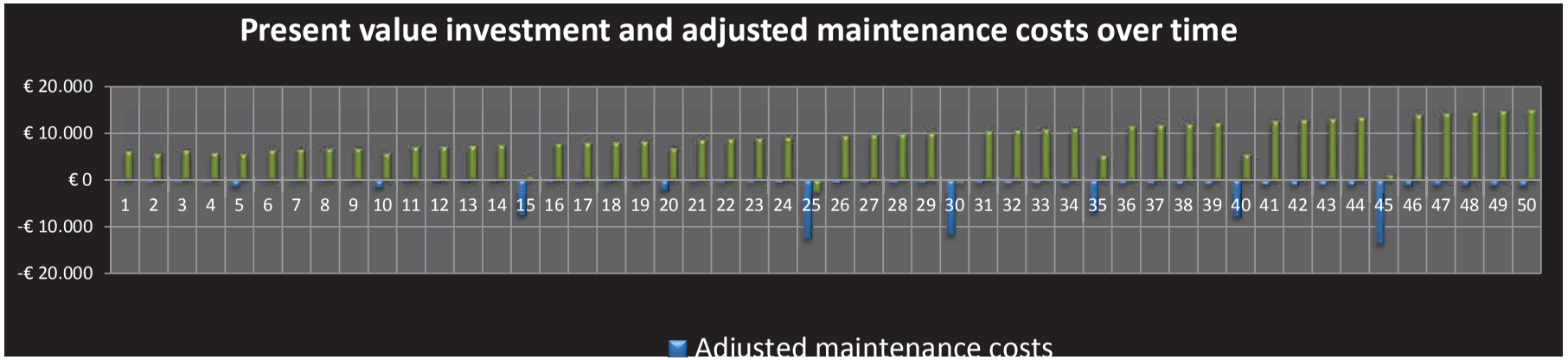
2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

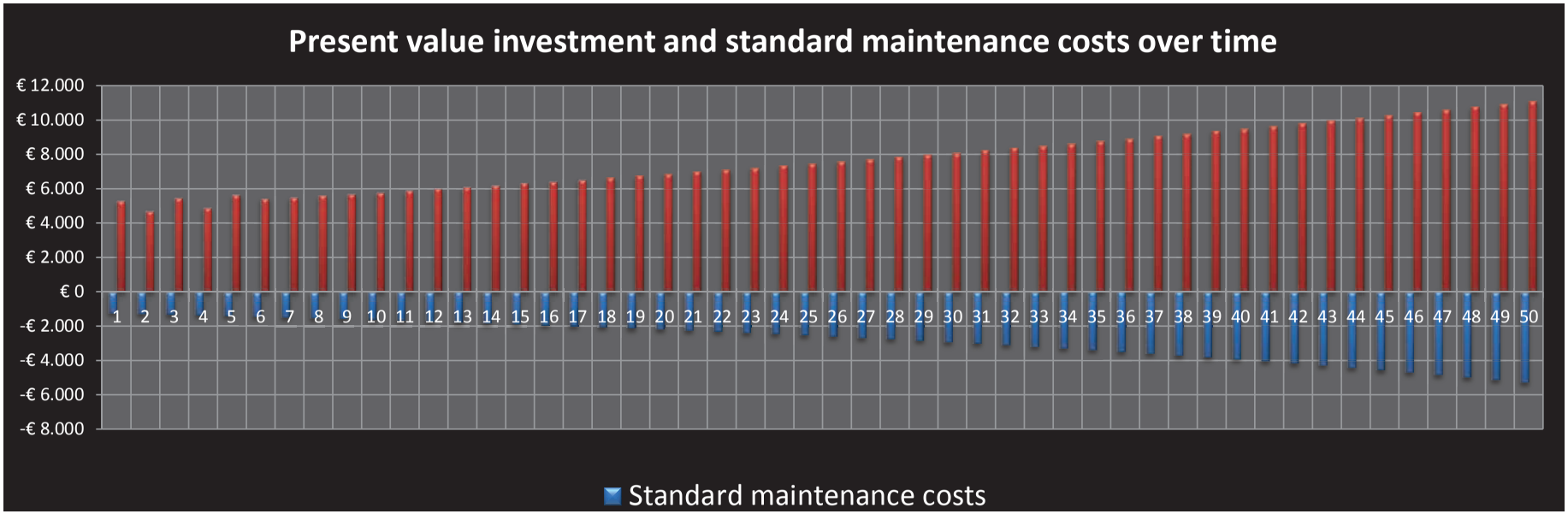
36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
15.519	15.830	16.146	16.469	16.799	17.135	17.477	17.827	18.184	18.547	18.918	19.297	19.682	20.076	20.478
-869	-896	-922	-950	-7.829	-1.008	-1.038	-1.069	-1.101	-13.614	-1.169	-1.204	-1.240	-1.277	-1.315
-2.040	-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-612	-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-471	-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
11.527	**11.749**	**11.975**	**12.205**	**5.589**	**12.679**	**12.922**	**13.170**	**13.423**	**1.201**	**13.943**	**14.210**	**14.482**	**14.759**	**15.042**

2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
15.519	15.830	16.146	16.469	16.799	17.135	17.477	17.827	18.184	18.547	18.918	19.297	19.682	20.076	20.478
-3.478	-3.582	-3.690	-3.800	-3.914	-4.032	-4.153	-4.277	-4.406	-4.538	-4.674	-4.814	-4.959	-5.107	-5.261
-2.040	-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-612	-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-471	-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
8.918	**9.062**	**9.207**	**9.355**	**9.504**	**9.655**	**9.808**	**9.962**	**10.119**	**10.277**	**10.437**	**10.599**	**10.763**	**10.929**	**11.096**


Total living costs development
€ 160.000,00
€ 140.000,00
€ 120.000,00
€ 100.000,00
€ 80.000,00
€ 60.000,00
€ 40.000,00
€ 20.000,00
€ 0,00
4000
3500
3000
2500
2000
1500
1000
500
0
Total living costs with sustainable refurbishment
Total living costs without sustainable refurbishment


Present value investment and adjusted maintenance costs over time
€ 20.000
€ 10.000
€ 0
-€ 10.000
-€ 20.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Adjusted maintenance costs


Present value investment and standard maintenance costs over time
€ 12.000
€ 10.000
€ 8.000
€ 6.000
€ 4.000
€ 2.000
€ 0
-€ 2.000
-€ 4.000
-€ 6.000
-€ 8.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Standard maintenance costs

Needed inves	€ 86.413,00	
Rent before r	€ 450,00	p/mnd
Energy before	€ 200,00	p/mnd
% energy sav	92%	
% passing on	100%	
Lifespan incre	20	jaar
Lifespan incre	50	jaar
Discount rate	4,00%	
Annual inflati	2,00%	
Current Mark	€ 150.000,00	
Future Marke	€ 180.000,00	

Resident	Before	After
Rent	450	634
Energy	200	16
Living costs	650	650

Corporation			
Investment	86.413		
Lifespan extension	20	Lifespan extension 2	50
Financial gap option 1	**-€ 50.882,64**	**Financial gap option 2**	**-€ 17.825,94**

Financial gap option 1 with maintenance included	**-€ 40.192,70**
Financial gap option 2 with maintenance included	**-€ 133,96**

Financial gap option 2 with maintenance and value increase included	**-€ 10.192,70**
Financial gap option 2 with maintenance and value increase included	**€ 29.866,04**

Calculations

Indexes	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Price increase energy	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Corporation	**Basis**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
NPV option 1	**35.530**	86.413-	2208	2.252	2.297	2.343	2.390	2.438	2.487	2.536	2.587	2.639	2.692	2.745
NPV option 2	**68.587**	86.413-	2.208	2.252	2.297	2.343	2.390	2.438	2.487	2.536	2.587	2.639	2.692	2.745

Resident	met energie renovatie	Basis	0	1	2	3	4	5	6	7	8	9	10	11	12
			450	634	647	660	673	686	700	714	728	743	758	773	788
			200	16	16,8	18	19	19	20	21	23	24	25	26	27
			650	650	663	677	691	706	720	735	751	766	783	799	816

Resident	zonder energie renovatie	Basis	0	1	2	3	4	5	6	7	8	9	10	11	12
			450	459	468	478	487	497	507	517	527	538	549	560	571
			200	210	221	232	243	255	268	281	295	310	326	342	359
			650	669	689	709	730	752	775	798	823	848	874	902	930

Difference in residents with or without sutainable refurbishment	0	1	2	3	4	5	6	7	8	9	10	11	12
	0,00	19,00	25,20	31,81	38,87	46,38	54,38	62,90	71,96	81,59	91,82	102,68	114,22

Annual production cost decrease	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Total NPV 0														
		3900	5200	3900	3250	1950	975	325	-260	-650	-910	-1300	-1625	
Construction cost decrease	86413	82513	77313	73413	70163	68213	67238	66913	67173	67823	68733	70033	71658	73091,16

Maintenance DCF Normal Situation

Discount Rate 4,00%

Indexes	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	Index		Basis	0	1	2	3	4	5	6	7	8	9	10	11	12
Rent	Huurstijging regulier		450	5.400	5.508	5.618	5.731	5.845	5.962	6.081	6.203	6.327	6.453	6.583	6.714	6.849
Maintenance costs	Onderhoudkostenstijging		1.200	-1.200	-1.236	-1.273	-1.311	-1.351	-1.391	-1.433	-1.476	-1.520	-1.566	-1.613	-1.661	-1.711
Management expenses	Beheerkostenstijging		1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104	-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268
Taxes and insurances	Index overige lasten		300	-300	-306	-312	-318	-325	-331	-338	-345	-351	-359	-366	-373	-380
Landlord levy	Index overige lasten		231	-231	-236	-240	-245	-250	-255	-260	-265	-271	-276	-282	-287	-293
Specific levys after 5 yea	Index overige lasten		330	-330	330	-330	330	-330	330							
Rest value	Prijsinflatie															
NPV 20 years			**€ 42.080,19**		**3.040**	**2.422**	**3.125**	**2.507**	**3.211**	**2.924**	**2.968**	**3.013**	**3.058**	**3.104**	**3.150**	**3.196**
NPV 50 years			**€ 75.526,29**													

Total maintenance costs 20 years		-22.037
Total maintenance costs 50 years		-46.687

Maintenance situation after upgrading to level 'Honselersdijk'

Discount Rate 4,00%

Indexes	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value	Index	Basis	0	1	2	3	4	5	6	7	8	9	10	11	12
Rent		634	7.608	7.760	7.915	8.074	8.235	8.400	8.568	8.739	8.914	9.092	9.274	9.460	9.649
Maintenance costs		1.200	-300	-309	-318	-328	-338	-1.391	-358	-369	-380	-391	-1.613	-415	-428
Management expenses		1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104	-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268
Taxes and insurances		300	-300	-306	-312	-318	-325	-331	-338	-345	-351	-359	-366	-373	-380
Landlord levy		231	-231	-236	-240	-245	-250	-255	-260	-265	-271	-276	-282	-287	-293
Specific levys after 5 years		330	-330	330	-330	330	-330	330							
Rest value															
NPV 20 years		**€ 88.300,48**		**6.220**	**5.674**	**6.451**	**5.910**	**5.648**	**6.485**	**6.612**	**6.740**	**6.871**	**5.795**	**7.141**	**7.279**
NPV 50 years		**€ 161.805,33**													

Difference NPV after upgrade and before upgrade - 20 year	€ 46.220,30
Difference NPV after upgrade and before upgrade - 50 year	€ 86.279,04

Total maintenance costs 20	-11.576
Total maintenance costs 50	-30.129

Difference maintenance costs 20 years	-10.461
Difference maintenance co	-16.558

Maintenance situation after upgrading to level 'Honselersdijk'

Discount Rat 4,00%

Indexes	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Price inflation	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Management cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Maintenance cost increase	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
Construction cost increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Empty value increase	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Index other costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index leasehold	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Index separation costs	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
Rent increase	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

Organizational value Index	Basis	0	1	2	3	4	5	6	7	8	9	10	11	12
Rent	634	7.608	7.760	7.915	8.074	8.235	8.400	8.568	8.739	8.914	9.092	9.274	9.460	9.649
Maintenance costs	1.200	-1.200	-1.236	-1.273	-1.311	-1.351	-1.391	-1.433	-1.476	-1.520	-1.566	-1.613	-1.661	-1.711
Management expenses	1.000	-1.000	-1.020	-1.040	-1.061	-1.082	-1.104	-1.126	-1.149	-1.172	-1.195	-1.219	-1.243	-1.268
Taxes and insurances	300	-300	-306	-312	-318	-325	-331	-338	-345	-351	-359	-366	-373	-380
Landlord levy	231	-231	-236	-240	-245	-250	-255	-260	-265	-271	-276	-282	-287	-293
Specific levys after 5 years	330	-330	330	-330	330	-330	330							
Rest value														
NPV 20 years	**€ 78.321,16**		**5.293**	**4.719**	**5.468**	**4.897**	**5.648**	**5.411**	**5.505**	**5.600**	**5.697**	**5.795**	**5.895**	**5.996**
NPV 50 years	**€ 145.485,09**													



2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
2.800	2.856	2.913	2.972	3.031	3.092	3.154	3.217	3.281	3.347	3.414	3.482	3.551	3.622	3.695	3.769	3.844	3.921	3.999	4.079
2.800	2.856	2.913	2.972	3.031	3.092	3.154	3.217	3.281	3.347	3.414	3.482	3.551	3.622	3.695	3.769	3.844	3.921	3.999	4.079

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
804	820	837	853	870	888	906	924	942	961	980	1000	1020	1040	1061	1082	1104	1126	1148	1171
29	30	32	33	35	37	39	40	42	45	47	49	52	54	57	60	63	66	69	73
833	850	868	887	905	924	944	964	985	1006	1027	1049	1071	1094	1118	1142	1167	1192	1218	1244

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
582	594	606	618	630	643	656	669	682	696	710	724	738	753	768	783	799	815	831	848
377	396	416	437	458	481	505	531	557	585	614	645	677	711	747	784	823	864	908	953
959	990	1021	1054	1089	1124	1161	1199	1239	1281	1324	1369	1416	1464	1515	1567	1622	1680	1739	1801

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
126,45	139,43	153,20	167,79	183,24	199,61	216,94	235,29	254,70	275,24	296,95	319,92	344,19	369,85	396,95	425,59	455,83	487,76	521,47	557,05

14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
74552,98	76044,04	77564,92	79116,22	80698,55	82312,52	83958,77	85637,94	87350,7	89097,72	90879,67	92697,26	94551,21	96442,23	98371,08	100338,5	102345,3	104392,2	106480	108609,6

2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
13	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
6.985	7.125	7.268	7.413	7.561	7.713	7.867	8.024	8.185	8.348	8.515	8.686	8.859	9.036	9.217	9.402	9.590	9.781	9.977	10.177
-1.762	-1.815	-1.870	-1.926	-1.983	-2.043	-2.104	-2.167	-2.232	-2.299	-2.368	-2.439	-2.513	-2.588	-2.666	-2.746	-2.828	-2.913	-3.000	-3.090
-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486	-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885
-388	-396	-404	-412	-420	-428	-437	-446	-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565
-299	-305	-311	-317	-323	-330	-337	-343	-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435
3.243	**3.290**	**3.338**	**3.386**	**3.434**	**3.483**	**3.532**	**3.582**	**3.632**	**3.682**	**3.733**	**3.784**	**3.835**	**3.887**	**3.938**	**3.991**	**4.043**	**4.095**	**4.148**	**4.201**

2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
9.842	10.039	10.239	10.444	10.653	10.866	11.083	11.305	11.531	11.762	11.997	12.237	12.482	12.731	12.986	13.246	13.511	13.781	14.056	14.338
-441	-454	-7.478	-481	-496	-511	-526	-2.167	-558	-575	-592	-610	-12.513	-647	-666	-686	-707	-11.651	-750	-773
-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486	-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885
-388	-396	-404	-412	-420	-428	-437	-446	-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565
-299	-305	-311	-317	-323	-330	-337	-343	-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435
7.421	**7.565**	**701**	**7.861**	**8.013**	**8.169**	**8.327**	**6.863**	**8.653**	**8.820**	**8.991**	**9.165**	**-2.543**	**9.522**	**9.706**	**9.894**	**10.085**	**-643**	**10.478**	**10.680**

2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
0,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
13	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
9.842	10.039	10.239	10.444	10.653	10.866	11.083	11.305	11.531	11.762	11.997	12.237	12.482	12.731	12.986	13.246	13.511	13.781	14.056	14.338
-1.762	-1.815	-1.870	-1.926	-1.983	-2.043	-2.104	-2.167	-2.232	-2.299	-2.368	-2.439	-2.513	-2.588	-2.666	-2.746	-2.828	-2.913	-3.000	-3.090
-1.294	-1.319	-1.346	-1.373	-1.400	-1.428	-1.457	-1.486	-1.516	-1.546	-1.577	-1.608	-1.641	-1.673	-1.707	-1.741	-1.776	-1.811	-1.848	-1.885
-388	-396	-404	-412	-420	-428	-437	-446	-455	-464	-473	-483	-492	-502	-512	-522	-533	-543	-554	-565
-299	-305	-311	-317	-323	-330	-337	-343	-350	-357	-364	-372	-379	-387	-394	-402	-410	-418	-427	-435
6.099	**6.203**	**6.309**	**6.417**	**6.526**	**6.637**	**6.749**	**6.863**	**6.978**	**7.096**	**7.215**	**7.335**	**7.457**	**7.581**	**7.707**	**7.835**	**7.964**	**8.095**	**8.228**	**8.362**

2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%	5,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
4.161	4.244	4.329	4.416	4.504	4.594	4.686	4.780	4.875	4.973	5.072	5.174	5.277	5.383	5.490	5.600	5.712	5.826
4.161	4.244	4.329	4.416	4.504	4.594	4.686	4.780	4.875	4.973	5.072	5.174	5.277	5.383	5.490	5.600	5.712	5.826

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
1195	1219	1243	1268	1293	1319	1346	1372	1400	1428	1456	1486	1515	1546	1577	1608	1640	1673
76	80	84	88	93	97	102	107	113	118	124	130	137	144	151	158	166	175
1271	1299	1327	1356	1386	1416	1448	1480	1513	1546	1581	1616	1652	1689	1727	1767	1807	1848

33	34	35	36	37	38	39	40	41	42	43	4	45	46	47	48	49	50
865	882	900	918	936	955	974	994	1013	1034	1054	1076	1097	1119	1141	1164	1187	1211
1001	1051	1103	1158	1216	1277	1341	1408	1478	1552	1630	1711	1797	1887	1981	2080	2184	2293
1866	1933	2003	2076	2153	2232	2315	2402	2492	2586	2684	2787	2894	3006	3123	3244	3372	3505

33	34	35	36	37	38	39	40	41	42	43	4	45	46	47	48	49	50
594,60	634,23	676,03	720,13	766,63	815,67	867,38	921,89	979,35	1039,91	1103,73	1170,98	1241,83	1316,47	1395,09	1477,90	1565,11	1656,95

34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
110781,8	112997,4	115257,4	117562,5	119913,8	122312,1	124758,3	127253,5	129798,5	132394,5	135042,4	137743,3	140498,1	143308,1	146174,2	149097,7	152079,7

2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
10.380	10.588	10.799	11.015	11.236	11.460	11.690	11.923	12.162	12.405	12.653	12.906	13.164	13.428	13.696	13.970	14.250	14.535
-3.183	-3.278	-3.377	-3.478	-3.582	-3.690	-3.800	-3.914	-4.032	-4.153	-4.277	-4.406	-4.538	-4.674	-4.814	-4.959	-5.107	-5.261
-1.922	-1.961	-2.000	-2.040	-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-577	-588	-600	-612	-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-444	-453	-462	-471	-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
4.254	**4.308**	**4.361**	**4.414**	**4.468**	**4.521**	**4.575**	**4.628**	**4.682**	**4.735**	**4.788**	**4.841**	**4.894**	**4.947**	**4.999**	**5.051**	**5.102**	**5.153**

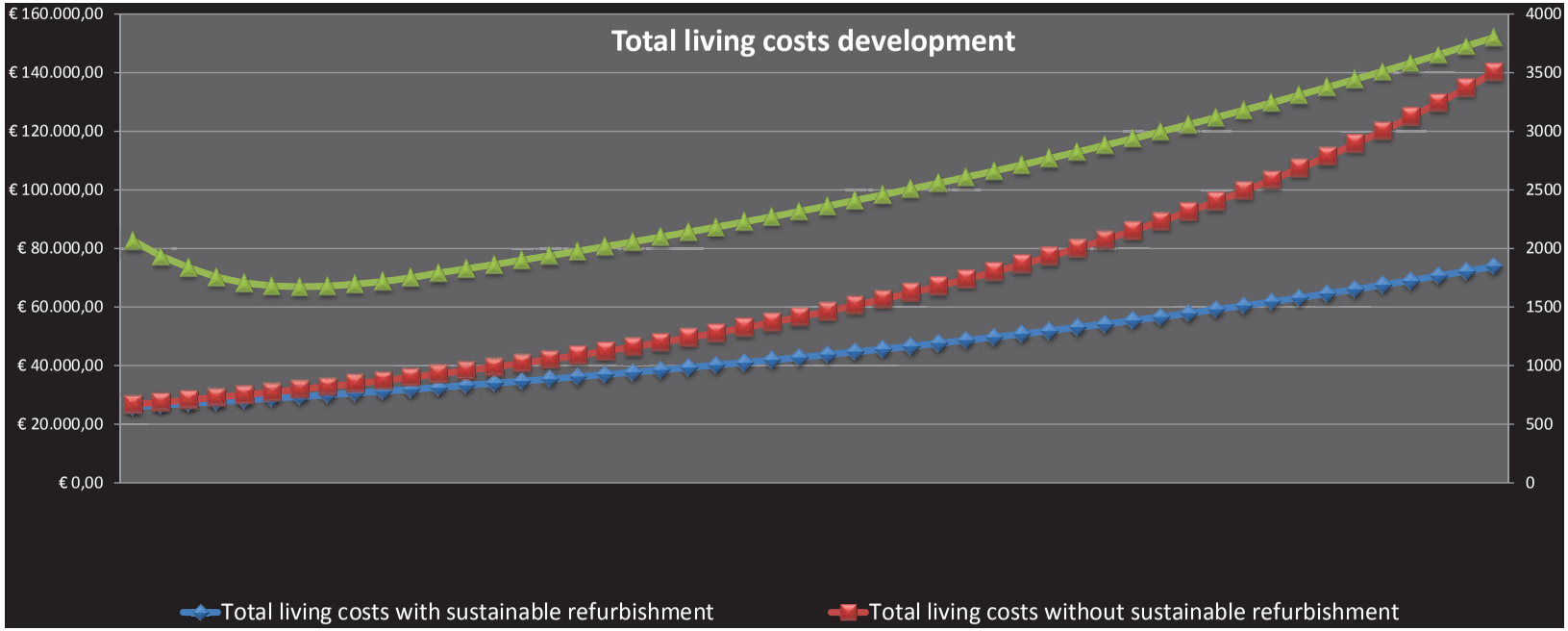


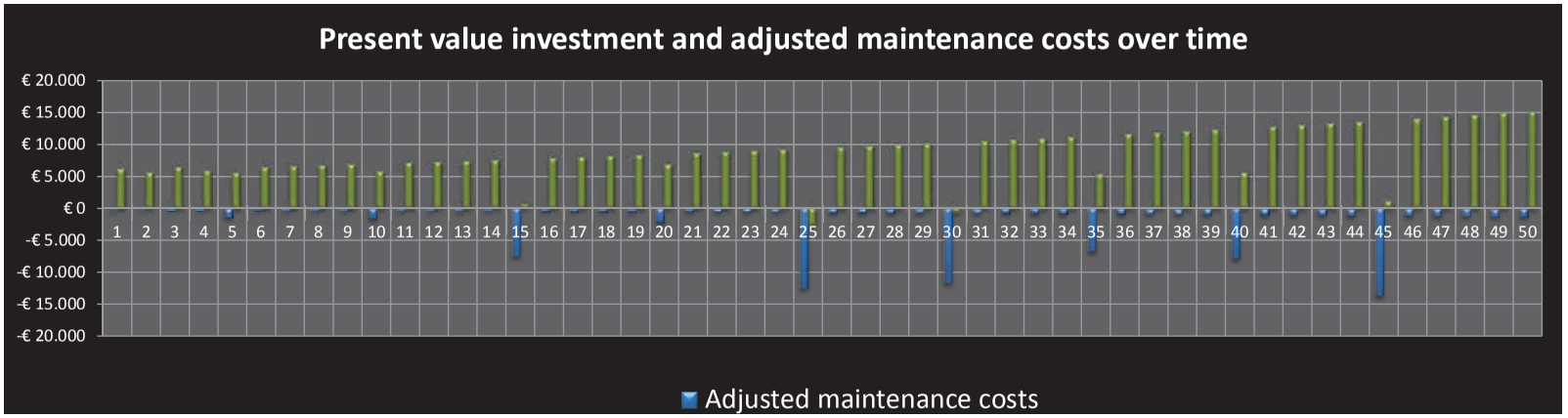
2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
14.624	14.917	15.215	15.519	15.830	16.146	16.469	16.799	17.135	17.477	17.827	18.184	18.547	18.918	19.297	19.682	20.076	20.478
-796	-820	-6.753	-869	-896	-922	-950	-7.829	-1.008	-1.038	-1.069	-1.101	-13.614	-1.169	-1.204	-1.240	-1.277	-1.315
-1.922	-1.961	-2.000	-2.040	-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-577	-588	-600	-612	-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-444	-453	-462	-471	-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
10.886	**11.095**	**5.400**	**11.527**	**11.749**	**11.975**	**12.205**	**5.589**	**12.679**	**12.922**	**13.170**	**13.423**	**1.201**	**13.943**	**14.210**	**14.482**	**14.759**	**15.042**

2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%	3,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
14.624	14.917	15.215	15.519	15.830	16.146	16.469	16.799	17.135	17.477	17.827	18.184	18.547	18.918	19.297	19.682	20.076	20.478
-3.183	-3.278	-3.377	-3.478	-3.582	-3.690	-3.800	-3.914	-4.032	-4.153	-4.277	-4.406	-4.538	-4.674	-4.814	-4.959	-5.107	-5.261
-1.922	-1.961	-2.000	-2.040	-2.081	-2.122	-2.165	-2.208	-2.252	-2.297	-2.343	-2.390	-2.438	-2.487	-2.536	-2.587	-2.639	-2.692
-577	-588	-600	-612	-624	-637	-649	-662	-676	-689	-703	-717	-731	-746	-761	-776	-792	-807
-444	-453	-462	-471	-481	-490	-500	-510	-520	-531	-541	-552	-563	-574	-586	-598	-610	-622
8.499	**8.637**	**8.777**	**8.918**	**9.062**	**9.207**	**9.355**	**9.504**	**9.655**	**9.808**	**9.962**	**10.119**	**10.277**	**10.437**	**10.599**	**10.763**	**10.929**	**11.096**


Total living costs development
€ 160.000,00
€ 140.000,00
€ 120.000,00
€ 100.000,00
€ 80.000,00
€ 60.000,00
€ 40.000,00
€ 20.000,00
€ 0,00
4000
3500
3000
2500
2000
1500
1000
500
0
Total living costs with sustainable refurbishment
Total living costs without sustainable refurbishment


Present value investment and adjusted maintenance costs over time
€ 20.000
€ 15.000
€ 10.000
€ 5.000
€ 0
-€ 5.000
-€ 10.000
-€ 15.000
-€ 20.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Adjusted maintenance costs

			Product cost ex. VAT		Labour cost per unit ex. VAT	Extra costs ex. VAT	Total cost per unit ex. VAT
N Facade							
Level 0							
Level 1	Walls	Cavity insulation	€ 15,00	/m2	€ -		€ 15,00
	remove existing windowframes		€ 10,00	/m2	€ 40,00		€ 50,00
	Plastic windowframes	HR++	€ 340,00	/m2	€ -		€ 340,00
	Door Draft Proofing	rubbers etc	€ 5,00	/m	€ 5,00		€ 10,00
Level 2	Walls	Panels	€ 140,00		€ -		€ 140,00
	remove existing windowframes		€ 10,00	/m2	€ 40,00		€ 50,00
	Plastic windowframes	HR+++	€ 380,00	/m2	€ -		€ 380,00
	Door	Insulated	€ 600,00	pp	€ 80,00		€ 680,00
	Shading	Interior shading	€ 100,00	/m2	€ -		€ 100,00
N roof							
Level 0							€ -
Level 1	Insulation	added insulation interior/exterior	€ 20,00	/m2	€ 25,00		€ 45,00
Level 2	Removing existing roofing		€ 5,00	/m2	€ 10,00		€ 15,00
	OSB or underlayment		€ 12,00	/m2	€ 20,00		€ 32,00
	Insulation + bitumen roofing		€ 45,00	/m2	€ -		€ 45,00
	Green roof finishing		€ 50,00	/m2	€ -		€ 50,00
S Facade							
Level 0							€ -
Level 1	Walls	Cavity insulation	€ 15,00	/m2	€ -		€ 15,00
	remove existing windowframes		€ 10,00	/m2	€ 40,00		€ 50,00
	Windowframes	HR++	€ 340,00	/m2	€ -		€ 340,00
	Door Draft Proofing	rubbers	€ -	/m	€ -		€ -
							€ -
							€ -
							€ -
Level 2	Walls	Panels	€ 140,00				€ 140,00
	remove existing windowframes		€ 10,00	/m2	€ 40,00		€ 50,00
	Windowframes	HR+++	€ 380,00	/m2	€ 55,00		€ 435,00
	Door	Insulated	€ 600,00	pp	€ 80,00		€ 680,00

	Shading	Interior shading	€	100,00				€	100,00
S roof									
Level 0								€	-
Level 1	Insulation	Draft proofing	€	5,00		€	5,00	€	10,00
Level 2	Insulation	added insulation	€	20,00	/m2	€	25,00	€	45,00
Greenhouse									
level 0								€	-
Level 1	Excavations for foundation		€	-	m2	€	40,00	€	40,00
	Reinforced concrete for foundation		€	50,00	pp	€	240,00	€	290,00
	Frame	Steel	€	2,00	/kg	€	-	€	2,00
		Aluminium	€	6.000,00		€	-	€	6.000,00
	Panels	regular	€	500,00		€	-	€	500,00
	Doors	Regular	€	6.000,00		€	-	€	6.000,00
	Construction time		€	5.360,00				€	5.360,00
Level 2	Excavations for foundation		€	-	m2	€	40,00	€	40,00
	Insulated concrete floor		€	60,00	m2			€	60,00
	Finishing		€	70,00	m2			€	70,00
	Piling		€	1.200,00	pp			€	1.200,00
	Reinforced concrete for foundation		€	100,00	m			€	100,00
	Frame	Steel	€	2,00	/kg			€	2,00
		Aluminium integrated	€	*12.000,00*		€	-	€	12.000,00
	Panels	Roof	€	*600,00*	unit	€	-	€	600,00
		Wall	€	*840,00*	unit	€	-	€	840,00
		Optimizers	€	*40,00*	unit	€	10,00	€	50,00
		labour	€	*1.000,00*	total			€	1.000,00
	Doors	Folding door	€	*10.000,00*		€	-	€	10.000,00
	Construction time		€	*5.360,00*				€	5.360,00
Floor									
Level 0									
Level 1	Insulation	Draft proofing	€	*100,00*		€	500,00	€	600,00
Level 2	Insulation	Panels etc	€	*700,00*		€	700,00	€	1.400,00

Installations							
	Rainwater collection	€	*400,00*	€	500,00	€	900,00
	WTW	€	*1.000,00*	€	1.280,00	€	2.280,00
	Greywater system	€	*1.000,00*	€	1.920,00	€	2.920,00
	Heat recovery shower	€	*400,00*	€	600,00	€	1.000,00
	Domotica	€	*800,00*	€	200,00	€	1.000,00
	Solar Compleet	€	*1.500,00*	€	960,00	€	2.460,00
	Shading	€	*1.000,00*	€	1.000,00	€	2.000,00
	windowmotors	€	-	€	-	€	-
Gadgets							
	Compost	€	*300,00*	€	200,00	€	500,00
	Foodgrowing	€	-	€	-	€	-
	Solatubes	€	*600,00*	€	200,00	€	800,00
	Car charger	€	*900,00*	€	300,00	€	1.200,00

	Construction time estimates based on Nobutec	Hours		Unit price
http:/	Steel frame	24	€	40,00
	Aluminium	24	€	40,00
	Doors mechanics etc.	8	€	40,00
	glazings	10	€	40,00
	Solar panels	4	€	40,00
http://ww	Crane	32	€	80,00
Total				

maintenance cost/unit/year ex. VAT	Quantity	Comments	SOURCE	Total cost ex. VAT	To be used in Honselersdijk
				€ -	
				€ -	
	30		http://www.hoe-	€ 450,00	
	9		Kengetallen	€ 450,00	
	9	windowframes, glass, rubbers and labour	Kengetallen	€ 3.060,00	
	5		http://www.gyzs.nl/p	€ 50,00	
			Kengetallen	€ -	
			Kengetallen	€ -	
			Kengetallen	€ -	
	33	95/m2 in case of plaster finish	Invoice Stolsoned	€ 4.620,00	x
	9		Kengetallen	€ 450,00	
	8	windowframes, glass, rubbers and labour	http://www.dubbelgl	€ 3.040,00	x
	1		http://www.bruynzee	€ 680,00	x
	6		https://www.google.	€ 600,00	x
				€ -	
				€ -	
				€ -	
	30	the only way to add insulation without changing the roofing, is from the inside; in that case you should add some wood, foil, plasterboard and finishing	http://houhetwarm.nl/isolatie/dakisolatie/kosten-dakisolatie/	€ 1.350,00	
	30		Kengetallen	€ 450,00	x
	30		Kengetallen	€ 960,00	x
	30		Kengetallen	€ 1.350,00	x
	30		Kengetallen	€ 1.500,00	x
				€ -	
				€ -	
				€ -	
	30		Kengetallen	€ 450,00	x
	9		Kengetallen	€ 450,00	
	9	windowframes, glass, rubbers and labour	Kengetallen	€ 3.060,00	x
	5	included in window frames	http://www.gyzs.nl/p	€ -	x
				€ -	
				€ -	
				€ -	
	30		Invoice Stolsoned	€ 4.200,00	
	9		Kengetallen	€ 450,00	
	9		http://www.dubbelgl	€ 3.915,00	
	1		http://www.bruynzee	€ 680,00	

6		https://www.google.	€	600,00	
			€	-	
			€	-	
			€	-	
30		See N-Roof	€	300,00	
30		See N-Roof	€	1.350,00	x
			€	-	
			€	-	
			€	-	
15		Kengetallen	€	600,00	x
2		Kengetallen	€	580,00	x
1875		Invoice Nobutec	€	3.750,00	x
1	simplified system for regular PV panels	Invoice Nobutec	€	6.000,00	x
25		Kengetallen	€	12.500,00	x
1		Kengetallen	€	6.000,00	x
1		Invoice Nobutec	€	5.360,00	x
15		Kengetallen	€	600,00	
15		Kengetallen	€	900,00	
15		Kengetallen	€	1.050,00	
2		Kengetallen	€	2.400,00	
11		Kengetallen	€	1.100,00	
1875		Invoice Nobutec	€	3.750,00	
1	Including aluminium profiles, mounting (zetwerk), glueing aluminium to PV-panels, perspex, motors and steering for the airwindows, gutters and transport. Coating of the aluminium would cost 4000 extra.	Invoice Nobutec	€	12.000,00	
25		Invoice Nobutec	€	15.000,00	
8		Invoice Nobutec	€	6.720,00	
20		Invoice Nobutec	€	1.000,00	
1		Invoice Nobutec	€	1.000,00	
1		Invoice Nobutec	€	10.000,00	
1			€	5.360,00	
			€	-	
			€	-	
			€	-	
1		Kengetallen	€	600,00	
1		Kengetallen	€	1.400,00	
			€	-	
			€	-	

			€	-	
	1		http://www.tuinvragen.com/index.php?view=article&catid=39%3Aartikelen-over-tuinzaken&id=113%3Anieuw-systeem-voor-regenwater-opvang&tmpl=component&print=1&page=&option=com_content	€	900,00	
	1		http://www.warmteservice.nl/Huis-&-Gereedschap/Warmteterugwinunit-(WTW)/c/202	€	2.280,00	x
	1			€	2.920,00	x
	1		**http://www.warmteservice.nl/Huis-&-Gereedschap/Warmteterugwinunit-(WTW)/c/202**	€	1.000,00	
	1			€	1.000,00	x
	1			€	2.460,00	x
	1			€	2.000,00	
	1	included in aluminium greenhouse		€	-	
				€	-	
	1			€	500,00	
	1			€	-	
	5			€	4.000,00	
	1			€	1.200,00	
				€	-	
				€	-	
				€	-	
				€	-	
				€	-	

					€	-	
					€	-	
					€	-	
					€	-	
					€	-	
					€	-	
total					Sum price		Price including additional cost
		Minimum approach	Level 1	€	48.290,00	€	58.553,82
€	960,00	Estimated approach for Honselersdijk	Honselersdijk	€	62.410,00	€	75.674,96
€	960,00	Maximum approach	Level 2	€	105.385,00	€	127.784,10
€	320,00						
€	400,00	Additional cost			used value		100,0%
€	160,00	Construction site costs (ABK)	6%-20%		10%		110,0%
€	2.560,00	Overhead cost(office etc.)			7%		117,7%
		Risk			2%		120,1%
€	5.360,00	Profit			1%		121,3%
		TOTAL					21,3%

Labour Tax 6% (40% of total)	Materials Tax 21% (60% of total)	Total incl
€ 24.826,82	€ 42.510,07	€ 67.336,89
€ 32.086,18	€ 54.940,02	€ 87.026,20
€ 54.180,46	€ 92.771,25	€ 146.951,71



2 INVESTMENT MODELS

Model A.1 represents the investment model for the housing associations and their tenants. Below one can find a description of the numbers in the model. All these numbers are based on the Pret-a-Loger method, thus including the greenhouse construction and other measures attached to it. The concept which is applied by other organizations, such as the one in the Stroomversnelling, is calculated with other numbers (80.000/dwelling investment costs).

1. Table 1 and number 1 represent households that have an average energy bill around 150-175 euro, which equals a minimum of 1800 euro on an annual basis. If a refurbishment is done whereby the tenants can expect a 60% energy performance improvement, an estimated 30.000 euro is needed. With an average annual inflation of 2,5%, the payback time for this investment would be approximately 17 years.

2. Table 2 and number 2 represent households that have an average energy bill around 150-175 euro, which equals a minimum of 1800 euro on an annual basis. If a refurbishment is done whereby the tenants can expect a 80% energy performance improvement, an estimated 35.000 euro is needed. With an average annual inflation of 2,5%, the payback time for this investment would be approximately 19 years.

3. Table 3 and number 3 also represent households that have an average energy bill around 150-175 euro, which equals a minimum of 1800 euro on an annual basis. If a refurbishment is done whereby the tenants can expect a 100% energy performance improvement (energy neutral), an estimated 40.000 euro is needed. With an average annual inflation of 2,5%, the payback time for this investment would be approximately 22 years.

4. Table 4 and number 4 also represent households that have an average energy bill around 150-175 euro, which equals a minimum of 1800 euro on an annual basis. If a refurbishment is done whereby the tenants can expect a 120% energy performance improvement, an estimated 50.000 euro is needed. A 120% energy improvement means that these houses generate more energy than needed and they can offset this redundant energy load to the electricity grid. For off-setting the redundant energy, the housing association will receive financial compensation. This is secured by law. With an average annual inflation of 2,5%, the payback time for this investment would be approximately 27 years. N.B., by off-setting redundant energy to the electricity grid, the housing associations are actually earning money. The 'REAL' pay-back time will therefore be shorter than 27 years. It still has to be researched how much shorter this will be.

5. Table 5 and number 5 represent households that have an average energy bill around 175-200 euro, which equals a minimum of 2100 euro on an annual basis. If a refurbishment is done whereby the tenants can expect a 60% energy performance improvement, an estimated 30.000 euro is

needed. With an average annual inflation of 2,5%, the payback time for this investment would be approximately 15 years.

6. Table 6 and number 6 represent households that have an average energy bill around 175-200 euro, which equals a minimum of 2100 euro on an annual basis. If a refurbishment is done whereby the tenants can expect a 80% energy performance improvement, an estimated 35.000 euro is needed. With an average annual inflation of 2,5%, the payback time for this investment would be approximately 17 years.

7. Table 7 and number 7 also represent households that have an average energy bill around 175-200 euro, which equals a minimum of 2100 euro on an annual basis. If a refurbishment is done whereby the tenants can expect a 100% energy performance improvement (energy neutral), an estimated 40.000 euro is needed. With an average annual inflation of 2,5%, the payback time for this investment would be approximately 20 years.

8. Table 8 and number 8 also represent households that have an average energy bill around 175-200 euro, which equals a minimum of 2100 euro on an annual basis. If a refurbishment is done whereby the tenants can expect a 120% energy performance improvement, an estimated 50.000 euro is needed. A 120% energy improvement means that these houses generate more energy than needed and they can offset this redundant energy load to the electricity grid. For off-setting the redundant energy, the housing association will receive financial compensation. This is secured by law. With an average annual inflation of 2,5%, the payback time for this investment would be approximately 24 years. N.B., by off-setting redundant energy to the electricity grid, the housing associations are actually earning money. The 'REAL' pay-back time will therefore be shorter than 24 years. It still has to be researched how much shorter this will be.

9. Table 9 and number 9 represent households that have an average energy bill of 200+ euro, which equals a minimum of 2400 euro on an annual basis. If a refurbishment is done whereby the tenants can expect a 60% energy performance improvement, an estimated 30.000 euro is needed. With an average annual inflation of 2,5%, the payback time for this investment would be approximately 13 years.

10. Table 10 and number 10 represent households that have an average energy bill of 200+ euro, which equals a minimum of 2400 euro on an annual basis. If a refurbishment is done whereby the tenants can expect a 80% energy performance improvement, an estimated 35.000 euro is needed. With an average annual inflation of 2,5%, the payback time for this investment would be approximately 15 years.

11. Table 11 and number 11 also represent households that have an average energy bill of 200+ euro, which equals a minimum of 2400 euro on an annual basis. If a refurbishment is done whereby

the tenants can expect a 100% energy performance improvement (energy neutral), an estimated 40.000 euro is needed. With an average annual inflation of 2,5%, the payback time for this investment would be approximately 17 years.

12. Table 12 and number 12 also represent households that have an average energy bill of 200+ euro, which equals a minimum of 2400 euro on an annual basis. If a refurbishment is done whereby the tenants can expect a 120% energy performance improvement, an estimated 50.000 euro is needed. A 120% energy improvement means that these houses generate more energy than needed and they can offset this redundant energy load to the electricity grid. For off-setting the redundant energy, the housing association will receive financial compensation. This is secured by law. With an average annual inflation of 2,5%, the payback time for this investment would be approximately 21 years. N.B., by off-setting redundant energy to the electricity grid, the housing associations are actually earning money. The 'REAL' pay-back time will therefore be shorter than 21 years. It still has to be researched how much shorter this will be.

Model B represents the investment model for the individual house owners. N.B. that the pay-off time of these investment are much lower than for housing associations. Below it will be explained why that is. This shorter pay-off period is necessary though, since house owners tend to prefer to earn any investment in their dwelling back before they sell their house. Since the average residence time of Dutch house owners is around 7 years, any model that can offer a pay-off time within 7 years is preferable. When the model does not offer a pay-off time within 7 years, an indirect reimbursement in the form of higher property value should balance this liability. Below one can find a description of the numbers in the model. All these numbers are based on the Pret-a-Loger method, thus including the greenhouse construction and other measures attached to it.

1. Table 1 and number 1 represent house owners that have an average energy bill around 150-175 euro, which equals a minimum of 1800 euro on an annual basis. If a refurbishment is done whereby the owners can expect a 60% energy performance improvement, an estimated 30.000 euro is needed. An average annual inflation of 2,5% has been used for the model. Furthermore, it is assumed that (partially) improving the energy performance of these dwellings, will induce a value increase of the property. To make the investment scenario more feasible for the house owner, the value increase is capitalized. Even if the house owner will sell his house before he starts profiting from his investment, he will still see a reimbursement in the form of a higher exit value of his property. Hence the higher exit value of the property makes the pay-off time of the investment shorter. For a 60% energy performance improvement, a 4% value increase is used for the calculations. The payback time for this investment would be approximately 14 years.

2. Table 2 and number 2 represent house owners that have an average energy bill around 150-175 euro, which equals a minimum of 1800 euro on an annual basis. If a refurbishment is done whereby the owners can expect a 80% energy performance improvement, an estimated 35.000 euro is needed. An average annual inflation of 2,5% has been used for the model. For an 80% energy performance improvement, a 6% value increase is used for the calculations. The payback time for

this investment would be approximately 14 years, whereby it has to be stated that investment option is paid back in the beginning of year 14, while option is paid back entirely at the end of year 14.

3. Table 3 and number 3 also represent house owners that have an average energy bill around 150-175 euro, which equals a minimum of 1800 euro on an annual basis. If a refurbishment is done whereby the owners can expect a 100% energy performance improvement (energy neutral), an estimated 40.000 euro is needed. An average annual inflation of 2,5% has been used for the model. For a 100% energy performance improvement, an 8% value increase is used for the calculations. The payback time for this investment would be approximately 15 years.

4. Table 4 and number 4 also represent house owners that have an average energy bill around 150-175 euro, which equals a minimum of 1800 euro on an annual basis. If a refurbishment is done whereby the owners can expect a 120% energy performance improvement (off-setting redundant energy in turn for a financial compensation), an estimated 50.000 euro is needed. An average annual inflation of 2,5% has been used for the model. For a 120% energy performance improvement, a 10% value increase is used for the calculations. The payback time for this investment would be approximately 19 years. N.B., by off-setting redundant energy to the electricity grid, the house owners actually earns money. The 'REAL' pay-back time will therefore be shorter than 19 years. It still has to be researched how much shorter this will be.

5. Table 5 and number 5 represent house owners that have an average energy bill around 175-200 euro, which equals a minimum of 2100 euro on an annual basis. If a refurbishment is done whereby the owners can expect a 60% energy performance improvement, an estimated 30.000 euro is needed. An average annual inflation of 2,5% has been used for the model. For a 60% energy performance improvement, a 6% value increase is used for the calculations. The payback time for this investment would be approximately 12 years.

6. Table 6 and number 6 represent house owners that have an average energy bill around 175-200 euro, which equals a minimum of 2100 euro on an annual basis. If a refurbishment is done whereby the owners can expect a 80% energy performance improvement, an estimated 35.000 euro is needed. An average annual inflation of 2,5% has been used for the model. For an 80% energy performance improvement, an 8% value increase is used for the calculations. The payback time for this investment would be approximately 13 years.

7. Table 7 and number 7 also represent households that have an average energy bill around 175-200 euro, which equals a minimum of 2100 euro on an annual basis. If a refurbishment is done whereby the owners can expect a 100% energy performance improvement (energy neutral), an estimated 40.000 euro is needed. An average annual inflation of 2,5% has been used for the model. For a 100% energy performance improvement, a 10% value increase is used for the calculations. The payback time for this investment would be approximately 14 years.

8. Table 8 and number 8 also represent households that have an average energy bill around 175-200 euro, which equals a minimum of 2100euro on an annual basis. If a refurbishment is done whereby the owners can expect a 120% energy performance improvement (off-setting redundant energy in turn for a financial compensation), an estimated 50.000 euro is needed. An average annual inflation of 2,5% has been used for the model. For a 120% energy performance improvement, a 10% value increase is used for the calculations. The payback time for this investment would be approximately 17 years. N.B., by off-setting redundant energy to the electricity grid, the house owners actually earns money. The 'REAL' pay-back time will therefore be shorter than 17 years. It still has to be researched how much shorter this will be.

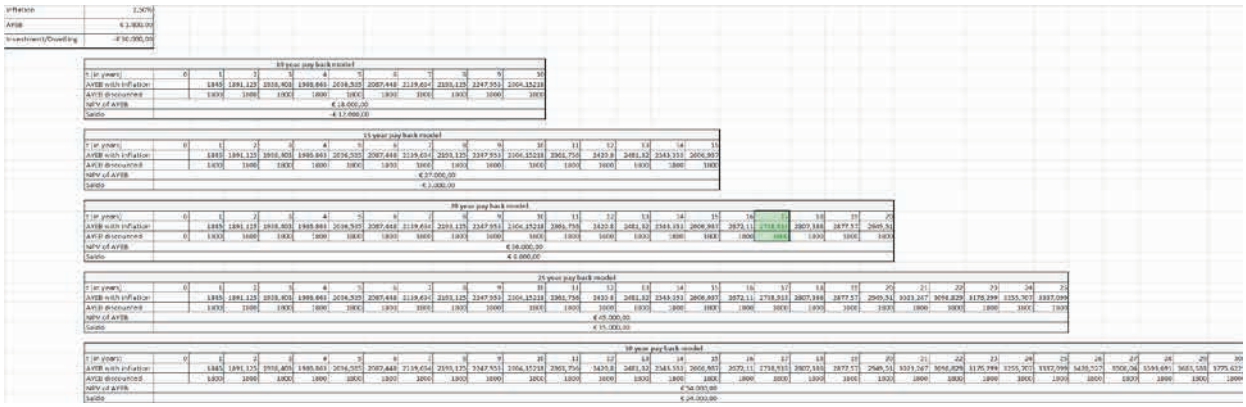
9. Table 9 and number 9 represent house owners that have an average energy bill of 200+ euro, which equals a minimum of 2400 euro on an annual basis. If a refurbishment is done whereby the owners can expect a 60% energy performance improvement, an estimated 30.000 euro is needed. An average annual inflation of 2,5% has been used for the model. For a 60% energy performance improvement, a 4% value increase is used for the calculations. The payback time for this investment would be approximately 10 years.

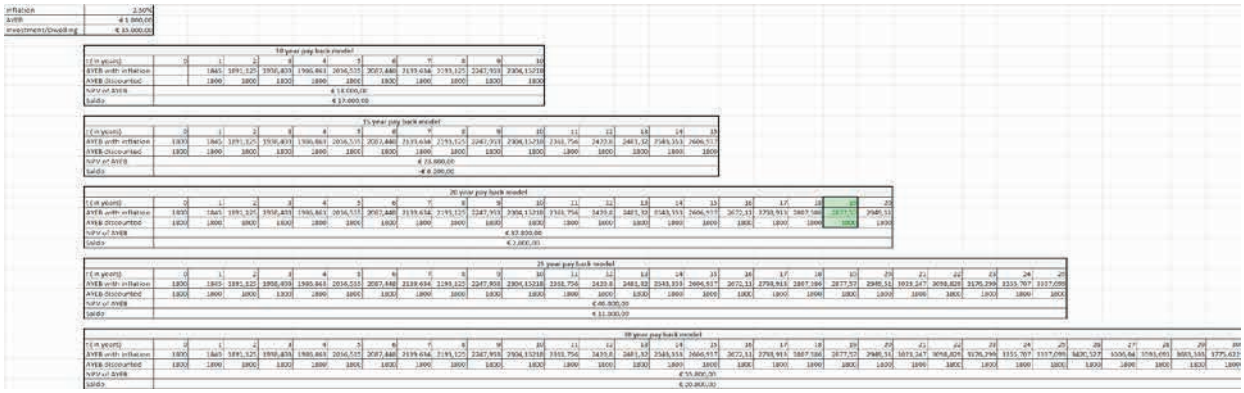
10. Table 10 and number 10 represent house owners that have an average energy bill of 200+ euro, which equals a minimum of 2400 euro on an annual basis. If a refurbishment is done whereby the owners can expect a 80% energy performance improvement, an estimated 35.000 euro is needed. An average annual inflation of 2,5% has been used for the model. For an 80% energy performance improvement, a 6% value increase is used for the calculations. The payback time for this investment would be approximately 11 years.

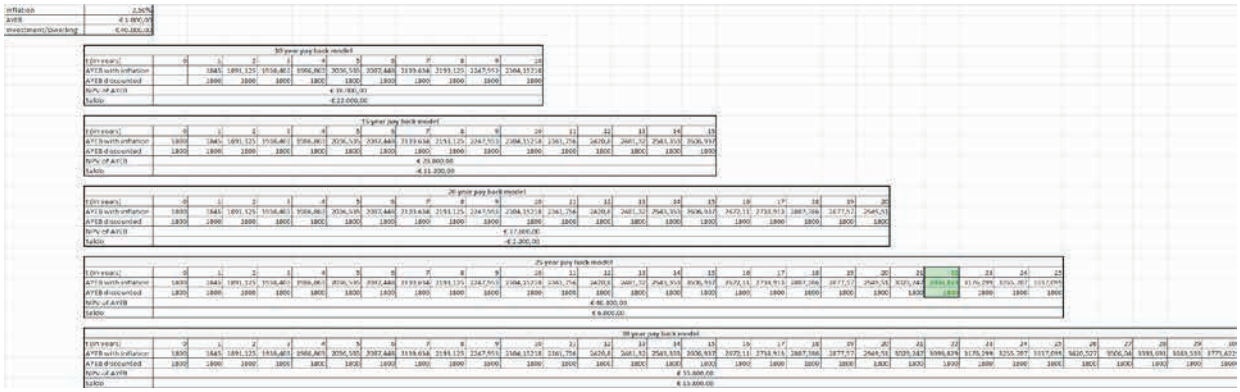
11. Table 11 and number 11 also represent households that have an average energy bill of 200+ euro, which equals a minimum of 2400 euro on an annual basis. If a refurbishment is done whereby the owners can expect a 100% energy performance improvement (energy neutral), an estimated 40.000 euro is needed. An average annual inflation of 2,5% has been used for the model. For a 100% energy performance improvement, an 8% value increase is used for the calculations. The payback time for this investment would be approximately 12 years.

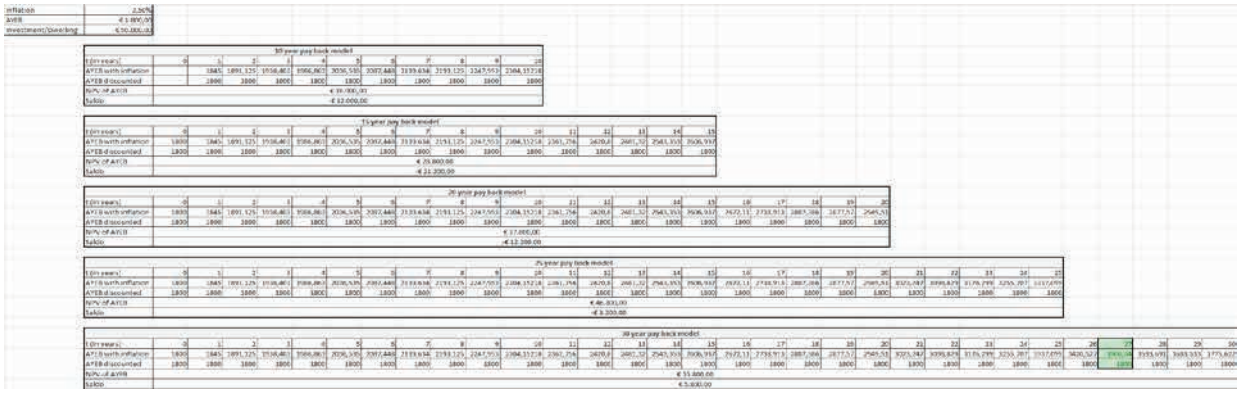
12. Table 12 and number 12 also represent households that have an average energy bill of 200+ euro, which equals a minimum of 2400 euro on an annual basis. If a refurbishment is done whereby the owners can expect a 120% energy performance improvement (off-setting redundant energy in turn for a financial compensation), an estimated 50.000 euro is needed. An average annual inflation of 2,5% has been used for the model. For a 120% energy performance improvement, a 10% value increase is used for the calculations. The payback time for this investment would be approximately 16 years. N.B., by off-setting redundant energy to the electricity grid, the house owners actually earns money. The 'REAL' pay-back time will therefore be shorter than 16 years. It still has to be researched how much shorter this will be.

Investment options for housing associations: Tables of AYEB 1.800

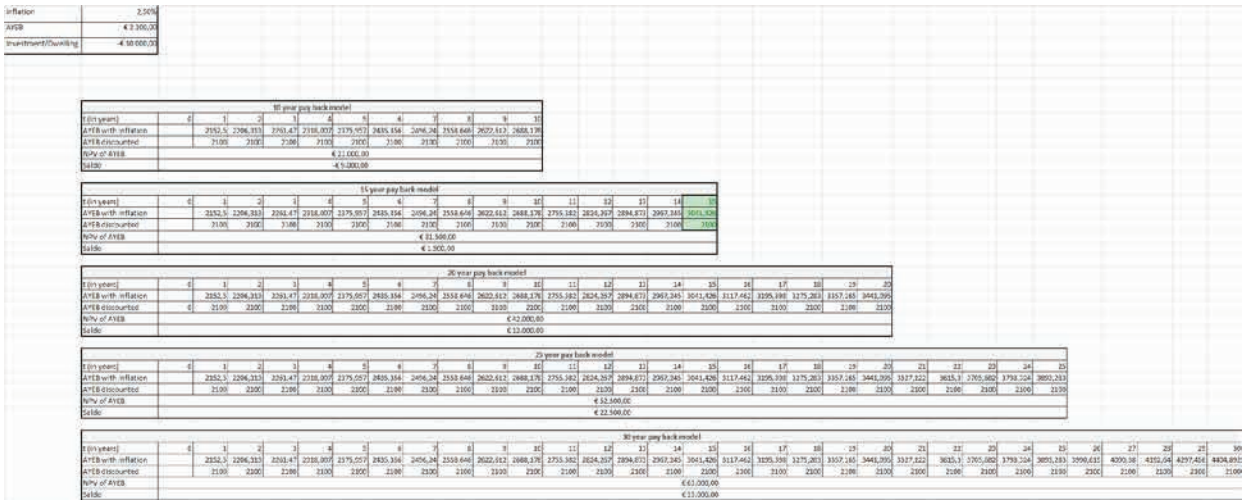


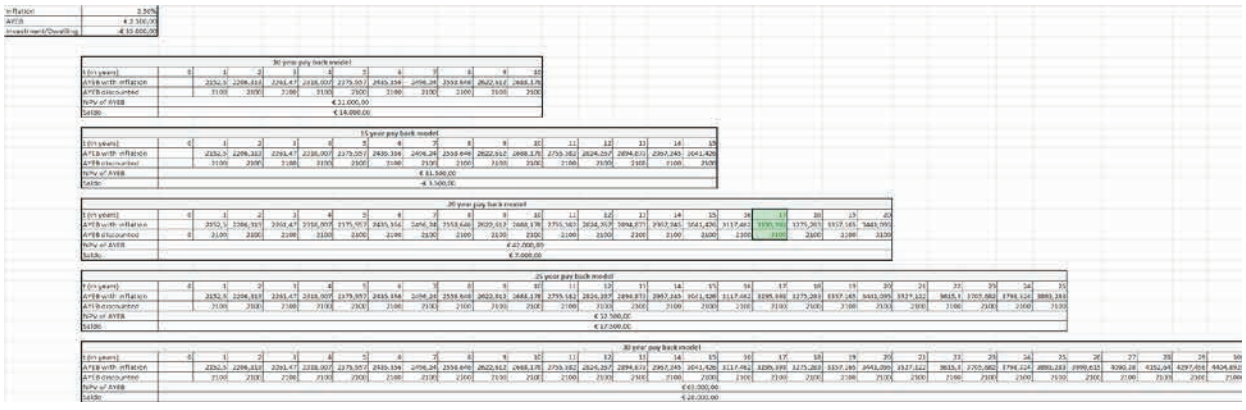


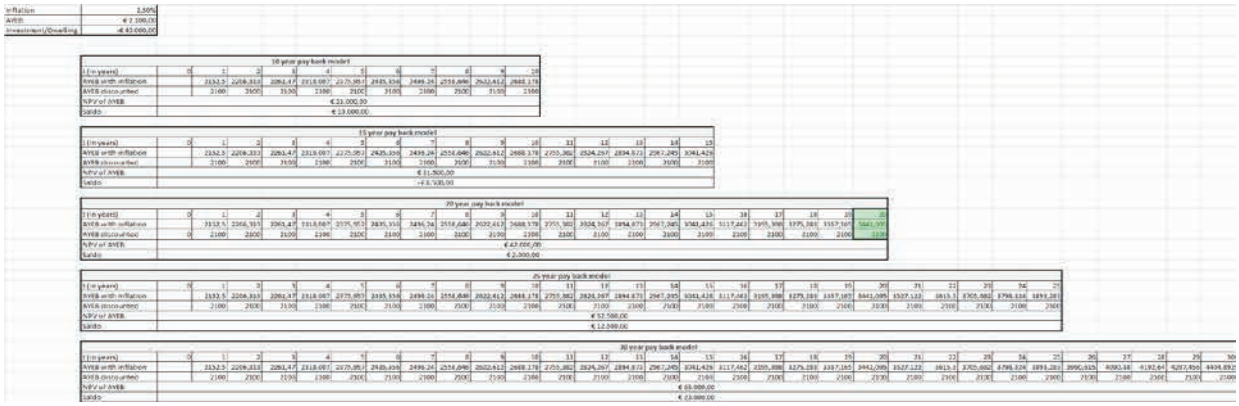


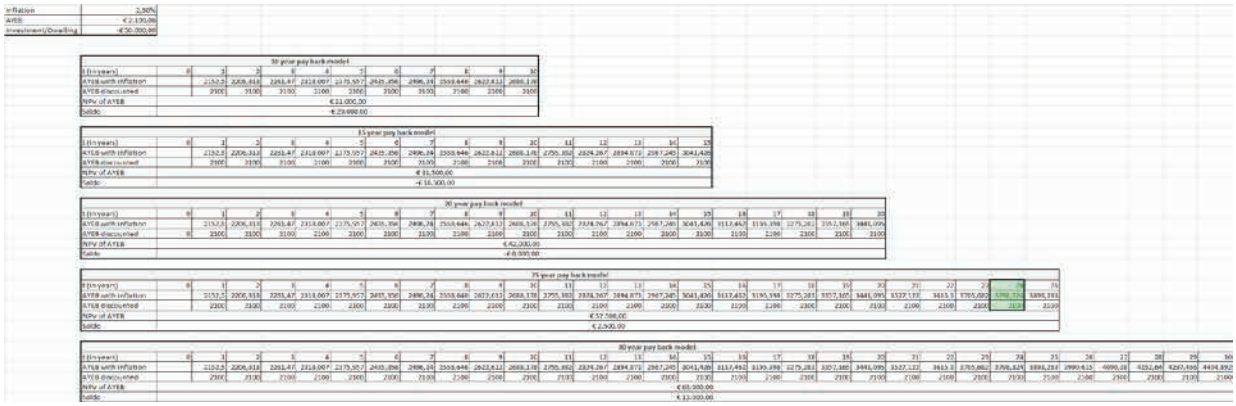


Investment options for housing associations: Tables of AYEB 2.100

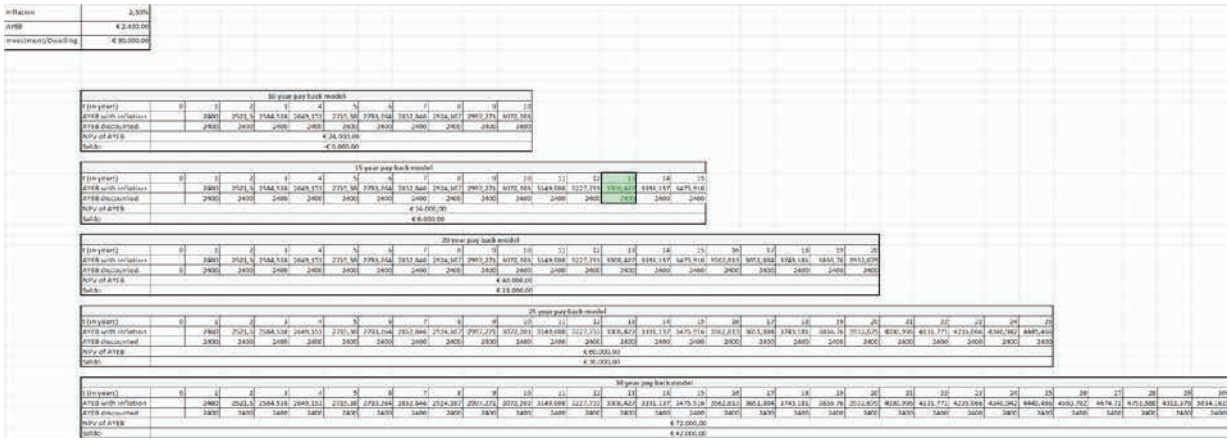


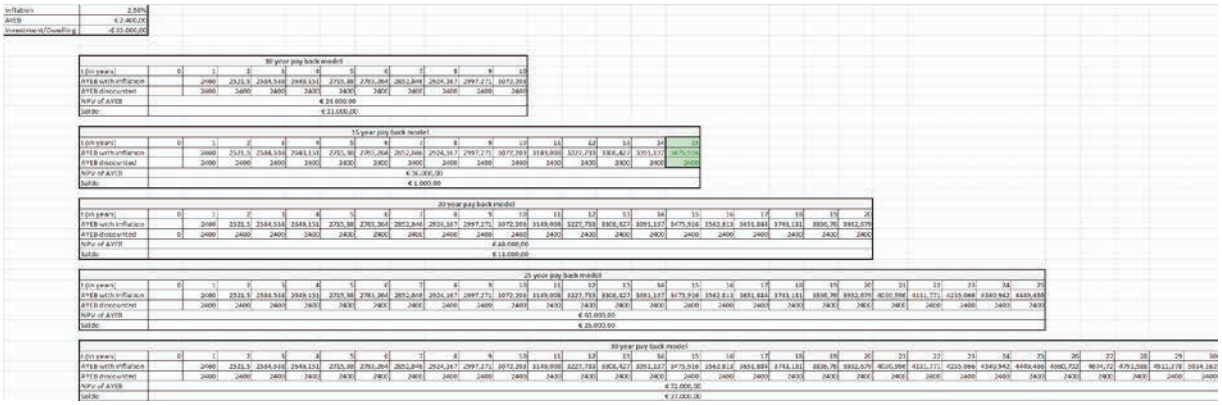






Investment options for housing associations: Tables of AYEB 2.400





Inflation	2.50%
AYEB	€ 2.400,00
Investment/Dwelling	-€ 10.000,00

10 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 24.000,00									
Saldo:		-€ 11.000,00									

15 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203	3149,008	3227,733	3308,427	3391,137	3475,916
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 36.000,00														
Saldo:		€ 1.000,00														

20 year pay back model

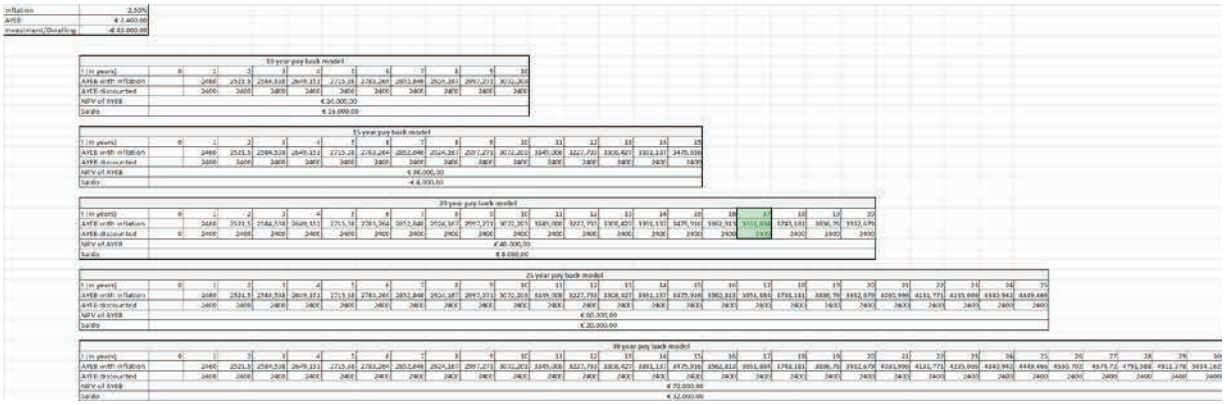
t (in years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203	3149,008	3227,733	3308,427	3391,137	3475,916	3562,813	3651,884	3743,181	3836,76	3932,679
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 48.000,00																			
Saldo:		€ 13.000,00																			

25 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203	3149,008	3227,733	3308,427	3391,137	3475,916	3562,813	3651,884	3743,181	3836,76	3932,679	4030,996	4131,771	4235,066	4340,942	4449,466
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 60.000,00																								
Saldo:		€ 25.000,00																								

30 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203	3149,008	3227,733	3308,427	3391,137	3475,916	3562,813	3651,884	3743,181	3836,76	3932,679	4030,996	4131,771	4235,066	4340,942	4449,466	4560,702	4674,72	4791,588	4911,378	5034,162
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 72.000,00																													
Saldo:		€ 37.000,00																													



Inflation	2.50%
AYEB	€ 2.400,00
Investment/Dwelling	-€ 12.000,00

10 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 24.000,00									
Saldo:		€ 12.000,00									

15 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203	3149,008	3227,733	3308,427	3391,137	3475,916
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 36.000,00														
Saldo:		€ 0,00														

20 year pay back model

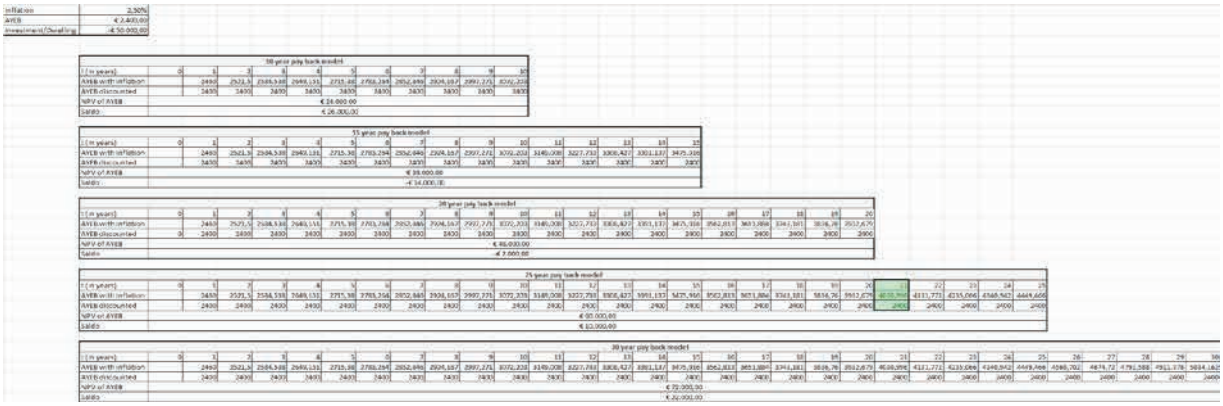
t (in years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203	3149,008	3227,733	3308,427	3391,137	3475,916	3562,813	3651,884	3743,181	3836,76	3932,679
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 48.000,00																			
Saldo:		€ 0,00																			

25 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203	3149,008	3227,733	3308,427	3391,137	3475,916	3562,813	3651,884	3743,181	3836,76	3932,679	4030,996	4131,771	4235,066	4340,942	4449,466
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 60.000,00																								
Saldo:		€ 20.000,00																								

30 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203	3149,008	3227,733	3308,427	3391,137	3475,916	3562,813	3651,884	3743,181	3836,76	3932,679	4030,996	4131,771	4235,066	4340,942	4449,466	4560,702	4674,72	4791,588	4911,378	5034,162
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 72.000,00																													
Saldo:		€ 42.000,00																													



Inflation	2.50%
AYEB	€ 2.400,00
Investment/Dwelling	-€ 50.000,00

10 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 24.000,00									
Saldo:		-€ 26.000,00									

15 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203	3149,008	3227,733	3308,427	3391,137	3475,916
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 36.000,00														
Saldo:		-€ 14.000,00														

20 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203	3149,008	3227,733	3308,427	3391,137	3475,916	3562,813	3651,884	3743,181	3836,76	3932,679
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 48.000,00																			
Saldo:		-€ 2.000,00																			

25 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203	3149,008	3227,733	3308,427	3391,137	3475,916	3562,813	3651,884	3743,181	3836,76	3932,679	4030,996	4131,771	4235,066	4340,942	4449,466
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 60.000,00																								
Saldo:		€ 10.000,00																								

30 year pay back model

t (in years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
AYEB with inflation		2460	2521,5	2584,538	2649,151	2715,38	2783,264	2852,846	2924,167	2997,271	3072,203	3149,008	3227,733	3308,427	3391,137	3475,916	3562,813	3651,884	3743,181	3836,76	3932,679	4030,996	4131,771	4235,066	4340,942	4449,466	4560,702	4674,72	4791,588	4911,378	5034,162
AYEB discounted		2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
NPV of AYEB		€ 72.000,00																													
Saldo:		€ 22.000,00																													



3 Installations' Equipment and Material Datasheets

3.1 Electrical Installation

System pro *M* compact ®

Miniature circuit-breakers
S 200 series

S 200-D

D

6000
3


SK 018 B 01


SK 019 B 01


SK 020 B 019


SK 030 B 01

Selection table

No. of poles	rated current I_n A	order details type code	order code	bbn 40 16779 EAN	price 1 piece €	price group	w'ght 1 pc. kg	pack. unit pc.
1	0.5	**S 201-D 0.5**	2CDS 251 001 R0981	**52993 8**			0.125	10/40
	1	**S 201-D 1**	2CDS 251 001 R0011	**52994 5**				
	1.6	**S 201-D 1.6**	2CDS 251 001 R0971	**52995 2**				
	2	**S 201-D 2**	2CDS 251 001 R0021	**52996 9**				
	3	**S 201-D 3**	2CDS 251 001 R0031	**52997 6**				
	4	**S 201-D 4**	2CDS 251 001 R0041	**52998 3**				
	6	**S 201-D 6**	2CDS 251 001 R0061	**52999 0**				
	8	**S 201-D 8**	2CDS 251 001 R0081	**53000 2**				
	10	**S 201-D 10**	2CDS 251 001 R0101	**53001 9**				
	13	**S 201-D 13**	2CDS 251 001 R0131	**53002 6**				
	16	**S 201-D 16**	2CDS 251 001 R0161	**53003 3**				
	20 ①	**S 201-D 20**	2CDS 251 001 R0201	**53004 0**				
U_{Bmax} 440 V ~ 60 V ⎓	25	**S 201-D 25**	2CDS 251 001 R0251	**53005 7**				
	32 ②	**S 201-D 32**	2CDS 251 001 R0321	**53006 4**				
	40 ③	**S 201-D 40**	2CDS 251 001 R0401	**53007 1**				
	50	**S 201-D 50**	2CDS 251 001 R0501	**55199 1**				
	63	**S 201-D 63**	2CDS 251 001 R0631	**55200 4**				
2	0.5	**S 202-D 0.5**	2CDS 252 001 R0981	**53048 4**			0.250	5/20
	1	**S 202-D 1**	2CDS 252 001 R0011	**53049 1**				
	1.6	**S 202-D 1.6**	2CDS 252 001 R0971	**53050 7**				
	2	**S 202-D 2**	2CDS 252 001 R0021	**53051 4**				
	3	**S 202-D 3**	2CDS 252 001 R0031	**53052 1**				
	4	**S 202-D 4**	2CDS 252 001 R0041	**53053 8**				
	6	**S 202-D 6**	2CDS 252 001 R0061	**53054 5**				
	8	**S 202-D 8**	2CDS 252 001 R0081	**53055 2**				
	10	**S 202-D 10**	2CDS 252 001 R0101	**53058 3**				
	13	**S 202-D 13**	2CDS 252 001 R0131	**53060 6**				
	16	**S 202-D 16**	2CDS 252 001 R0161	**53061 3**				
	20	**S 202-D 20**	2CDS 252 001 R0201	**53063 7**				
U_{Bmax} 440 V ~ 125 V ⎓ ④	25	**S 202-D 25**	2CDS 252 001 R0251	**53064 4**				
	32	**S 202-D 32**	2CDS 252 001 R0321	**53065 1**				
	40	**S 202-D 40**	2CDS 252 001 R0401	**53066 8**				
	50	**S 202-D 50**	2CDS 252 001 R0501	**55203 5**				
	63	**S 202-D 63**	2CDS 252 001 R0631	**55204 2**				
3	0.5	**S 203-D 0.5**	2CDS 253 001 R0981	**53081 1**			0.375	3/12
	1	**S 203-D 1**	2CDS 253 001 R0011	**53082 8**				
	1.6	**S 203-D 1.6**	2CDS 253 001 R0971	**53083 5**				
	2	**S 203-D 2**	2CDS 253 001 R0021	**53084 2**				
	3	**S 203-D 3**	2CDS 253 001 R0031	**53085 9**				
	4	**S 203-D 4**	2CDS 253 001 R0041	**53086 6**				
	6	**S 203-D 6**	2CDS 253 001 R0061	**53088 0**				
	8	**S 203-D 8**	2CDS 253 001 R0081	**53089 7**				
	10	**S 203-D 10**	2CDS 253 001 R0101	**53090 3**				
	13	**S 203-D 13**	2CDS 253 001 R0131	**53091 0**				
	16	**S 203-D 16**	2CDS 253 001 R0161	**53092 7**				
	20 ①	**S 203-D 20**	2CDS 253 001 R0201	**53093 4**				
U_{Bmax} 440 V ~	25	**S 203-D 25**	2CDS 253 001 R0251	**53094 1**				
	32 ②	**S 203-D 32**	2CDS 253 001 R0321	**53095 8**				
	40 ③	**S 203-D 40**	2CDS 253 001 R0401	**53096 5**				
	50	**S 203-D 50**	2CDS 253 001 R0501	**55205 9**				
	63	**S 203-D 63**	2CDS 253 001 R0631	**55206 6**				
4	0.5	**S 204-D 0.5**	2CDS 254 001 R0981	**53112 2**			0.500	2
	1	**S 204-D 1**	2CDS 254 001 R0011	**53113 9**				
	1.6	**S 204-D 1.6**	2CDS 254 001 R0971	**53114 6**				
	2	**S 204-D 2**	2CDS 254 001 R0021	**53115 3**				
	3	**S 204-D 3**	2CDS 254 001 R0031	**53116 0**				
	4	**S 204-D 4**	2CDS 254 001 R0041	**53117 7**				
	6	**S 204-D 6**	2CDS 254 001 R0061	**53118 4**				
	8	**S 204-D 8**	2CDS 254 001 R0081	**53119 1**				
	10	**S 204-D 10**	2CDS 254 001 R0101	**53120 7**				
	13	**S 204-D 13**	2CDS 254 001 R0131	**53121 4**				
U_{Bmax} 440 V ~ 125 V ⎓ ④	16	**S 204-D 16**	2CDS 254 001 R0161	**53122 1**				
	20	**S 204-D 20**	2CDS 254 001 R0201	**53123 8**				
	25	**S 204-D 25**	2CDS 254 001 R0251	**53129 0**				
	32	**S 204-D 32**	2CDS 254 001 R0321	**53130 6**				
	40	**S 204-D 40**	2CDS 254 001 R0401	**53131 3**				
	50	**S 204-D 50**	2CDS 254 001 R0501	**55209 7**				
	63	**S 204-D 63**	2CDS 254 001 R0631	**55210 3**				

① suitable for flow-type heaters 12 kW
② suitable for flow-type heaters 18 kW
③ suitable for flow-type heaters 21, 24 and 27 kW
④ U_{Bmax} 125 V ⎓ with 2 poles connected in series

B

10000
3



SK 032 B 02

Selection table

No. of poles	rated current I_n A	order details type code	order code	bbn 40 16779 EAN	price 1 piece €	price group	w'ght 1 pc. kg	pack. unit pc.
1	6	**S 201 M-B 6**	2CDS 271 001 R0065	**54942 4**			0.125	10/40
	10	**S 201 M-B 10**	2CDS 271 001 R0105	**54943 1**				
	13	**S 201 M-B 13**	2CDS 271 001 R0135	**54944 8**				
	16	**S 201 M-B 16**	2CDS 271 001 R0165	**54945 5**				
	20 ①	**S 201 M-B 20**	2CDS 271 001 R0205	**54946 2**				
	25	**S 201 M-B 25**	2CDS 271 001 R0255	**54947 9**				
U_{Bmax} 440 V ~ 60 V ⎓	32 ②	**S 201 M-B 32**	2CDS 271 001 R0325	**54948 6**				
	40 ③	**S 201 M-B 40**	2CDS 271 001 R0405	**54949 3**				
	50	**S 201 M-B 50**	2CDS 271 001 R0505	**54381 1**				
	63	**S 201 M-B 63**	2CDS 271 001 R0635	**54382 8**				
2	6	**S 202 M-B 6**	2CDS 272 001 R0065	**54958 5**			0.250	5/20
	10	**S 202 M-B 10**	2CDS 272 001 R0105	**54959 2**				
	13	**S 202 M-B 13**	2CDS 272 001 R0135	**54960 8**				
	16	**S 202 M-B 16**	2CDS 272 001 R0165	**54961 5**				
	20	**S 202 M-B 20**	2CDS 272 001 R0205	**54962 2**				
	25	**S 202 M-B 25**	2CDS 272 001 R0255	**54963 9**				
U_{Bmax} 440 V ~ 125 V ⎓ ④	32	**S 202 M-B 32**	2CDS 272 001 R0325	**54964 6**				
	40	**S 202 M-B 40**	2CDS 272 001 R0405	**54965 3**				
	50	**S 202 M-B 50**	2CDS 272 001 R0505	**54385 9**				
	63	**S 202 M-B 63**	2CDS 272 001 R0635	**54386 6**				
3	6	**S 203 M-B 6**	2CDS 273 001 R0065	**54966 0**			0.375	3/12
	10	**S 203 M-B 10**	2CDS 273 001 R0105	**54967 7**				
	13	**S 203 M-B 13**	2CDS 273 001 R0135	**54968 4**				
	16	**S 203 M-B 16**	2CDS 273 001 R0165	**54969 1**				
	20 ①	**S 203 M-B 20**	2CDS 273 001 R0205	**54970 7**				
	25	**S 203 M-B 25**	2CDS 273 001 R0255	**54971 4**				
U_{Bmax} 440 V ~	32 ②	**S 203 M-B 32**	2CDS 273 001 R0325	**54972 1**				
	40 ③	**S 203 M-B 40**	2CDS 273 001 R0405	**54973 8**				
	50	**S 203 M-B 50**	2CDS 273 001 R0505	**54387 3**				
	63	**S 203 M-B 63**	2CDS 273 001 R0635	**54388 0**				
4	6	**S 204 M-B 6**	2CDS 274 001 R0065	**54982 0**			0.500	2
	10	**S 204 M-B 10**	2CDS 274 001 R0105	**54983 7**				
	13	**S 204 M-B 13**	2CDS 274 001 R0135	**54984 4**				
	16	**S 204 M-B 16**	2CDS 274 001 R0165	**54985 1**				
	20	**S 204 M-B 20**	2CDS 274 001 R0205	**54986 8**				
	25	**S 204 M-B 25**	2CDS 274 001 R0255	**54987 5**				
U_{Bmax} 440 V ~ 125 V ⎓ ④	32	**S 204 M-B 32**	2CDS 274 001 R0325	**54988 2**				
	40	**S 204 M-B 40**	2CDS 274 001 R0405	**54989 9**				
	50	**S 204 M-B 50**	2CDS 274 001 R0505	**54391 0**				
	63	**S 204 M-B 63**	2CDS 274 001 R0635	**54392 7**				

① suitable for flow-type heaters 12 kW
② suitable for flow-type heaters 18 kW
③ suitable for flow-type heaters 21, 24 and 27 kW
④ U_{Bmax} 125 V ⎓ with 2 poles connected in series

S 200 M-B

B

10000
3



SK 032 B 02

Selection table

No. of poles	rated current I_n A	order details type code	order code	bbn 40 16779 EAN	price 1 piece €	price group	w'ght 1 pc. kg	pack. unit pc.
With disconnecting neutral NA								
1 + NA	6	**S 201 M-B 6 NA**	2CDS 271 103 R0065	**54950 9**			0.250	50/40
	10	**S 201 M-B 10 NA**	2CDS 271 103 R0105	**54951 6**				
	13	**S 201 M-B 13 NA**	2CDS 271 103 R0135	**54952 3**				
	16	**S 201 M-B 16 NA**	2CDS 271 103 R0165	**54953 0**				
	20 ①	**S 201 M-B 20 NA**	2CDS 271 103 R0205	**54954 7**				
	25	**S 201 M-B 25 NA**	2CDS 271 103 R0255	**54955 4**				
U_{Bmax} 440 V ~ 60 V ⎓	32 ②	**S 201 M-B 32 NA**	2CDS 271 103 R0325	**54956 1**				
	40 ③	**S 201 M-B 40 NA**	2CDS 271 103 R0405	**54957 8**				
	50	**S 201 M-B 50 NA**	2CDS 271 103 R0505	**54383 5**				
	63	**S 201 M-B 63 NA**	2CDS 271 103 R0635	**54384 2**				
3 + NA	6	**S 203 M-B 6 NA**	2CDS 273 103 R0065	**54974 5**			0.500	2/20
	10	**S 203 M-B 10 NA**	2CDS 273 103 R0105	**54975 2**				
	13	**S 203 M-B 13 NA**	2CDS 273 103 R0135	**54976 9**				
	16	**S 203 M-B 16 NA**	2CDS 273 103 R0165	**54977 6**				
	20 ①	**S 203 M-B 20 NA**	2CDS 273 103 R0205	**54978 3**				
	25	**S 203 M-B 25 NA**	2CDS 273 103 R0255	**54979 0**				
U_{Bmax} 440 V ~	32 ②	**S 203 M-B 32 NA**	2CDS 273 103 R0325	**54980 6**				
	40 ③	**S 203 M-B 40 NA**	2CDS 273 103 R0405	**54981 3**				
	50	**S 203 M-B 50 NA**	2CDS 273 103 R0505	**54389 7**				
	63	**S 203 M-B 63 NA**	2CDS 273 103 R0635	**54390 3**			0.580	

① suitable for flow-type heaters 12 kW
② suitable for flow-type heaters 18 kW
③ suitable for flow-type heaters 21, 24 and 27 kW

C

10000
3


SK 044 B 02


SK 045 B 02


SK 046 B 02

Selection table

No. of poles	rated current I_n A	order details type code	order code	bbn 40 16779 EAN	price 1 piece €	price group	w'ght 1 pc. kg	pack. unit pc.
1	0.5	**S 201 M-C 0.5**	2CDS 271 001 R0984	**54990 5**			0.125	10/40
	1	**S 201 M-C 1**	2CDS 271 001 R0014	**54992 9**				
	1.6	**S 201 M-C 1.6**	2CDS 271 001 R0974	**54991 2**				
	2	**S 201 M-C 2**	2CDS 271 001 R0024	**54993 6**				
	3	**S 201 M-C 3**	2CDS 271 001 R0034	**54994 3**				
	4	**S 201 M-C 4**	2CDS 271 001 R0044	**54995 0**				
	6	**S 201 M-C 6**	2CDS 271 001 R0064	**54996 7**				
	8	**S 201 M-C 8**	2CDS 271 001 R0084	**54997 4**				
	10	**S 201 M-C 10**	2CDS 271 001 R0104	**54998 1**				
	13	**S 201 M-C 13**	2CDS 271 001 R0134	**54999 8**				
	16	**S 201 M-C 16**	2CDS 271 001 R0164	**55000 0**				
	20 ①	**S 201 M-C 20**	2CDS 271 001 R0204	**55001 7**				
U_{Bmax} 440 V ~	25	**S 201 M-C 25**	2CDS 271 001 R0254	**55002 4**				
	32 ②	**S 201 M-C 32**	2CDS 271 001 R0324	**55003 1**				
60 V ⎓	40 ③	**S 201 M-C 40**	2CDS 271 001 R0404	**55004 8**				
	50	**S 201 M-C 50**	2CDS 271 001 R0504	**54393 4**				
	63	**S 201 M-C 63**	2CDS 271 001 R0634	**54394 1**				
2	0.5	**S 202 M-C 0.5**	2CDS 272 001 R0984	**55020 8**			0.250	5/20
	1	**S 202 M-C 1**	2CDS 272 001 R0014	**55022 2**				
	1.6	**S 202 M-C 1.6**	2CDS 272 001 R0974	**55021 5**				
	2	**S 202 M-C 2**	2CDS 272 001 R0024	**55023 9**				
	3	**S 202 M-C 3**	2CDS 272 001 R0034	**55024 6**				
	4	**S 202 M-C 4**	2CDS 272 001 R0044	**55025 3**				
	6	**S 202 M-C 6**	2CDS 272 001 R0064	**55026 0**				
	8	**S 202 M-C 8**	2CDS 272 001 R0084	**55027 7**				
	10	**S 202 M-C 10**	2CDS 272 001 R0104	**55028 4**				
	13	**S 202 M-C 13**	2CDS 272 001 R0134	**55029 1**				
	16	**S 202 M-C 16**	2CDS 272 001 R0164	**55030 7**				
	20	**S 202 M-C 20**	2CDS 272 001 R0204	**55031 4**				
U_{Bmax} 440 V ~	25	**S 202 M-C 25**	2CDS 272 001 R0254	**55032 1**				
	32	**S 202 M-C 32**	2CDS 272 001 R0324	**55033 8**				
125 V ⎓	40	**S 202 M-C 40**	2CDS 272 001 R0404	**55034 5**				
④	50	**S 202 M-C 50**	2CDS 272 001 R0504	**54397 2**				
	63	**S 202 M-C 63**	2CDS 272 001 R0634	**54398 9**				
3	0.5	**S 203 M-C 0.5**	2CDS 273 001 R0984	**55035 2**			0.375	3/12
	1	**S 203 M-C 1**	2CDS 273 001 R0014	**55037 6**				
	1.6	**S 203 M-C 1.6**	2CDS 273 001 R0974	**55036 9**				
	2	**S 203 M-C 2**	2CDS 273 001 R0024	**55038 3**				
	3	**S 203 M-C 3**	2CDS 273 001 R0034	**55039 0**				
	4	**S 203 M-C 4**	2CDS 273 001 R0044	**55040 6**				
	6	**S 203 M-C 6**	2CDS 273 001 R0064	**55041 3**				
	8	**S 203 M-C 8**	2CDS 273 001 R0084	**55042 0**				
	10	**S 203 M-C 10**	2CDS 273 001 R0104	**55043 7**				
	13	**S 203 M-C 13**	2CDS 273 001 R0134	**55044 4**				
	16	**S 203 M-C 16**	2CDS 273 001 R0164	**55045 1**				
	20 ①	**S 203 M-C 20**	2CDS 273 001 R0204	**55046 8**				
U_{Bmax} 440 V ~	25	**S 203 M-C 25**	2CDS 273 001 R0254	**55047 5**				
	32 ②	**S 203 M-C 32**	2CDS 273 001 R0324	**55048 2**				
	40 ③	**S 203 M-C 40**	2CDS 273 001 R0404	**55049 9**				
	50	**S 203 M-C 50**	2CDS 273 001 R0504	**54399 6**				
	63	**S 203 M-C 63**	2CDS 273 001 R0634	**54400 9**				
4	0.5	**S 204 M-C 0.5**	2CDS 274 001 R0984	**55065 9**			0.500	2
	1	**S 204 M-C 1**	2CDS 274 001 R0014	**55067 3**				
	1.6	**S 204 M-C 1.6**	2CDS 274 001 R0974	**55066 6**				
	2	**S 204 M-C 2**	2CDS 274 001 R0024	**55068 0**				
	3	**S 204 M-C 3**	2CDS 274 001 R0034	**55069 7**				
	4	**S 204 M-C 4**	2CDS 274 001 R0044	**55070 3**				
	6	**S 204 M-C 6**	2CDS 274 001 R0064	**55071 0**				
	8	**S 204 M-C 8**	2CDS 274 001 R0084	**55072 7**				
	10	**S 204 M-C 10**	2CDS 274 001 R0104	**55073 4**				
	13	**S 204 M-C 13**	2CDS 274 001 R0134	**55074 1**				
	16	**S 204 M-C 16**	2CDS 274 001 R0164	**55075 8**				
	20	**S 204 M-C 20**	2CDS 274 001 R0204	**55076 5**				
U_{Bmax} 440 V ~	25	**S 204 M-C 25**	2CDS 274 001 R0254	**55077 2**				
	32	**S 204 M-C 32**	2CDS 274 001 R0324	**55078 9**				
125 V ⎓	40	**S 204 M-C 40**	2CDS 274 001 R0404	**55079 6**				
④	50	**S 204 M-C 50**	2CDS 274 001 R0504	**54403 0**				
	63	**S 204 M-C 63**	2CDS 274 001 R0634	**54404 7**				

① suitable for flow-type heaters 12 kW
② suitable for flow-type heaters 18 kW
③ suitable for flow-type heaters 21, 24 and 27 kW
④ U_{Bmax} 125 V ⎓ with 2 poles connected in series

S 200 M-C

C

10000
3



SK 032 B 02

Attention:
S 200 M, B and C
with integrated auxiliary contact
on request.

Selection table

No. of poles	rated current I_n, A	order details type code	order code	bbn 40 16779 EAN	price 1 piece €	price group	w'ght 1 pc. kg	pack. unit pc.
With disconnecting neutral NA								
1 + NA	0.5	**S 201 M-C 0.5 NA**	2CDS 271 103 R0984	**55005 5**			0.250	5
	1	**S 201 M-C 1 NA**	2CDS 271 103 R0014	**55007 9**				
	1.6	**S 201 M-C 1.6 NA**	2CDS 271 103 R0974	**55006 2**				
	2	**S 201 M-C 2 NA**	2CDS 271 103 R0024	**55008 6**				
	3	**S 201 M-C 3 NA**	2CDS 271 103 R0034	**55009 3**				
	4	**S 201 M-C 4 NA**	2CDS 271 103 R0044	**55010 9**				
	6	**S 201 M-C 6 NA**	2CDS 271 103 R0064	**55011 6**				
	8	**S 201 M-C 8 NA**	2CDS 271 103 R0084	**55012 3**				
	10	**S 201 M-C 10 NA**	2CDS 271 103 R0104	**55013 0**				
	13	**S 201 M-C 13 NA**	2CDS 271 103 R0134	**55014 7**				
	16	**S 201 M-C 16 NA**	2CDS 271 103 R0164	**55015 4**				
	20 ①	**S 201 M-C 20 NA**	2CDS 271 103 R0204	**55016 1**				
U_{Bmax} 440 V ~ 60 V ⎓	25	**S 201 M-C 25 NA**	2CDS 271 103 R0254	**55017 8**				
	32 ②	**S 201 M-C 32 NA**	2CDS 271 103 R0324	**55018 5**				
	40 ③	**S 201 M-C 40 NA**	2CDS 271 103 R0404	**55019 2**				
	50	**S 201 M-C 50 NA**	2CDS 271 103 R0504	**54395 8**			0.290	
	63	**S 201 M-C 63 NA**	2CDS 271 103 R0634	**54396 5**				
3 + NA	0.5	**S 203 M-C 0.5 NA**	2CDS 273 103 R0984	**55051 2**			0.500	2
	1	**S 203 M-C 1 NA**	2CDS 273 103 R0014	**55052 9**				
	1.6	**S 203 M-C 1.6 NA**	2CDS 273 103 R0974	**55050 5**				
	2	**S 203 M-C 2 NA**	2CDS 273 103 R0024	**55053 6**				
	3	**S 203 M-C 3 NA**	2CDS 273 103 R0034	**55054 3**				
	4	**S 203 M-C 4 NA**	2CDS 273 103 R0044	**55055 0**				
	6	**S 203 M-C 6 NA**	2CDS 273 103 R0064	**55056 7**				
	8	**S 203 M-C 8 NA**	2CDS 273 103 R0084	**55057 4**				
	10	**S 203 M-C 10 NA**	2CDS 273 103 R0104	**55058 1**				
	13	**S 203 M-C 13 NA**	2CDS 273 103 R0134	**55059 8**				
	16	**S 203 M-C 16 NA**	2CDS 273 103 R0164	**55060 4**				
	20 ①	**S 203 M-C 20 NA**	2CDS 273 103 R0204	**55061 1**				
U_{Bmax} 440 V ~	25	**S 203 M-C 25 NA**	2CDS 273 103 R0254	**55062 8**				
	32 ②	**S 203 M-C 32 NA**	2CDS 273 103 R0324	**55063 5**				
	40 ③	**S 203 M-C 40 NA**	2CDS 273 103 R0404	**55064 2**				
	50	**S 203 M-C 50 NA**	2CDS 273 103 R0504	**54401 6**			0.580	
	63	**S 203 M-C 63 NA**	2CDS 273 103 R0634	**54402 3**				

① suitable for flow-type heaters 12 kW
② suitable for flow-type heaters 18 kW
③ suitable for flow-type heaters 21, 24 and 27 kW



SK 011 B 02

SC-S/H6R



SK 209 B 02

S 2C-A

Description	order details type code	order code	bbn 40 16779 EAN	price 1 piece €	price group	w'ght 1 pc. kg	pack. unit pc.
Signalcontact/Auxiliary switch (universal) Retrofittable to the right side of MCB's, RCB's and Shunt trip's							
1 change over	**S 2C-S/H6R**	2CDS 200 922 R0001	**56381 9**			0.04	1
Auxiliary contact Retrofittable to the right side of MCB's							
1 change over	**S 2C-H6R**	2CDS 200 912 R0001	**56382 6**			0.04	1
Shunt trip							
AC/DC 12 … 60 V AC 110 … 415 V und DC 110 … 250 V	**S 2C-A1** **S 2C-A2**	2CDS 200 909 R0001 2CDS 200 909 R0002	**57099 2** **57100 5**			0.15	1
Undervoltage release (in preparation)							
DC 12 V	**S 2C-UA 12**	2CDS 200 911 R0001	**57101 2**			0.09	1
AC/DC 24 V	**S 2C-UA 24**	2CDS 200 911 R0002	**57102 9**				
AC/DC 48 V	**S 2C-UA 48**	2CDS 200 911 R0003	**57103 6**				
AC/DC 110 V	**S 2C-UA 110**	2CDS 200 911 R0004	**57104 3**				
AC/DC 220 V	**S 2C-UA 220**	2CDS 200 911 R0005	**57105 0**				
AC 380 V	**S 2C-UA 380**	2CDS 200 911 R0006	**57106 7**				



F200 Residual current devices

F200 Series
Residual current devices

UL 1053 residual current devices

The F200 product range is approved as a UL 1053 recognized component. ABB recommends the installation of F200 RCDs wherever uptime is a critical factor.

Product range

The F200 series includes 2 and 4-pole devices designed to protect against AC ground faults (AC type) and both AC and pulsating DC ground faults (A type). AP-R models provide high resistance to nuisance tripping. Selective S models provide an intentional trip delay.

F200 AC Type

Catalog number	Description
F202AC-16/0.01	RCD F200 2P 16A 10mA AC
F202AC-25/0.03	RCD F200 2P 25A 30mA AC
F202AC-40/0.03	RCD F200 2P 40A 30mA AC
F202AC-63/0.03	RCD F200 2P 63A 30mA AC
F202AC-80/0.03	RCD F200 2P 80A 30mA AC
F202AC-100/0.03	RCD F200 2P 100A 30mA AC
F202AC-25/0.1	RCD F200 2P 25A 100mA AC
F202AC-40/0.1	RCD F200 2P 40A 100mA AC
F202AC-63/0.1	RCD F200 2P 63A 100mA AC
F202AC-80/0.1	RCD F200 2P 80A 100mA AC
F202AC-100/0.1	RCD F200 2P 100A 100mA AC
F202AC-25/0.3	RCD F200 2P 25A 300mA AC
F202AC-40/0.3	RCD F200 2P 40A 300mA AC
F202AC-63/0.3	RCD F200 2P 63A 300mA AC
F202AC-80/0.3	RCD F200 2P 80A 300mA AC
F202AC-100/0.3	RCD F200 2P 100A 300mA AC
F202AC-25/0.5	RCD F200 2P 25A 500mA AC
F202AC-40/0.5	RCD F200 2P 40A 500mA AC
F202AC-63/0.5	RCD F200 2P 63A 500mA AC
F202AC-80/0.5	RCD F200 2P 80A 500mA AC
F202AC-100/0.5	RCD F200 2P 100A 500mA AC
F204AC-25/0.03	RCD F200 4P 25A 30mA AC

Catalog number	Description
F204AC-40/0.03	RCD F200 4P 40A 30mA AC
F204AC-63/0.1	RCD F200 4P 63A 100mA AC
F204AC-80/0.03	RCD F200 4P 80A 30mA AC
F204AC-100/0.03	RCD F200 4P 100A 30mA AC
F204AC-125/0.03 ①	RCD F200 4P 125A 30mA AC
F204AC-25/0.1	RCD F200 4P 25A 100mA AC
F204AC-40/0.1	RCD F200 4P 40A 100mA AC
F204AC-63/0.1	RCD F200 4P 63A 100mA AC
F204AC-80/0.1	RCD F200 4P 80A 100mA AC
F204AC-100/0.1	RCD F200 4P 100A 100mA AC
F204AC-125/0.1 ①	RCD F200 4P 125A 100mA AC
F204AC-25/0.3	RCD F200 4P 25A 300mA AC
F204AC-40/0.3	RCD F200 4P 40A 300mA AC
F204AC-63/0.3	RCD F200 4P 63A 300mA AC
F204AC-80/0.3	RCD F200 4P 80A 300mA AC
F204AC-100/0.3	RCD F200 4P 100A 300mA AC
F204AC-125/0.3 ①	RCD F200 4P 125A 300mA AC
F204AC-25/0.5	RCD F200 4P 25A 500mA AC
F204AC-40/0.5	RCD F200 4P 40A 500mA AC
F204AC-63/0.5	RCD F200 4P 63A 500mA AC
F204AC-80/0.5	RCD F200 4P 80A 500mA AC
F204AC-100/0.5	RCD F200 4P 100A 500mA AC
F204AC-125/0.5 ①	RCD F200 4P 125A 500mA AC

F200 A Type

Catalog number	Description
F202A-16/0.01	RCD F200 2P 16A 10mA A
F202A-25/0.03	RCD F200 2P 25A 30mA A
F202A-40/0.03	RCD F200 2P 40A 30mA A
F202A-63/0.03	RCD F200 2P 63A 30mA A
F202A-80/0.03	RCD F200 2P 80A 30mA A
F202A-100/0.03	RCD F200 2P 100A 30mA A
F202A-25/0.1	RCD F200 2P 25A 100mA A
F202A-40/0.1	RCD F200 2P 40A 100mA A
F202A-63/0.1	RCD F200 2P 63A 100mA A
F202A-80/0.1	RCD F200 2P 80A 100mA A
F202A-100/0.1	RCD F200 2P 100A 100mA A
F202A-25/0.3	RCD F200 2P 25A 300mA A
F202A-40/0.3	RCD F200 2P 40A 300mA A
F202A-63/0.3	RCD F200 2P 63A 300mA A
F202A-80/0.3	RCD F200 2P 80A 300mA A
F202A-100/0.3	RCD F200 2P 100A 300mA A
F202A-25/0.5	RCD F200 2P 25A 500mA A
F202A-40/0.5	RCD F200 2P 40A 500mA A
F202A-63/0.5	RCD F200 2P 63A 500mA A
F202A-80/0.5	RCD F200 2P 80A 500mA A
F202A-100/0.5	RCD F200 2P 100A 500mA A

① 125A versions are not UL approved.

Catalog number	Description
F204A-25/0.03	RCD F200 4P 25A 30mA A
F204A-40/0.03	RCD F200 4P 40A 30mA A
F204A-63/0.03	RCD F200 4P 63A 30mA A
F204A-80/0.03	RCD F200 4P 80A 30mA A
F204A-100/0.03	RCD F200 4P 100A 30mA A
F204A-125/0.03 ①	RCD F200 4P 125A 30mA A
F204A-25/0.1	RCD F200 4P 25A 100mA A
F204A-40/0.1	RCD F200 4P 40A 100mA A
F204A-63/0.1	RCD F200 4P 63A 100mA A
F204A-80/0.1	RCD F200 4P 80A 100mA A
F204A-100/0.1	RCD F200 4P 100A 100mA A
F204A-125/0.1 ①	RCD F200 4P 125A 100mA A
F204A-25/0.3	RCD F200 4P 25A 300mA A
F204A-40/0.3	RCD F200 4P 40A 300mA A
F204A-63/0.3	RCD F200 4P 63A 300mA A
F204A-80/0.3	RCD F200 4P 80A 300mA A
F204A-100/0.3	RCD F200 4P 100A 300mA A
F204A-125/0.3 ①	RCD F200 4P 125A 300mA A
F204A-25/0.5	RCD F200 4P 25A 500mA A
F204A-40/0.5	RCD F200 4P 40A 500mA A
F204A-63/0.5	RCD F200 4P 63A 500mA A

① 125A versions are not UL approved.

Power and productivity
for a better world™

F200 A Type, cont.

Catalog number	Description
F204A-80/0.5	RCD F200 4P 80A 500mA A
F204A-100/0.5	RCD F200 4P 100A 500mA A
F204A-125/0.5 ①	RCD F200 4P 125A 500mA A
F202A-25/0.03APR	RCD F200 2P 25A 30mA A AP-R
F202A-40/0.03APR	RCD F200 2P 40A 30mA A AP-R
F202A-63/0.03APR	RCD F200 2P 63A 30mA A AP-R
F202A-80/0.03APR	RCD F200 2P 80A 30mA A AP-R
F202A-100/0.03APR	RCD F200 2P 100A 30mA A AP-R
F204A-25/0.03APR	RCD F200 4P 25A 30mA A AP-R
F204A-40/0.03APR	RCD F200 4P 40A 30mA A AP-R
F204A-63/0.03APR	RCD F200 4P 63A 30mA A AP-R
F204A-80/0.03APR	RCD F200 4P 80A 30mA A AP-R
F204A-100/0.03APR	RCD F200 4P 100A 30mA A AP-R
F204A-125/0.03APR ①	RCD F200 4P 125A 30mA A AP-R
F202AS-40/0.1	RCD F200 2P 40A 100mA A S
F202AS-63/0.1	RCD F200 2P 63A 100mA A S
F202AS-100/0.1	RCD F200 2P 100A 100mA A S
F202AS-40/0.3	RCD F200 2P 40A 300mA A S
F202AS-63/0.3	RCD F200 2P 63A 300mA A S
F202AS-100/0.3	RCD F200 2P 100A 300mA A S

Catalog number	Description
F202AS-40/0.5	RCD F200 2P 40A 500mA A S
F202AS-63/0.5	RCD F200 2P 63A 500mA A S
F202AS-100/0.5	RCD F200 2P 100A 500mA A S
F202AS-40/1.0	RCD F200 2P 40A 1000mA A S
F202AS-63/1.0	RCD F200 2P 63A 1000mA A S
F202AS-100/1.0	RCD F200 2P 100A 1000mA A S
F204AS-40/0.1	RCD F200 4P 40A 100mA A S
F204AS-63/0.1	RCD F200 4P 63A 100mA A S
F204AS-100/0.1	RCD F200 4P 100A 100mA A S
F204AS-40/0.3	RCD F200 4P 40A 300mA A S
F204AS-63/0.3	RCD F200 4P 63A 300mA A S
F204AS-100/0.3	RCD F200 4P 100A 300mA A S
F204AS-125/0.3 ①	RCD F200 4P 125A 300mA A S
F204AS-40/0.5	RCD F200 4P 40A 500mA A S
F204AS-63/0.5	RCD F200 4P 63A 500mA A S
F204AS-100/0.5	RCD F200 4P 100A 500mA A S
F204AS-125/0.5 ①	RCD F200 4P 125A 500mA A S
F204AS-40/1.0	RCD F200 4P 40A 1000mA A S
F204AS-63/1.0	RCD F200 4P 63A 1000mA A S
F204AS-100/1.0	RCD F200 4P 100A 1000mA A S

① 125A versions are not UL approved.

Technical data

Item	F200AC	F200A
Standards		
UL	1053	1053
CSA	-	-
VDE	-	-
IEC	61008	61008
Number of poles	2, 4	2, 4
Rated currents	16, 25, 40, 63, 80, 100, 125 A ①	16, 25, 40, 63, 80, 100, 125 A ①
Operating voltage	480Y/277 VAC	480Y/277 VAC
Sensitivity IΔn	10, 30, 100, 300, 500, 1000 mA	10, 30, 100, 300, 500, 1000 mA
Pick up current	0.65 x Sensitivity IΔn	0.65 x Sensitivity IΔn
Rated conditional short-circuit current Inc=IΔc with gG fuse 100 A ②	10 kA	10 kA
Rated residual breaking capacity IΔm=Im	1 kA	1 kA
Working temperature	-25...+55°C	-25...+55°C
CPI	yes	yes
Protection category	IP20	IP20
Depth of unit per DIN 43880	68 mm/ 2.68 in.	68 mm/ 2.68 in.
Mounting position	vertical, horizontal	vertical, horizontal
Standard mounting	35 mm DIN rail	35 mm DIN rail

① 125 A versions are not UL approved.
② For 125 A F200, the fuse is gG 125 A

Item	F200A AP-R	F200A S
Standards		
UL	1053	1053
CSA	-	-
VDE	-	-
IEC	61008	61008
Number of poles	2, 4	2, 4
Rated currents	25, 40, 63, 80, 100, 125 A ①	40, 63, 100, 125 A ①
Operating voltage	480Y/277 VAC	480Y/277 VAC
Sensitivity IΔn	10, 30, 100, 300, 500, 1000 mA	10, 30, 100, 300, 500, 1000 mA
Pick up current	0.65 x Sensitivity IΔn	0.65 x Sensitivity IΔn
Rated conditional short-circuit current Inc=IΔc with gG fuse 100 A ②	10 kA	10 kA
Rated residual breaking capacity IΔm=Im	1 kA	1 kA
Working temperature	-25...+55°C	-25...+55°C
CPI	yes	yes
Protection category	IP20	IP20
Depth of unit per DIN 43880	68 mm/ 2.68 in.	68 mm/ 2.68 in.
Mounting position	vertical, horizontal	vertical, horizontal
Standard mounting	35 mm DIN rail	35 mm DIN rail

① 125 A versions are not UL approved.
② For 125 A F200, the fuse is gG 125 A

1SXU430065L0201 Rev.C April 2013

ABB Inc.
Low Voltage Control Products
16250 W. Glendale Drive
New Berlin, WI 53151
Phone: 888-385-1221
Fax: 800-726-1441
Web: www.abb.us/lowvoltage

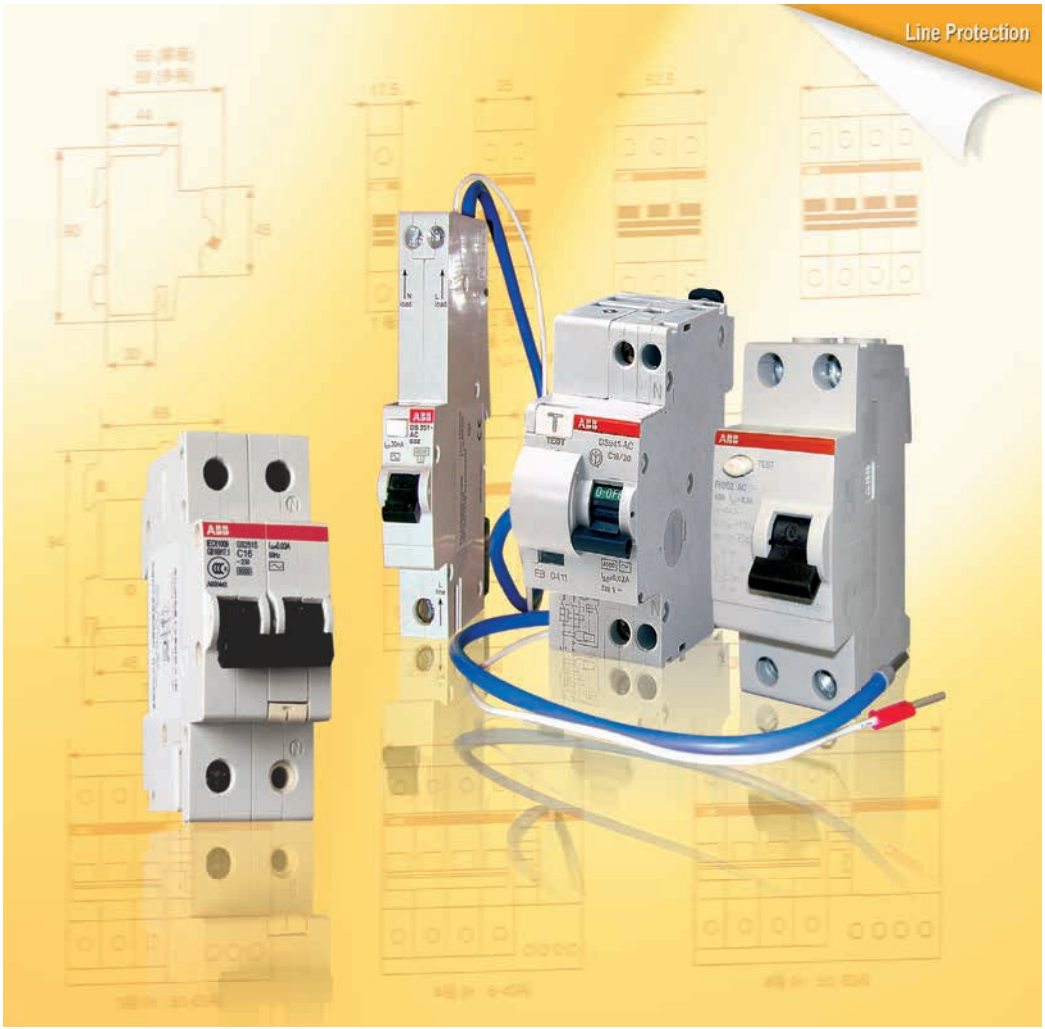
Power and productivity
for a better world™

Technical Data

Residual Current Devices (RCD)

- GS250S
- DS251
- DS271
- DS9
- FH200
- F200

1SXE401001L0201 05-2008



Residual Current Devices (RCD)

Product Overview









The “Earthed Fault Current” is the flow of electricity from the power supply leaking towards the earth, under faulty electrical condition. Its degree of danger depends on the amount of leakage and the surrounding conditions.

Users of leaking equipment may get electrical shock. If this current persists for a long time, fire hazard may be caused. A residual current operated circuit breaker can be installed on the distribution system in order to detect the leakage and cut off the circuit before any damaged occurs.

ABB’s offer both residual current operated breaker with (the RCBO) and without (the RCCB) integral over-current protection. Both breakers employ zero current transformer (ZCT) and permanent electro-magnet or electronic tripping mechanism, giving a high sensitivity for detecting and cutting off faulty current.

GS250S - electronic RCBO

The earthed protection devices GS250S series protects users against leakage current. The rated leakage current to activate these devices can be chosen from 10mA, 30mA or 300mA.

The series adopts a specially designed residual current detection CMOS chips with anti-jamming capability. The device conforms to the IEC61000-4 electromagnetic compatibility (EMC) requirements.

DS251 & DS271 - electronic RCBO

Besides protection against earthed faults, the DS251 & DS271 series electronic RCBO also protect the single-phase circuits from overloading or short circuit.

DS9 - electromagnetic RCBO

The electromagnetic RCBO series DS9 offers a complete protection for single-phase circuit. The series has innovative two-colour operation lever (red and green), which enables users to check the status of the device in a distance. Also the tripping status can be observed on the front indicator window of the device.

The rated leakage current to activate these devices can be chosen from 30mA. The breaking current capacities according to IEC 61009 are 4.5kA (DS941 type), 6kA (DS951 type) and 10kA (DS971 type).

FH200 and F200 - RCCB

RCCBs are only sensitive to current leakage to earth. They must be used in series with an MCB or fuse which protects them from the potentially damaging thermal and dynamic stresses of any overcurrents.

These devices are used in systems already equipped with MCBs which preferably limit the specific energy passing through, also acting as the main disconnecting switches upstream of any derived MCBs (e.g. domestic consumer unit).

Residual Current Devices (RCD)

Technical Data



Type	GS250S		DS251	DS271	DS9	FH200 / F200
Standards	IEC61009		IEC61009, BSEN 61009-2-2		IEC61009	IEC61008
Pole	1 + NA	2, 3, 4	1 + NA	1 + NA	1 + NA	2, 4
Tripping Characteristics	C	C、D	C	B、C	C	-
Tripping Type	Electronic Type				Electro-Magnetic Type	
Rated breaking capacity Icu	6kA	6kA (6-40A) 4.5kA (50, 63A)	6kA	10kA	10kA (DS971) 6kA (DS951) 4.5kA (DS941)	-
Rated current In	6 - 40A	6 - 63A	6 - 32A	6 - 32A	6 - 40A	25 - 63A (FH200) 80 - 100A (F200)
Rated voltage Un / AC	230V	230 / 400V	230 / 240V	230 / 240V	230V	230 / 400V
Type	AC	AC, A	AC	AC	AC	AC
Rated sensitivity	0.01, 0.03	0.01, 0.03, 0.3	0.03	0.01, 0.03, 0.1	0.03	0.03, 0.1, 0.3
Frequency Hz	50 - 60					
Mechanical Life no. of operation	20,000					
Protection degree Terminals Housing	IP20 IP40					
Ambient temperature Operating Temperature °C Storage Temperature °C	-25...+55 -40...+70		-25...+55 -25...+70		-25...+55 -35...+70	
Tropicalization (IEC 60068-2) constant climate conditions [°C/RH] variable climate conditions [°C/RH]	23/83, 40/93, 55/20 25/95, 40/93					
Terminal Size mm²	0.75 - 16		1 - 25 (Line side) 1 - 10 (Load side)		1 - 16	1 - 25
Tightening Torque Nm	2		2 (Line side) 1.2 (Load side)		2	

Residual Current Devices (RCD)

Order Information

Type Designation

GS2□ □ S - □ □ / □

- Rated residual current：0.03A or 0.01A
- Rated current：6、10、16、20、25、32、40、50、63A
- Tripping Characteristics：C、D
- Pole：1 + NA、2、3、4
- Type（Electronic Type）



GS250S (RCBO)

C Characteristic

Rated current (A)	Rated residual current (mA)	AC (Tripping time：Instantaneous)			
		1 Pole + NA	2 Poles	3 Poles	4 Poles
6	10	-	GS252S-C6 / 0.01	GS253S-C6 / 0.01	GS254S-C6 / 0.01
10		-	GS252S-C10 / 0.01	GS253S-C10 / 0.01	GS254S-C10 / 0.01
16		-	GS252S-C16 / 0.01	GS253S-C16 / 0.01	GS254S-C16 / 0.01
20		-	GS252S-C20 / 0.01	GS253S-C20 / 0.01	GS254S-C20 / 0.01
25		-	GS252S-C25 / 0.01	GS253S-C25 / 0.01	GS254S-C25 / 0.01
32		-	GS252S-C32 / 0.01	GS253S-C32 / 0.01	GS254S-C32 / 0.01
40		-	GS252S-C40 / 0.01	GS253S-C40 / 0.01	GS254S-C40 / 0.01
50		-	GS252S-C50 / 0.01	GS253S-C50 / 0.01	GS254S-C50 / 0.01
63		-	GS252S-C63 / 0.01	GS253S-C63 / 0.01	GS254S-C63 / 0.01
6	30	GS251S-C6 / 0.03	GS252S-C6 / 0.03	GS253S-C6 / 0.03	GS254S-C6 / 0.03
10		GS251S-C10 / 0.03	GS252S-C10 / 0.03	GS253S-C10 / 0.03	GS254S-C10 / 0.03
16		GS251S-C16 / 0.03	GS252S-C16 / 0.03	GS253S-C16 / 0.03	GS254S-C16 / 0.03
20		GS251S-C20 / 0.03	GS252S-C20 / 0.03	GS253S-C20 / 0.03	GS254S-C20 / 0.03
25		GS251S-C25 / 0.03	GS252S-C25 / 0.03	GS253S-C25 / 0.03	GS254S-C25 / 0.03
32		GS251S-C32 / 0.03	GS252S-C32 / 0.03	GS253S-C32 / 0.03	GS254S-C32 / 0.03
40		GS251S-C40 / 0.03	GS252S-C40 / 0.03	GS253S-C40 / 0.03	GS254S-C40 / 0.03
50		-	GS252S-C50 / 0.03	GS253S-C50 / 0.03	GS254S-C50 / 0.03
63		-	GS252S-C63 / 0.03	GS253S-C63 / 0.03	GS254S-C63 / 0.03

D Characteristic

Rated current (A)	Rated residual current (mA)	AC (Tripping time：Instantaneous)		
		2 Poles	3 Poles	4 Poles
6	10	GS252S-D6 / 0.01	GS253S-D6 / 0.01	GS254S-D6 / 0.01
10		GS252S-D10 / 0.01	GS253S-D10 / 0.01	GS254S-D10 / 0.01
16		GS252S-D16 / 0.01	GS253S-D16 / 0.01	GS254S-D16 / 0.01
20		GS252S-D20 / 0.01	GS253S-D20 / 0.01	GS254S-D20 / 0.01
25		GS252S-D25 / 0.01	GS253S-D25 / 0.01	GS254S-D25 / 0.01
32		GS252S-D32 / 0.01	GS253S-D32 / 0.01	GS254S-D32 / 0.01
40		GS252S-D40 / 0.01	GS253S-D40 / 0.01	GS254S-D40 / 0.01
50		GS252S-D50 / 0.01	GS253S-D50 / 0.01	GS254S-D50 / 0.01
63		GS252S-D63 / 0.01	GS253S-D63 / 0.01	GS254S-D63 / 0.01
6	30	GS252S-D6 / 0.03	GS253S-D6 / 0.03	GS254S-D6 / 0.03
10		GS252S-D10 / 0.03	GS253S-D10 / 0.03	GS254S-D10 / 0.03
16		GS252S-D16 / 0.03	GS253S-D16 / 0.03	GS254S-D16 / 0.03
20		GS252S-D20 / 0.03	GS253S-D20 / 0.03	GS254S-D20 / 0.03
25		GS252S-D25 / 0.03	GS253S-D25 / 0.03	GS254S-D25 / 0.03
32		GS252S-D32 / 0.03	GS253S-D32 / 0.03	GS254S-D32 / 0.03
40		GS252S-D40 / 0.03	GS253S-D40 / 0.03	GS254S-D40 / 0.03
50		GS252S-D50 / 0.03	GS253S-D50 / 0.03	GS254S-D50 / 0.03
63		GS252S-D63 / 0.03	GS253S-D63 / 0.03	GS254S-D63 / 0.03





DS251 (RCBO) AC Type

C Characteristic

Rated current (A)	Breaking Capacity (kA)	Rated residual current (mA)	1 Pole
6	6	30	DS251 AC-C6 / 0.03
10			DS251 AC-C10 / 0.03
16			DS251 AC-C16 / 0.03
20			DS251 AC-C20 / 0.03
25			DS251 AC-C25 / 0.03
32			DS251 AC-C32 / 0.03

DS271 (RCBO) AC Type

B Characteristic

Rated current (A)	Breaking Capacity (kA)	Rated residual current (mA)	1 Pole
6	10	10	DS271 AC-B6 / 0.01
10			DS271 AC-B10 / 0.01
16			DS271 AC-B16 / 0.01
20			DS271 AC-B20 / 0.01
25			DS271 AC-B25 / 0.01
32			DS271 AC-B32 / 0.01
6		30	DS271 AC-B6 / 0.03
10			DS271 AC-B10 / 0.03
16			DS271 AC-B16 / 0.03
20			DS271 AC-B20 / 0.03
25			DS271 AC-B25 / 0.03
32			DS271 AC-B32 / 0.03
6		100	DS271 AC-B6 / 0.1
10			DS271 AC-B10 / 0.1
16			DS271 AC-B16 / 0.1
20			DS271 AC-B20 / 0.1
25			DS271 AC-B25 / 0.1
32			DS271 AC-B32 / 0.1

C Characteristic

Rated current (A)	Breaking Capacity (kA)	Rated residual current (mA)	1 Pole
6	10	10	DS271 AC-C6 / 0.01
10			DS271 AC-C10 / 0.01
16			DS271 AC-C16 / 0.01
20			DS271 AC-C20 / 0.01
25			DS271 AC-C25 / 0.01
32			DS271 AC-C32 / 0.01
6		30	DS271 AC-C6 / 0.03
10			DS271 AC-C10 / 0.03
16			DS271 AC-C16 / 0.03
20			DS271 AC-C20 / 0.03
25			DS271 AC-C25 / 0.03
32			DS271 AC-C32 / 0.03
6		100	DS271 AC-C6 / 0.1
10			DS271 AC-C10 / 0.1
16			DS271 AC-C16 / 0.1
20			DS271 AC-C20 / 0.1
25			DS271 AC-C25 / 0.1
32			DS271 AC-C32 / 0.1
6		300	DS271 AC-C6 / 0.3
10			DS271 AC-C10 / 0.3
16			DS271 AC-C16 / 0.3
20			DS271 AC-C20 / 0.3
25			DS271 AC-C25 / 0.3
32			DS271 AC-C32 / 0.3





DS9 (RCBO)

C Characteristic

Rated current (A)	Rated residual current (mA)	AC (1 pole + NA)		
		4.5 kA	6 kA	10 kA
6	30	DS941-C6 / 0.03	DS951-C6 / 0.03	DS971-C6 / 0.03
10		DS941-C10 / 0.03	DS951-C10 / 0.03	DS971-C10 / 0.03
16		DS941-C16 / 0.03	DS951-C16 / 0.03	DS971-C16 / 0.03
20		DS941-C20 / 0.03	DS951-C20 / 0.03	DS971-C20 / 0.03
25		DS941-C25 / 0.03	DS951-C25 / 0.03	DS971-C25 / 0.03
32		DS941-C32 / 0.03	DS951-C32 / 0.03	DS971-C32 / 0.03
40		DS941-C40 / 0.03	DS951-C40 / 0.03	DS971-C40 / 0.03

FH200 (RCCB)

Rated current (A)	Rated residual current (mA)	AC Type	
		2 Poles	4 Poles
25	30	FH202 AC-25 / 0.03	FH204 AC-25 / 0.03
40		FH202 AC-40 / 0.03	FH204 AC-40 / 0.03
63		FH202 AC-63 / 0.03	FH204 AC-63 / 0.03
25	100	FH202 AC-25 / 0.1	FH204 AC-25 / 0.1
40		FH202 AC-40 / 0.1	FH204 AC-40 / 0.1
63		FH202 AC-63 / 0.1	FH204 AC-63 / 0.1
25	300	FH202 AC-25 / 0.3	FH204 AC-25 / 0.3
40		FH202 AC-40 / 0.3	FH204 AC-40 / 0.3
63		FH202 AC-63 / 0.3	FH204 AC-63 / 0.3

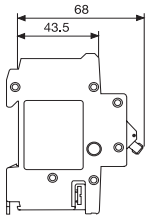
F200 (RCCB)

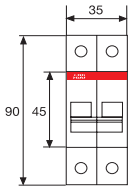
Rated current (A)	Rated residual current (mA)	AC Type	
		2 Poles	4 Poles
80	30	F202 AC-80 / 0.03	F204 AC-80 / 0.03
100		F202 AC-100 / 0.03	F204 AC-100 / 0.03
80	100	F202 AC-80 / 0.1	F204 AC-80 / 0.1
100		F202 AC-100 / 0.1	F204 AC-100 / 0.1
80	300	F202 AC-80 / 0.3	F204 AC-80 / 0.3
100		F202 AC-100 / 0.3	F204 AC-100 / 0.3

Residual Current Devices (RCD)

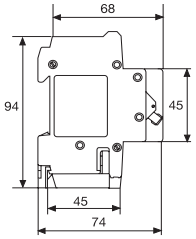
Dimensions (mm)

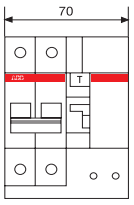
GS250S



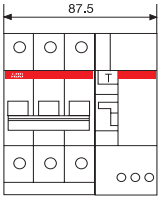


1 pole + NA (In : 6-63A)

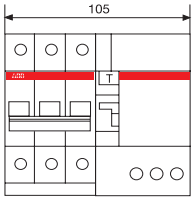




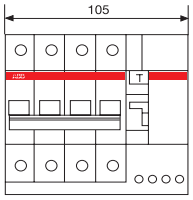
2 poles (In : 6-63A)



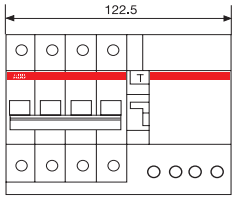
3 poles (In : 6-40A)



3 poles (In : 50-63A)

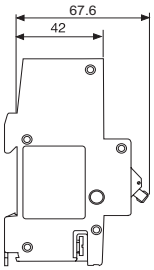


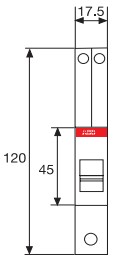
4 poles (In : 6-40A)



4 poles (In : 50, 63A)

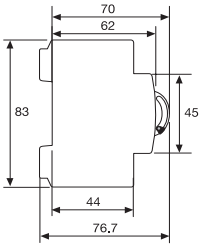
DS251 / DS271

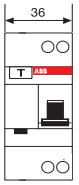




1 Pole + NA

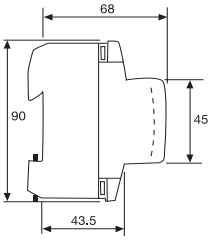
DS9

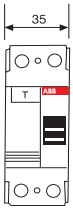




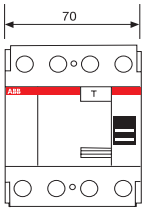
1 Pole + NA

FH200 / F200





2 poles



4 poles

Technical features

OVR Surge Protective Devices - Type 1 & Type 1+2






	Type 1 OVR T1 ☐ 25 255-7 Triggered spark-gap		Type1+2 OVR T1+2 25 255 TS Triggered spark-gap/varistor	Type 1+2 OVR T1+2 ☐ 15 255-7 Triggered spark-gap		Type 1+2 OVR T1+2 ☐ 7 275 s P Varistor				
	IEC 61643-1 / EN 61643-11		IEC 61643-1 / EN 61643-11	IEC 61643-1 / EN 61643-11		IEC 61643-1 / EN 61643-11				
	1 / I		1/ I	1 / I		1 / I				
	1P -	3P+N 3N		1P -	3P+N 3N	1P -	3P 3L	4P 4L	1P+N 1N	3P+N 3N
	TT*-TNS-TNC	TT - TNS	TT* - TNS - TNC	TT*-TNS-TNC	TT - TNS	TT*-TNS-TNC	TNC	TNS	TT - TNS	TT - TNS
	A.C.		A.C.	A.C.		A.C.				
	230	230/400	230	230	230/400	230	230/400		230	230/400
	255	-	255	255	-	275			275	275 / 255
	-	255 / 255	-	-	255 / 255					
	25	-	25	15	-	7			-	-
	-	25 / 100	-	-	15 / 50	-			7 / 12	7 / 12
	-	-	40	60	-	70			-	-
	-	-	-	-	60/60	-			70/70	70/70
	25	-	25	15	-	6			-	-
	-	25 / 100	-	-	15 / 50	-			6	6
	2.5	-	1.5	1.5	-	0.9			-	-
	-	2.5 / 1.5	-	-	1.5 / 1.5	-			0.9 / 1.4	0.9 / 1.5
	7	-	15	7	-	NA			-	-
	-	7 / 0.1	-	-	7 / 0.1	-			NA / 0.1	NA / 0.1
	650	-	334	650	-	334			-	-
	-	650 / 1200	-	-	650 / 1200	-			334 / 1200	
	< 2 (LED)		< 1 (Varistor leakage)	< 2 (LED)		< 1				
	50		50	50		50				
	-		125	-		-				
	≤125		≤125	≤125		≤50				
	NA		125	NA		NA				
	-40 to +80		-40 to +80	-40 to +80		-40 to +80				
	IP 20		IP 20	IP 20		IP 20				
	V0		V0	V0		V0				
	Polyarylamide grey RAL 7035		Polyarylamide grey RAL 7035	Polyarylamide grey RAL 7035		PC grey RAL 7035				
	Yes		Yes	Yes		Yes				
	No		Yes	No		No				
	2.5 ... 50		2.5 ... 50	2.5 ... 50		2.5 ... 25				
	2.5 ... 35		2.5 ... 35	2.5 ... 35		2.5 ... 16				
	15		15	15		12.5				
	3.5		3.5	3.5		2.8				
	-		1NO (1 normally open contact),	-		-				
	-		+1NC (1 normally closed contact)							
	-		12V D.C. - 10 mA	-		-				
	-		250V A.C. - 1 A	-		-				
	-		None	-		-				
	-		1.5	-		-				

TT* : in TT network for L/N protection only

The new SN201 circuit-breaker

Ideal profile

2CSC402001B0201



New miniature circuit-breakers 1P+N in one module SN201





SN201 series
is compliant with
IEC EN 60898-1
standards

2



A universal model

Perfectly compatible with the whole range.

The System pro *M* compact® complete miniature system, designed by ABB to meet all the installation requirements, expands its offering with the new SN201 series 1P+N miniature circuit-breakers in a module. Totally renewed, these products replace the S9 series and perfectly integrate with the System pro *M* compact® MCB range, starting from the identical profile, that lends a coordinated and streamlined look to the installation.
The new 1P+N miniature circuit-breakers are a technologically advanced and comprehensive range, as concerns size, tripping characteristics, breaking capacity and accessories.
They are available with rated currents from 2 to 40A, in the version with “C” characteristic, and with rated currents from 6 to 40A, in the version with “B” and “D” characteristics. As for breaking capacity, the range includes 4.5kA, 6kA and 10kA versions.
The new SN201 series, with its innovative features, is the ideal choice for all the installation configurations required by the residential and commercial market sectors.

The miniature circuit-breakers protect installations from overload and short circuit, ensuring reliability and safety under all operating conditions. The new series, for the commercial and industrial market sector, also provides the version with “D” characteristic (6kA breaking capacity), for systems containing loads with high peak current.



An innovation example

Details that make the difference



Quick and safe assembly, compatibility with the range and the associated accessories, extremely clear reading of the product codes are just a few of the characteristics that make the SN201 circuit-breakers the ideal solution for an effective, safe and truly integrated technology.

A safe device.

Space for insulated screwdrivers.
Space for safety.

The larger neutral hole allows the use of an insulated screwdriver to tighten the screws of both wire terminals, ensuring maximum safety of the operation.

A single screwdriver.

Two bistable fixing devices for maximum ease of use.

Due to larger size of the DIN rail fixing system, made with 2 bistable fixing devices, the same screwdriver used for tightening the terminals can also be used for assembling and disassembling the device.





The new SN201 series has been designed with the same profile as the System pro *M* compact® range, thus ensuring a coordinated and streamlined look of the switchboard, for all the installations required by the residential and commercial market.





Safe identification.

Practical label carrier, great clarity.

Increasingly complex systems require easier identification of the sections corresponding to each single circuit-breaker installed in the switchboard. With the practical label carrier fitted in the new SN201 circuit-breakers you can give maximum visibility to the information relating to the protected loads.

Standardized accessories.

Standardized accessories for the whole range.

The SN201 fully integrates with the range of System pro *M* compact® miniature circuit-breakers, sharing the wide selection of accessories available through a dedicated interface (half module), which also can be used as auxiliary contact.



Technical data



Technical data					
			SN201 L	SN201	SN201 M
Reference standard			IEC EN 60898-1		
Rated current In		[A]	2 ≤ In ≤ 40		
Poles			1P+N		
Rated voltage Ue		[V]	230		
Insulation voltage Ui		[V]	500		
Max operating voltage Ub Max.	AC	[V]	254		
	DC 1P	[V]	60		
	DC 1P+N	[V]	125		
Min. operating voltage Ub Min.		[V]	12VAC - 12VDC		
Rated frequency		[Hz]	50…60		
Breaking capacity	rated Icn	[A]	4500	6000	10000
Rated making and breaking capacity of an individual pole	Icn1	[kA]	4,5	6	6
Rated breaking capacity	ultimate Icu	[kA]	6	10	10
	Service Ics	[kA]	4,5	6	7,5
Rated impulse withstand voltage (1.2/50) Uimp		[kV]	4		
Dielectric test voltage at ind. freq. for 1 min		[kV]	2,5		
Thermomagnetic release characteristic	B: 3 In ≤ Im ≤ 5 In		■	■	■
	C: 5 In ≤ Im ≤ 10 In		■	■	■
	D: 10 In ≤ Im ≤ 20 In			■	
Toggle			black sealable in ON-OFF position		
Electrical life			10000		
Mechanical life			20000		
Protection degree of the appliance	housing		IP4X		
	terminals		IP2X		
Tropicalization according to IEC 60068-2	humid heat	[°C/RH]	28 cycles with 55/95…100		
	constant climatic conditions	[°C/RH]	23/83 - 40/93 - 55/20		
	variable climatic conditions	[°C/RH]	25/95 - 40/95		
Calibration temperature of thermal release		[°C]	30		
Ambient temperature (daily average <=+35°C)		[°C]	-25…+55		
Storage temperature		[°C]	-40…+70		
Top/bottom terminal size per cable		[mm²]	16/16		
Tightening torque		[N*m]	1,2		
Mounting			on DIN rail EN 60715 (35mm) with quick coupling device		
Dimension per pole		[mm]	H: 85 x D: 68,9 x L: 17,6		
Weight per pole		[g]	110		

Order codes

SN201 L - B Characteristic
Applications: residential.
Standard: IEC EN 60898-1
Icn: 4,5 kA



Number of poles	Rated Current In A	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece Kg	Pack Unit pc.
1+N	2	SN201 L B2	2CSS245101R0025	087359	0,110	6
	4	SN201 L B4	2CSS245101R0045	087458	0,110	6
	6	SN201 L B6	2CSS245101R0065	087557	0,110	6
	10	SN201 L B10	2CSS245101R0105	087656	0,110	6
	16	SN201 L B16	2CSS245101R0165	087755	0,110	6
	20	SN201 L B20	2CSS245101R0205	087854	0,110	6
	25	SN201 L B25	2CSS245101R0255	087953	0,110	6
	32	SN201 L B32	2CSS245101R0325	088059	0,110	6
	40	SN201 L B40	2CSS245101R0405	088158	0,110	6

SN201 L - C Characteristic
Applications: residential.
Standard: IEC EN 60898-1
Icn: 4,5 kA



Number of poles	Rated Current In A	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece Kg	Pack Unit pc.
1+N	2	SN201 L C2	2CSS245101R0024	088257	0,110	6
	4	SN201 L C4	2CSS245101R0044	088356	0,110	6
	6	SN201 L C6	2CSS245101R0064	088455	0,110	6
	10	SN201 L C10	2CSS245101R0104	088554	0,110	6
	16	SN201 L C16	2CSS245101R0164	088653	0,110	6
	20	SN201 L C20	2CSS245101R0204	088752	0,110	6
	25	SN201 L C25	2CSS245101R0254	088851	0,110	6
	32	SN201 L C32	2CSS245101R0324	088950	0,110	6
	40	SN201 L C40	2CSS245101R0404	089056	0,110	6

Order codes

SN201 - B Characteristic
Applications: residential and commercial.
Standard: IEC EN 60898-1
Icn: 6 kA



Number of poles	Rated Current In A	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece Kg	Pack Unit pc.
1+N	6	SN201 B6	2CSS255101R0065	090755	0,110	6
	10	SN201 B10	2CSS255101R0105	090854	0,110	6
	16	SN201 B16	2CSS255101R0165	090953	0,110	6
	20	SN201 B20	2CSS255101R0205	091059	0,110	6
	25	SN201 B25	2CSS255101R0255	091158	0,110	6
	32	SN201 B32	2CSS255101R0325	091257	0,110	6
	40	SN201 B40	2CSS255101R0405	091356	0,110	6

SN201 - C Characteristic
Applications: residential and commercial.
Standard: IEC EN 60898-1
Icn: 6 kA



Number of poles	Rated Current In A	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece Kg	Pack Unit pc.
1+N	2	SN201 C2	2CSS255101R0024	091455	0,110	6
	4	SN201 C4	2CSS255101R0044	091554	0,110	6
	6	SN201 C6	2CSS255101R0064	091653	0,110	6
	10	SN201 C10	2CSS255101R0104	091752	0,110	6
	13	SN201 C13	2CSS255101R0134	091851	0,110	6
	16	SN201 C16	2CSS255101R0164	091950	0,110	6
	20	SN201 C20	2CSS255101R0204	092056	0,110	6
	25	SN201 C25	2CSS255101R0254	092155	0,110	6
	32	SN201 C32	2CSS255101R0324	092254	0,110	6
	40	SN201 C40	2CSS255101R0404	092353	0,110	6

SN201 - D Characteristic
Applications: residential and commercial.
Standard: IEC EN 60898-1
Icn: 6 kA



Number of poles	Rated Current In A	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece Kg	Pack Unit pc.
1+N	6	SN201 D6	2CSS255101R0061	092452	0,110	6
	10	SN201 D10	2CSS255101R0101	092551	0,110	6
	16	SN201 D16	2CSS255101R0161	092650	0,110	6
	20	SN201 D20	2CSS255101R0201	092759	0,110	6
	25	SN201 D25	2CSS255101R0251	092858	0,110	6
	32	SN201 D32	2CSS255101R0321	092957	0,110	6
	40	SN201 D40	2CSS255101R0401	093053	0,110	6

Order codes

SN201 M - B Characteristic
Applications: residential and industrial.
Standard: IEC EN 60898-1
Icn: 10 kA



Number of poles	Rated Current In A	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece Kg	Pack Unit pc.
1+N	6	SN201 M B6	2CSS275101R0065	093152	0,110	6
	10	SN201 M B10	2CSS275101R0105	093251	0,110	6
	16	SN201 M B16	2CSS275101R0165	093350	0,110	6
	20	SN201 M B20	2CSS275101R0205	093459	0,110	6
	25	SN201 M B25	2CSS275101R0255	093558	0,110	6
	32	SN201 M B32	2CSS275101R0325	093657	0,110	6
	40	SN201 M B40	2CSS275101R0405	093756	0,110	6

SN201 M - C Characteristic
Applications: residential and industrial.
Standard: IEC EN 60898-1
Icn: 10 kA



Number of poles	Rated Current In A	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece Kg	Pack Unit pc.
1+N	2	SN201 M C2	2CSS275101R0024	093855	0,110	6
	4	SN201 M C4	2CSS275101R0044	093954	0,110	6
	6	SN201 M C6	2CSS275101R0064	094050	0,110	6
	10	SN201 M C10	2CSS275101R0104	094159	0,110	6
	16	SN201 M C16	2CSS275101R0164	094258	0,110	6
	20	SN201 M C20	2CSS275101R0204	094357	0,110	6
	25	SN201 M C25	2CSS275101R0254	094456	0,110	6
	32	SN201 M C32	2CSS275101R0324	094555	0,110	6
	40	SN201 M C40	2CSS275101R0404	094654	0,110	6

Order codes



Signal contact
This signal contact is dedicated to SN201 range only.

Description	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece kg	Pack Unit pc.
Signal contact 1NO+1NC	SN201-S	2CSS200924R0001	104957	0,040	1



Auxiliary contact / interface module
This auxiliary contact is dedicated to SN201 range only. The auxiliary contact can be used as an interface module between SN201 and other S200 compact auxiliary elements

Description	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece kg	Pack Unit pc.
Interface module / Aux. contact 1NO+1NC	SN201-IH	2CSS200923R0001	104858	0,050	1



Signal / auxiliary contact

Description	Order details Type code	Order code	Bbn 4016779 EAN	Weight 1 piece kg	Pack Unit pc.
Signal contact / auxiliary switch	S 2C-S/H6R	2CDS200922R0001	563819	0,04	1



Auxiliary contact

Description	Order details Type code	Order code	Bbn 4016779 EAN	Weight 1 piece kg	Pack Unit pc.
Auxiliary contact	S2C-H6R	2CDS200912R0001	563826	0,04	1



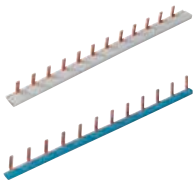
Shunt trips

Rated voltage	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece kg	Pack Unit pc.
AC / DC 12...60V	F2C-A1	2CSS200933R0011	974901	0,15	1
AC 110...415V / DC 110...250V	F2C-A2	2CSS200933R0012	975007	0,15	1



Undervoltage releases

Rated voltage	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece kg	Pack Unit pc.
12VDC	S2C-UA 12 DC	2CSS200911R0001	839705	0,09	1
24VAC	S2C-UA 24 AC	2CSS200911R0002	839804	0,09	1
24VDC	S2C-UA 24 DC	2CSS200911R0007	896401	0,09	1
48VAC	S2C-UA 48 AC	2CSS200911R0003	839903	0,09	1
48VDC	S2C-UA 48 DC	2CSS200911R0008	896500	0,09	1
110VAC	S2C-UA 110 AC	2CSS200911R0004	840008	0,09	1
110VDC	S2C-UA 110 DC	2CSS200911R0009	896609	0,09	1
230VAC	S2C-UA 230 AC	2CSS200911R0005	840107	0,09	1
230VDC	S2C-UA 230 DC	2CSS200911R0010	896708	0,09	1
400VAC	S2C-UA 400 AC	2CSS200911R0006	840206	0,09	1



Busbars for SN201

No. pins	Phases	Cross section mm²	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece kg	Pack Unit pc.
12	1	10	BS9 1/12	2CSL910001R1012	047650	0,050	10
12	1	10	BS9 1/12 NA	2CSL910011R1012	047759	0,050	10
56	1	10	BS9 1/56	2CSL910001R1056	047353	0,140	10
56	1	10	BS9 1/56 NA	2CSL910011R1056	047452	0,140	10
12	3	10	BS9 3/12	2CSL930001R1012	047551	0,090	5
57	3	10	BS9 3/57	2CSL930001R1057	047858	0,470	5

Busbars for F200/S200 and SN201

No. pins	Phases	Cross section mm²	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece kg	Pack Unit pc.
2 + 10 x 1+N	2	10	BF2-S9 UP 1N/12	2CSL920009R1012	046950	0,110	5
4 + 8 x 1+N	4	10	BF2-S9 UP 3N/12	2CSL940009R1012	047056	0,110	5
2 + 10 x 1+N	2	10	BF2-S9 DOWN 1N/12	2CSL920002R1012	047155	0,110	5
4 + 8 x 1+N	4	10	BF2-S9 DOWN 3N/12	2CSL940002R1012	047254	0,110	5

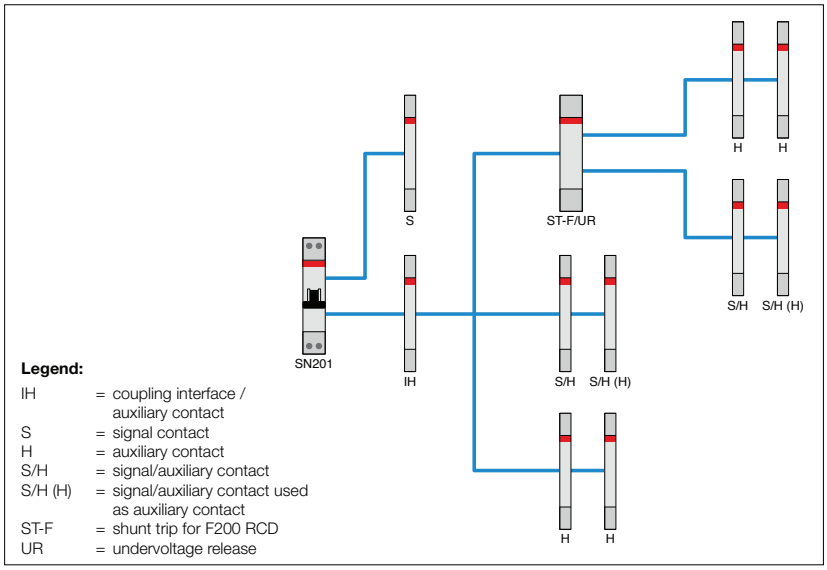
Terminals, insulated

Conn. capacity mm²	Type of connect.	Terminal lug L mm	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece kg	Pack Unit pc.
25	pin	15	FEED-IN 25/15 1P	2CSL980001R2515	047957	0,010	5
25	pin	30	FEED-IN 25/30 3P	2CSL980001R2530	048053	0,010	5

End caps

	Order details Type code	Order code	Bbn 8012542 EAN	Weight 1 piece kg	Pack Unit pc.
	BS9-END 3P	2CSL980001R0001	064251	0,001	20

Auxiliary elements and accessories

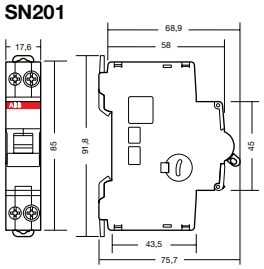


Legend:

IH	=	coupling interface / auxiliary contact
S	=	signal contact
H	=	auxiliary contact
S/H	=	signal/auxiliary contact
S/H (H)	=	signal/auxiliary contact used as auxiliary contact
ST-F	=	shunt trip for F200 RCD
UR	=	undervoltage release

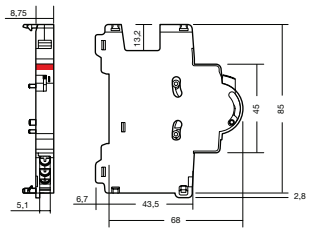
Overall dimensions

SN201

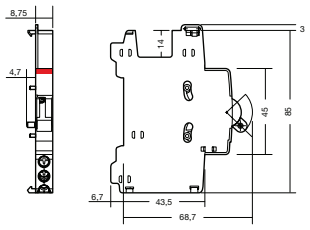


Auxiliary components for SN201

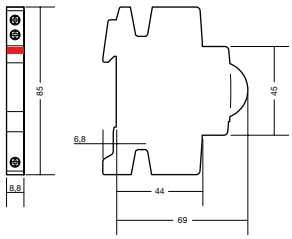
SN201-S



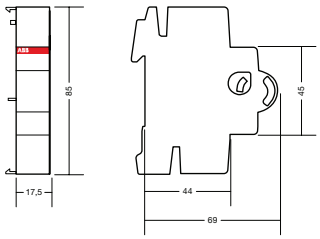
SN201-IH



S 2C-S/H6R, S2C-H6R



S2C-UA..., F2C-A...



Dimensions in mm

Due to possible developments of standards as well as of materials, the characteristics and dimensions specified in the present document may only be considered binding after confirmation by ABB SACE.

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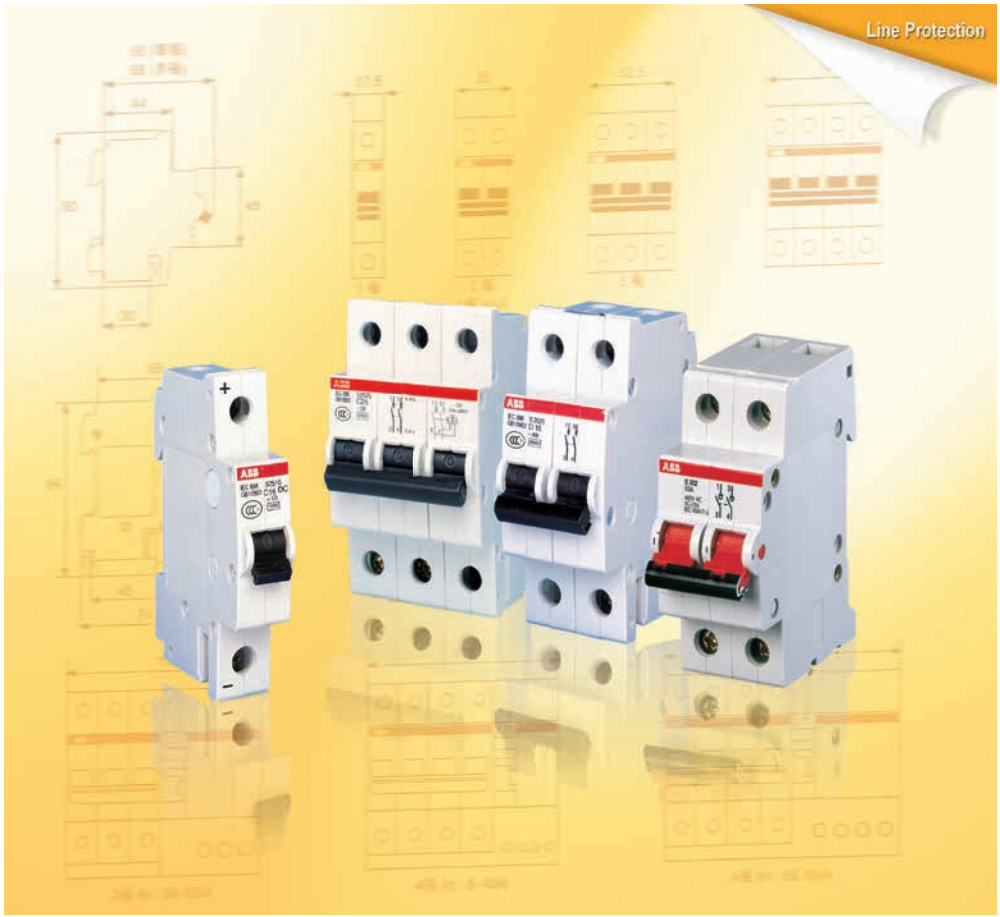
http://www.abb.com

Technical Data

Miniature Circuit Breakers and Isolators

- S250S
- E200

1SXE420001L0201 05-2008



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S2 series Miniature Circuit Breakers (MCBs)

The S2 series MCBs can be used in domestic, commercial and industrial applications for protection against over-current and short circuit.

Features:

- All-round protection against contact with live parts in accordance with IEC 60364.
- Dual-function terminals enables simultaneous connection of busbar and cable without additional connection pieces.
- Positioning of the M.C.B. on the DIN-rail now possible before snapping on, as the mounting clip is on the lower side.
- Padlocking and sealing facility for every pole in ON or OFF position.
- Accessories can be fitted to the S2... range, on site by the user.
- High short-circuit switching capacity.
- Low let-through energy at the point of fault.
- Rated voltage : 230 / 400 V AC (single pole)

S250S

S250 series MCBs integrate contacts, over-current protection, short circuit protection and tripping switch together in a single metallic switching mechanism. This special design guarantees the reliability of the operation without influencing external equipment. The rapid electromagnetic operated hammer system ensures the current limiting capacity.

S250S-DC

Based on the S250S series, the S250S-DC MCBs is designed for direct current distribution system, according to IEC 60898-2 (GB 10963.2).



Isolators

- Forced opening and suitable for use as main switch.
- High short circuit withstanding capacity.
- Optimal protection against unintentional touch of live parts.
- Dual-function terminals
- Quick mounting clip,lockable in open position.
- Same form and design as MCB Series S2.
- The harmonised design enables interconnection of switch-isolators and MCBs of the Series S2 with busbars.
- The switch-isolators are equipped with dual-function terminals which enable simultaneous connection of conductors and busbar.
- Cross-/ slotted-head screws size 2, system Pozidriv, enable easy, reliable and time-saving wiring.
- Facility for sealing or padlocking in closed or isolated position.
- Internal connection of switching mechanisms ensures simultaneous switching even without toggle linkage.

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MCBs and Isolators

Technical Data

	MCB			Isolator
				
Type	**S250S**	**S250H**	**S250S-DC**	**E200**
Standards	IEC60898		IEC60898-2	IEC60947-3
Pole	1, 2, 3, 4		1, 2, 3, 4	2, 3, 4
Tripping Characteristics	B、C、D	B、C	C	-
Tripping Type	Electro-Magnetic Type			-
Rated breaking capacity Icu	6kA (1-40A) 4.5kA (50, 63A)	6kA (50, 63A)	10kA	-
Rated short-time withstand current Icw	-	-	-	20 In. 1s
Rated short current capacity Icm	-	-	-	15 In
Rated current In	1 - 63A	50, 63A	1 - 63A	63 - 125A
Rated voltage AC single pole Un	230 / 400V		-	230 / 400V
AC multi-pole Un	400V		-	-
DC single pole Un	160V		125V	-
DC multi-pole Un	110V		250V	-
Frequency Hz	50 - 60		-	50 - 60
Mechanical Life no. of operaction	20,000			-
Electrical Life no. of operaction	10,000			-
Protection degree Terminals	IP20			
Housing	IP40			
Ambient temperature				
Operating Temperature °C	-25...+55			-
Storage Temperature °C	-40...+70			-
Tropicalization				
constant climate conditions [°C/RH]	23/83, 40/93, 55/20			
variable climate conditions [°C/RH]	25/95, 40/93			
Terminal Size mm^2	0.75 - 25			1 - 50
Tightening Torque Nm	2			5

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Type Designation

S25 ☐S- ☐ ☐

- Rated Current
- Tripping
- Pole
- Type





S250S

Characteristic B

Rated current (A)	Breaking capacity (kA)	S250S-B			
		1 Pole	2 Poles	3 Poles	4 Poles
6	6	S251S-B6	S252S-B6	S253S-B6	S254S-B6
10		S251S-B10	S252S-B10	S253S-B10	S254S-B10
16		S251S-B16	S252S-B16	S253S-B16	S254S-B16
20		S251S-B20	S252S-B20	S253S-B20	S254S-B20
25		S251S-B25	S252S-B25	S253S-B25	S254S-B25
32		S251S-B32	S252S-B32	S253S-B32	S254S-B32
40		S251S-B40	S252S-B40	S253S-B40	S254S-B40

Characteristic C

Rated current (A)	Breaking capacity (kA)	S250S-C			
		1 Pole	2 Poles	3 Poles	4 Poles
1	6	S251S-C1	S252S-C1	S253S-C1	S254S-C1
2		S251S-C2	S252S-C2	S253S-C2	S254S-C2
3		S251S-C3	S252S-C3	S253S-C3	S254S-C3
4		S251S-C4	S252S-C4	S253S-C4	S254S-C4
6		S251S-C6	S252S-C6	S253S-C6	S254S-C6
10		S251S-C10	S252S-C10	S253S-C10	S254S-C10
16		S251S-C16	S252S-C16	S253S-C16	S254S-C16
20		S251S-C20	S252S-C20	S253S-C20	S254S-C20
25		S251S-C25	S252S-C25	S253S-C25	S254S-C25
32		S251S-C32	S252S-C32	S253S-C32	S254S-C32
40		S251S-C40	S252S-C40	S253S-C40	S254S-C40
50	4.5	S251S-C50	S252S-C50	S253S-C50	S254S-C50
63		S251S-C63	S252S-C63	S253S-C63	S254S-C63

Characteristic D

Rated current (A)	Breaking capacity (kA)	S250S-D			
		1 Pole	2 Poles	3 Poles	4 Poles
1	6	S251S-D1	S252S-D1	S253S-D1	S254S-D1
4		S251S-D4	S252S-D4	S253S-D4	S254S-D4
6		S251S-D6	S252S-D6	S253S-D6	S254S-D6
10		S251S-D10	S252S-D10	S253S-D10	S254S-D10
16		S251S-D16	S252S-D16	S253S-D16	S254S-D16
20		S251S-D20	S252S-D20	S253S-D20	S254S-D20
25		S251S-D25	S252S-D25	S253S-D25	S254S-D25
32		S251S-D32	S252S-D32	S253S-D32	S254S-D32
40		S251S-D40	S252S-D40	S253S-D40	S254S-D40
50	4.5	S251S-D50	S252S-D50	S253S-D50	S254S-D50
63		S251S-D63	S252S-D63	S253S-D63	S254S-D63

S250H

Characteristic B

Rated current (A)	Breaking capacity (kA)	S250H-B		
		1 Pole	2 Poles	3 Poles
50	6	S251H-B50	S252H-B50	S253H-B50
63		S251H-B63	S252H-B63	S253H-B63

Characteristic C

Rated current (A)	Breaking capacity (kA)	S250H-C			
		1 Pole	2 Poles	3 Poles	4 Poles
50	6	S251H-C50	S252H-C50	S253H-C50	S254H-C50
63		S251H-C63	S252H-C63	S253H-C63	S254H-C63

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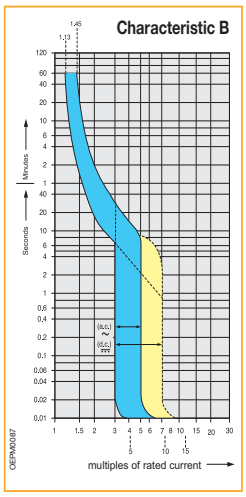
S250S-DC
Characteristic C

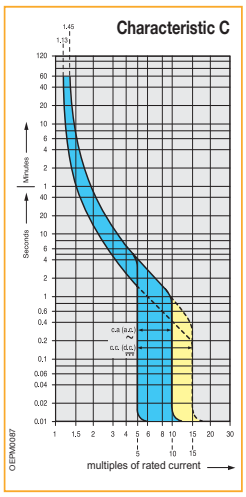
Rated current	Breaking capacity	S250S-DC			
(A)	(kA)	1 Pole	2 Poles	3 Poles	4 Poles
1	10	S251S-C1 DC	S252S-C1 DC	S253S-C1 DC	S254S-C1 DC
2		S251S-C2 DC	S252S-C2 DC	S253S-C2 DC	S254S-C2 DC
3		S251S-C3 DC	S252S-C3 DC	S253S-C3 DC	S254S-C3 DC
4		S251S-C4 DC	S252S-C4 DC	S253S-C4 DC	S254S-C4 DC
6		S251S-C6 DC	S252S-C6 DC	S253S-C6 DC	S254S-C6 DC
10		S251S-C10 DC	S252S-C10 DC	S253S-C10 DC	S254S-C10 DC
16		S251S-C16 DC	S252S-C16 DC	S253S-C16 DC	S254S-C16 DC
20		S251S-C20 DC	S252S-C20 DC	S253S-C20 DC	S254S-C20 DC
25		S251S-C25 DC	S252S-C25 DC	S253S-C25 DC	S254S-C25 DC
32		S251S-C32 DC	S252S-C32 DC	S253S-C32 DC	S254S-C32 DC
40		S251S-C40 DC	S252S-C40 DC	S253S-C40 DC	S254S-C40 DC
50		S251S-C50 DC	S252S-C50 DC	S253S-C50 DC	S254S-C50 DC
63		S251S-C63 DC	S252S-C63 DC	S253S-C63 DC	S254S-C63 DC

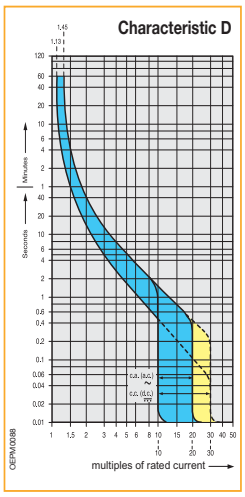
E200

Rated current	E200		
(A)	2 Poles	3 Poles	4 Poles
63	E202/63r	E203/63r	E204/63r
80	E202/80r	E203/80r	E204/80r
100	E202/100r	E203/100r	E204/100r
125	E202/125r	E203/125r	E204/125r

Tripping Curve

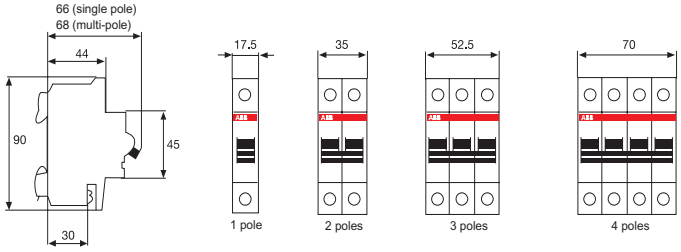




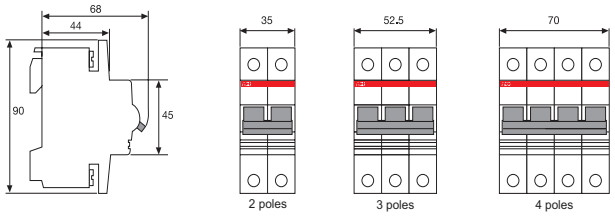


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S250S / S250H / S250S-DC



E200



1SXE420001L0201
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ABB Low Voltage Product Enquiry Contact : LV-hotline@cn.abb.com

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Product leaflet

Single phase electricity meters B21
EQ meters in Bronze version from ABB

The compact and versatile EQ meters B21 in Bronze versions is a single phase meter with full four quadrants measuring meaning both active/reactive energy measurements and import/export of energy. It can be used in most of the common applications for reliable and trustworthy metering of energy usage.

EQ meters B21 in Bronze version can be used in stand-alone applications or metering network installations with the option of inbuilt M-Bus or Modbus.



General features

B21 is a single phase direct connected meter up to 65 A. The B21 is measuring active energy with accuracy class B (Cl. 1) and reactive energy with accuracy class 2. The low rated or base currents of the meter ensures high dynamic performance with superior accuracy even at low currents. Navigation the meter is easily done via the push-buttons below the display. The exceptional low power consumption of the meter, less than 0.8 VA, makes it economical in the long run - an important feature specially for large meter populations.

Communication

Data from B21 can be collected via pulse output or serial communication. The meter is equipped with a transistor output for 5-40 VDC external supply. It can be used for pulses proportionally to the measured energy or various alarms. The meter is also available with built-in serial communication interfaces for Modbus RTU (RS-485) or M-Bus as option.

Import and export measurements

B21 Bronze version measures the energy flowing both in (imported) and out (exported) through the meter and saves the energy in separate registers.

Approvals

The B21 meter is type approved according to IEC as well as type approved and verified according to MID.
MID is the Measure Instruments Directive 2004/22/EC from European Commission. The type approval is according to standards that covers all relevant technical aspects of the meter. These include climate conditions, electromagnetic compatibility (EMC), electrical requirements, mechanical requirements and accuracy.

Instrumentation

The B21 meter supports reading of instrument values.
A large number of electrical properties can be read.

- Active power
- Reactive power
- Apparent power
- Current
- Voltage
- Power factor

Ordering details

65 A direct connected, 2 DIN

Voltage V	Communication	Type	Order code	Weight 1 pc
Bronze Active and reactive energy, import/export, pulse output, class B (Cl. 1), reactive Cl. 2				
1 x 230 V AC	RS-485	B21 212 - 100	2CMA100152R1000	0.15

Power and productivity for a better world™

B series
Technical data

	B21
Voltage/current inputs	
Nominal voltage	230 V AC
Voltage range	220-240 VAC (-20% - +15%)
Power dissipation voltage circuits	0.9 VA (0,4 W) total
Power dissipation current circuits	0.014 VA (0,014 W) at 230 V AC and I_b
Base current I_b	5 A
Rated current I_t	-
Reference current I_{ref}	5 A
Transitional current I_tr	0.5 A
Maximum current I_{max}	65 A
Minimum current I_{min}	0.25 A
Starting current I_st	< 20 mA
Terminal wire area	1 - 25 mm²
Recommended tightening torque	3 Nm
Communication	
Terminal wire area	0.5 - 1 mm²
Recommended tightening torque	0.25 Nm
Pulse indicator (LED)	
Pulse frequency	1000 imp/kWh
Pulse length	40 ms
General data	
Frequency	50 or 60 Hz ± 5%
Accuracy Class	B (Cl. 1)
Active energy	1%
Display of energy	6 digit LCD
Environmental	
Operating temperature	-40°C - +70°C
Storage temperature	-40°C - +85°C
Humidity	75% yearly average, 95% on 30 days/year
Resistance to fire and heat	Terminal 960 °C, cover 650°C (IEC 60695-2-1)
Resistance to water and dust	IP20 on terminal block without protective enclosure and IP51 in protective enclosure, according to IEC 60529.
Mechanical environment	Class M1 in accordance with the Measuring Instrument Directive (MID). (2004/22/EC).
Electromagnetic environment	Class E2 in accordance with the Measuring Instrument Directive (MID), (2004/22/EC).
Outputs	
Current	2 - 100 mA
Voltage	5 - 40 VDC.
Pulse output frequency	Programmable: 1 - 999999 imp/kWh
Pulse length	Programmable: 10 - 990 ms
Terminal wire area	0.5 - 1 mm²
Recommended tightening torque	0.25 Nm
EMC compatibility	
Impulse voltage test	6 kV 1.2/50µs (IEC 60060-1)
Surge voltage test	4 kV 1.2/50µs (IEC 61000-4-5)
Fast transient burst test	4kV (IEC 61000-4-4)
Immunity to electromagnetic HF-fields	80 MHz - 2 GHz (IEC 61000-4-6)
Immunity to conducted disturbance	150kHz - 80MHz (IEC 61000-4-6)
Immunity to disturbance with harmonics	2kHz - 150kHz
Radio frequency emission	EN 55022, class B (CISPR22)
Electrostatic discharge	15 kV (IEC 61000-4-2)
Standards	IEC 62052-11, IEC 62053-21 class 1, IEC 62053-23 class 2, IEC 62054-21, GB/T 17215.211-2006, GB/T 17215.312-2008 class 1 & 2, GB 4208-2008, EN 50470-1, EN 50470-3 category B
Mechanical	
Material	Polycarbonate in transparent front glass. Glass reinforced polycarbonate in bottom case and upper case. Polycarbonate in terminal cover.
Dimensions	
Width	35 mm
Height	97 mm
Depth	65 mm
DIN modules	2

Wiring diagram B21

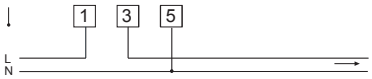


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This QR-code is linked to our web site www.abb.com/lowvoltage.
You will have to download a QR-code reader app to your phone in order to use

Product leaflet 2CMC485006L0201, rev. A, March 2014 Prod ABB AB, LP/XM

Power and productivity for a better world™

1088: HWD50 Hollow wall junction box Ø 16 mm



All benefits at a glance

- Without rear lead-in.
- 2 HWT tabs (for normal attachment) included per junction box (art.no. 1051).
- Automatic conduit fixation by means of click connection.
- Suitable for 'hollow' walls.
- Distance to conduit lead-in 16 mm: 32 mm.

Trade Characteristics

articlenumber:	1088
Article:	HWD50 Hollow wall junction box
Packaging quantity:	10 x 10 pcs

Technical Specification

Conduit diameter:	16 mm
External dimension:	55 mm
Internal depth:	50 mm
Diameter of circle saw to use:	76 mm
Centre-to-centre distance of the holes to be drilled:	71 mm

Tips & Tricks

Hollow wall sockets - the right centre distance:	A properly drilled hole has a positive influence on the mounting of the hollow wall box in the wall. Make sure you have the right centre distance (71mm) in case of coupled boxes.

Extra Information

6021: AK2-W8 Cover, 2x3p WIELAND



Trade Characteristics

articlenumber:	6021
Article:	AK2-W8 Cover, 2x3p
Packaging quantity:	10 pcs

Technical Specification

Halogen free:	Yes
With locking devices:	Yes

All benefits at a glance

- Equipped with halogen free connection wires 2,5 mm2.
- All chassis parts are equipped with latches as standard.

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ATTEMA®

6041: AK2-W8 Cover, 4x3p WIELAND



Trade Characteristics

articlenumber:	6041
Article:	AK2-W8 Cover, 4x3p
Packaging quantity:	10 pcs

Technical Specification

Halogen free:	Yes
With locking devices:	Yes

All benefits at a glance

- Equipped with halogen free connection wires 2,5 mm2.
- All chassis parts are equipped with latches as standard.

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6197: AK2-W5 Cover, 2x5p WIELAND



Trade Characteristics

articlenumber:	6197
Article:	AK2-W5 Cover, 2x5p
Packaging quantity:	10 pcs

Technical Specification

Halogen free:	Yes
With locking devices:	Yes

All benefits at a glance

- 5-pole section for use as power supply for dimmable high-frequency lighting fixtures.
- Equipped with halogen free connection wires 2,5 mm2.
- All chassis parts are equipped with latches as standard.

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Innovative ideas for a changing world.

ATTEMA®

1107: US50 Junction box for masonary walls Ø 16 mm



Trade Characteristics

articlenumber:	1107
Article:	US50 Junction box for masonary walls
Packaging quantity:	100 pcs

Technical Specification

Conduit diameter:	16 mm
Internal depth:	50 mm
Halogen free:	Yes

All benefits at a glance

- Suitable for half-brick walls: Box diameter = brick height + joints.
- Includes 2 conical conduit lead-ins at the rear of the box, one of which is covered with a knock-out.
- Conduit fixation with supplied mounting cramp (art.no. 3410).
- Anchoring in mortar by means of flange at rear of box.

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Innovative ideas for a changing world.

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NWPK special

120743: NWPK-spec bk# 3G2,5 mm2



RMcLz 450/750 V (≤ 6 mm²)
RMcLzz 450/750 V (≥ 10 m²)
CLC: H07RN-F
IEC: 60245 IEC 66

Application:
· Flexible connection of electrical equipment, like machines, engines, tools and other appliances in factories and workshops, for situations where medium mechanical stress occurs
· The multicore types are very suitable as control cables for the connection of portable electrical appliances, especially when the cords have to endure rough usage

Properties regarding fire performance:
· Self-extinguishing in accordance with NEN-EN-IEC 60332-1

General properties:
· Very flexible
· Strong and abrasion-resistant sheath
· Excellent resistance to oil and greases
· Good resistance to weather influences (including ozone)
. Moderate waterproof

Remarks:
· For special water resistant applications choose NWPK AQUA

Construction:
Conductor: flexible tinned copper (class 5)
Insulation: rubber
Assembly: cores cabled together
Outer sheath: polychloroprene (PCP)

Electrical properties:
Voltage rating: 450/750 V
Test voltage: 2,5 kV

Core colours:
1 core: black
2 cores: brown, blue
3 cores: brown, blue, green-and-yellow
4 cores: brown, black, grey, green-and-yellow
5 cores: brown, black, grey, blue, green-and-yellow
Multi cores: two adjacent cores blue and brown, other cores black; in 12-core types, an additional brown core in the innermost layer

Standards/References:
NEN-EN 50525
HD 22
NEN-EN-IEC 60332-1

Additional information:
Minimum installation temperature: -25 °C
Maximum conductor temperature: +60 °C
Operating temperature: min. -25 °C, max. +50 °C
Sheath colour: black
Approval: <HAR>
Packaging: boxes, coils, drums

Construction data

Nominal cross section conductor	2.5 mm²
Conductor category	Class 5 = flexible
Number of cores	3
Core insulation	Rubber (EPR)
Core identification	Colour
Protective conductor	Yes
Screen	No
Material outer sheath	CR (polychloroprene)
Colour outer sheath	Black
Model	Round
Outer diameter approx.	11.6 mm
Conductor material	Cu, tinned
Stranding	Multi-core
Nom diam over insulation	3.7 mm
Weight	205 kg/km

Properties

Low smoke (acc. EN 61034-2)	No
Halogen free (acc. EN 50267-2-2)	No
Flame retardant	In accordance with EN 60332-1-2
Oil resistant (acc. EN 60811-2-1)	Yes
Max. conductor temperature	60 °C
Operating temperature, flexible	-25/50 °C
Operating temperature, fix	-25/50 °C
Bending radius	50 mm
Max. tractive force	110 N

Electrical

Nominal voltage U0	450 V
Nominal voltage U	750 V
Conductor resistance 20°C	8.21 ohm/km
Current carrying capacity	25 A
Conductor resistance operating temperature	9.5 ohm/km
Operating self-induction	0.32

Product packing

Product number	Description
120743NN	Length of 1 m
120743D3	Carton of 100 m
120743H5	Reel of 500 m

Laagspanningskabels
Instalflex mb 0,6/1 kV



De Instalflex YMvK mb ss 0,6/1kV is een nieuwe generatie flexibele installatiekabels met klasse 5 geleiders, weerstandseisen IEC 60228 klasse 2. Voor laagspanningsinstallaties waarbij extra flexibiliteit voordelen biedt. Erg flexibel en daardoor makkelijker te buigen, hierdoor is een forse besparing op de installatietijd te realiseren.

Handelsinformatie	Specificaties	Eenheid
Productgroep	Installatiekabel	
Serie	Twenkaplus installatiekabel	
Type	Instalflex mb 0,6/1 kV	
Omschrijving	4 G 16 rss	
Netto Gewicht	878	kg/Km
Mantelstempeling	{Length} TKF - Instalflex - YMvKmb 0,6/1 kV- 4G16rss KEMA-KEUR {Batch}	

Artikelnummer per handelslengte	EAN nummer	Specificaties	Eenheid
6481	8713182016678	Haspel à 1	m
6481H X 500/20	8713182024109	Haspel à 500	m

Constructie	Specificaties	Eenheid
Normering	K42C-1-4-D / HD 604-4-D / NEN 3617	
Norm geleidermateriaal	IEC 60228	
Aantal aders	4	
Nominale geleiderdoorsnede	16	mm²
Geleidermateriaal	Cu	
Geleidervorm	Rond	
Samenstelling geleider	Klasse 5+/R2 = extra soepel / weerstand = klasse 2	
Aderisolatie	XLPE	
Adercodering	HD 308 S2	
Aderkleuren	Gn/ge-br-zw-gr	
Geel/Groene ader	Ja	
Samenslag	Geslagen met een vaste spoed + vulling	
Materiaal buitenmantel	PVC	
Mantelkleur	Grijs	

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BV TWENTSCHE KABELFABRIEK
Kies bewust voor beter!

Gebruikseigenschappen	Specificaties	Eenheid
Brandvertraging	IEC 60332-3-24 Cat. C	
Nominale geleiderdiameter	5.3	mm
Isolatiedikte	0.7	mm
Diameter over isolatie (bij sector: sector hoogte)	6.7	mm
Dikte buitenmantel	1.8	mm
Buitendiameter circa	20	mm
Buigstraal geïnstalleerd	60	mm
Buigstraal tijdens verlegging	100	mm
Trekkracht met kop	3200	N
Trekkracht met kous	1200	N

Technische eigenschappen	Specificaties	Eenheid
Nominale spanning U0	0.6	kV
Nominale spanning U	1	kV
Testspanning	3.5	kV
Geleider DC weerstand @ 20 ºC	1.15	Ohm/km
Inductie	0.25	mH/km
Bedrijfscapaciteit (nom.)	212	nF/km
Kortsluitstroom geleider (5 sec)	1	kA
Max. toelaatbare geleidertemperatuur	90	°C
Minimale installatietemperatuur	0	°C
Min/max bedrijfstemperatuur	-40 / 70	°C

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Laagspanningskabels
YMvKmb 0,6/1 kV

10415



De Twenkaplus kabels YMvKmb 0,6/1kV kunnen in laagspannings-installaties worden toegepast waar hoge eisen worden gesteld aan de brandveiligheid.

Handelsinformatie	Specificaties	Eenheid
Productgroep	Installatiekabel	
Serie	Twenkaplus installatiekabel	
Type	YMvKmb 0,6/1 kV	
Omschrijving	3 X 6 rm	
Netto Gewicht	321	kg/Km
Mantelstempeling	{Length} TKF YMvKmb 0,6/1kV 3X6rm TWENKAPLUS KEMA-KEUR {Batch}	

Artikelnummer per handelslengte	EAN nummer	Specificaties	Eenheid
10415	8713182070267	Haspel à 1	m
10415H X 500/20	8713182070243	Haspel à 500	m

Constructie	Specificaties	Eenheid
Normering	K42C-1-4-D / HD 604-4-D / NEN 3617	
Norm geleidermateriaal	IEC 60228	
Aantal aders	3	
Nominale geleiderdoorsnede	6	mm²
Geleidermateriaal	Cu	
Geleidervorm	Rond	
Samenstelling geleider	Klasse 1 = massief	
Aderisolatie	XLPE	
Adercodering	HD 308 S2	
Aderkleuren	Br-zw-gr	
Geel/Groene ader	Neen	
Samenslag	Geslagen met een vaste spoed + vulling	
Materiaal buitenmantel	PVC	
Mantelkleur	Grijs	

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Kies bewust voor beter!

Laagspanningskabels
YMvKmb 0,6/1 kV

10415

Gebruikseigenschappen	Specificaties	Eenheid
Brandvertraging	IEC 60332-3-24 Cat. C	
Nominale geleiderdiameter	2.73	mm
Isolatiedikte	0.7	mm
Diameter over isolatie (bij sector: sector hoogte)	4.1	mm
Dikte buitenmantel	1.8	mm
Buitendiameter circa	13.1	mm
Buigstraal geïnstalleerd	52	mm
Buigstraal tijdens verlegging	91	mm
Trekkracht met kop	900	N
Trekkracht met kous	510	N

Technische eigenschappen	Specificaties	Eenheid
Nominale spanning U0	0.6	kV
Nominale spanning U	1	kV
Testspanning	3.5	kV
Geleider DC weerstand @ 20 ºC	3.08	Ohm/km
Inductie	0.28	mH/km
Bedrijfscapaciteit (nom.)	72	nF/km
Kortsluitstroom geleider (5 sec)	0.4	kA
Max. toelaatbare geleidertemperatuur	90	°C
Minimale installatietemperatuur	0	°C
Min/max bedrijfstemperatuur	-40 / 70	°C

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BV Twentsche Kabelfabriek
Spinnerstraat 15 - Postbus 6 - 7480 AA Haaksbergen - Nederland
Tel: +31 (0)53 573 22 55 - Fax: +31 (0)53 573 21 85 - info@TKF.nl - www.tkf.nl

BV TWENTSCHE KABELFABRIEK
Kies bewust voor beter!

DRAKA - NWPK-SPECIAAL 4G1,5 QMM DRAKA



Artikelnummer	314729
Fabrikaat	DRAKA
Typenummer	NWPK-SPEC 4X1,5
Artikelnummer Leverancier	120741D3
EAN Code	8711401142115
Minimale afname	100

Product omschrijving

Soepele leiding met Polychloropreen mantelNEN: RMcLz 450/750
CLC: H07RN-F
IEC: 60245 IEC 66
Geleider: soepel blank of vertint koper
Aders: samengeslagen
Isolatie: rubber
Buitenmantel: polychloropreen (PCP)
Nominale spanning: 450/750 V
Beproevingsspanning: 2,5 kV

Technische specificaties

Nom. geleiderdoorsnede	1.5 mmý
Samenstelling geleider	Klasse 5 = soepel
Aantal aders	4
Aderisolatie	Rubber (EPR)
Adercodering	Kleur
Geel/Groene ader	Ja
Scherm	Nee
Materiaal buitenmantel	PCP (Polychloropreen)
Mantelkleur	Zwart
Uitvoering	Rond
Rookarm volgens EN 61034-2	Nee
Halogeenvrij volgens EN 50267-2-2	Nee
Brandvertraging	Volgens EN 60332-1-2
Oliebestendig volgens EN 60811-2-1	Ja
Buitendiameter circa	10.8 mm
Max. toelaatbare geleidertemperatuur	60 øC
Min/max installatietemperatuur	-25 - 50 øC

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Min/max bedrijfstemperatuur	-25 - 50 øC
Nom. spanning U0	450 V
Nom. spanning U	750 V

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Declaration of Conformity

We ABB b.v.
Automation Products Division NL
Frankeneng 15
6716 AA Ede
The Netherlands

Declare under our sole responsibility that,

The product(s)	:	**inbouwdozen voor open en gesloten holle wanden**
Type	:	**HW40-F, HW51-F, HW150-F, HW180-F**
ABB Identity number	:	1SPA007126F0100, 7126.162, 7126.201, 7126.305

To which this declaration relates,

are free of Halogen	:	Fluorine (F),
	:	Chloor (Cl),
	:	Bromine (Br),
	:	Iodine (I),

according to DIN-VDE 0472 Part 815 (F<0,1 gew.%, Cl, Br and I<0,2 gew.%) or substances as mentioned in the EC RoHS Directive 2002/95/EC.

Although the above-mentioned substances as such are not intentionally added to this/these material(s), and the absence has not been checked by tests, this does not exclude the presence of negligibly slight traces due to, amongst others, impurities in the components supplied by external parties and used in the production of such components.

This Declaration is subject to the provisions of the respective delivery contract.

Ede, 10-11-2010.

H. Reindersma
Manager R&D

Aad Fokker
Quality Manager

Document No.: 9AJK000388

ABB b.v.

Postbus 104
NL 6710 BC EDE

Frankeneng 15
NL 6716 AA EDE

Telephone: +31 (0)318 66 93 00
Telefax: +31 (0)318 63 17 18

Web address:
www.abb.nl

Commercial register:
Rotterdam No. 24000504

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At your request a copy of the conditions, relevant to you, will be sent to you immediately.

BUSCH-JAEGER

Product Declaration
Produkterklärung

This product declaration is issued under the sole responsibility of the manufacturer
Die alleinige Verantwortung für die Ausstellung dieser Produkterklärung trägt der Hersteller

Busch-Jaeger Elektro GmbH
Freisenbergstraße 2, 58513 Lüdenscheid
Deutschland

Object of the product declaration:
Gegenstand der Produkterklärung:

1012-0-1606
WIPPSCH.-EINS.UP F.SERIEN

Declaration created
Erklärung erstellt

31.07.2013

The object of the product declaration described above does not contain any of the
Der oben beschriebene Gegenstand der Produkterklärung enthält keine der in der

DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) from 08 June 2011 prohibited substances above the specified limits.

RICHTLINIE 2011/65/EU DES EUROPÄISCHEN PARLAMENTS UND DES RATES zur Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten (Neufassung) vom 08. Juni 2011 verbotenen Substanzen oberhalb der Grenzwerte.

Busch-Jaeger Elektro GmbH,

Lüdenscheid

Jürgen Högener
Managing Board
Geschäftsführung

ppa. Wolfgang Niggemann
Head of Quality Management / IMS
Leiter Qualitätsmanagement / IMS

Dieses Dokument wurde elektronisch erstellt und ist ohne Unterschrift gültig.

Filename / Dateiname.: **1012-0-1606_RoHS_2013_07_31.pdf**

Busch-Jaeger Elektro GmbH (Ein Unternehmen der ABB Gruppe)

BUSCH-JAEGER

Product Declaration
Produkterklärung

This product declaration is issued under the sole responsibility of the manufacturer
Die alleinige Verantwortung für die Ausstellung dieser Produkterklärung trägt der Hersteller

Busch-Jaeger Elektro GmbH
Freisenbergstraße 2, 58513 Lüdenscheid
Deutschland

Object of the product declaration:
Gegenstand der Produkterklärung:

2013-0-4706
SI-SCHUKO-STECKD.-EINSATZ

Declaration created
Erklärung erstellt

31.07.2013

The object of the product declaration described above does not contain any of the
Der oben beschriebene Gegenstand der Produkterklärung enthält keine der in der

DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) from 08 June 2011 prohibited substances above the specified limits.

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Busch-Jaeger Elektro GmbH,

Lüdenscheid

Jürgen Högener
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Head of Quality Management / IMS
Leiter Qualitätsmanagement / IMS

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Busch-Jaeger Elektro GmbH (Ein Unternehmen der ABB Gruppe)

Product Declaration
Produkterklärung

This product declaration is issued under the sole responsibility of the manufacturer
Die alleinige Verantwortung für die Ausstellung dieser Produkterklärung trägt der Hersteller

Busch-Jaeger Elektro GmbH
Freisenbergstraße 2, 58513 Lüdenscheid
Deutschland

Object of the product declaration:
Gegenstand der Produkterklärung:

1012-0-1598
WIPPSCH.-EINS.UP F. AUS

Declaration created
Erklärung erstellt

31.07.2013

The object of the product declaration described above does not contain any of the
Der oben beschriebene Gegenstand der Produkterklärung enthält keine der in der

DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) from 08 June 2011 prohibited substances above the specified limits.

RICHTLINIE 2011/65/EU DES EUROPÄISCHEN PARLAMENTS UND DES RATES zur Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten (Neufassung) vom 08. Juni 2011 verbotenen Substanzen oberhalb der Grenzwerte.

Busch-Jaeger Elektro GmbH,

Lüdenscheid

Jürgen Högener
Managing Board
Geschäftsführung

ppa. Wolfgang Niggemann
Head of Quality Management / IMS
Leiter Qualitätsmanagement / IMS

Dieses Dokument wurde elektronisch erstellt und ist ohne Unterschrift gültig.

Filename / Dateiname.: **1012-0-1598_RoHS_2013_07_31.pdf**

Busch-Jaeger Elektro GmbH (Ein Unternehmen der ABB Gruppe)



2273-203

Name	Description		Value
BESTNR	ITEM-NO.		2273-203
QUERSCHNITT1	Cross section		0.5 - 2.5 mm²
QUERSCHNITT2	Cross section		18 - 14 AWG
ABISOLIERLAENGE	Strip length		11 mm
SPANNUNG	Measured voltage		450 V
BEMESSSTOSSSPG	Measured shock voltage		4 kV
VERSCHMUTZGRAD	Pollution degree		2
STROM	Current intensity		24 A
P	NO. OF POLES		3
HOEHE	Height		5.8 mm
BREITE	Width		14.0 mm
TIEFE	Depth		16.7 mm
ANZAHLKLEMMSTEL	No. of connection Points		3
ANZAHLPOTENTIAL	No. of potentials		1
FARBE	COLOR		transparent / orange
GEWICHT	WEIGHT		1.007 g

aeger Schakelaar Tweepolige schakela	
	Tweepolige schakelaar
	Wip/drukker
	Basiselement met complete behu
ar	Nee
	1
	Opbouw (stucwerk)
	Bevestiging met schroef
	Kunststof
	Thermoplast
	Nee
erming	Geen (onbehandeld)
akte	Glanzend
	Grijs
vingsvlak	Nee
	Controleschakelaar
ad (IP)	IP44
ng	250 V
	10 A
or fluorescentielampen	16 AX
	Nee
kelaar	Nee
	Ja

All around the house

Gira products provide safety and comfort all around the house. It is advisable to use the Gira TX_44 water-protected switch range for the entire outdoor area because it meets the higher requirements outdoors and in publicly-accessible areas with its reinforced cover frame, rugged material and safe installation. An exceptionally large number of functions can be integrated water-protected IP44 - from a light switch and socket outlet to door communication and bus technology. The Gira energy and light profiles can also be equipped with the functions of Gira TX_44. The Gira Tectiv 220° and the Gira Observer 70 monitor the property.

Products all around the house

Security products and alarm systems
In addition to the Gira Tectiv 220° and the Gira Observer 70, Gira also offers other security products for the outdoor area, e.g. the key switch / VdS. The Gira product range comprises complex alarm systems with a large number of matched products for monitoring home and property.

Socket outlets and light
To use socket outlets outdoors, water-protected versions with hinged covers must always be used for safety reasons. Gira offers two variants for this purpose. The Gira TX_44 switch range consists of theft and water-protected socket outlets and other functions for flush-mounted installation. For installation on the wall, there is the Gira water-protected, surface-mounted switch range.

Top 5

The most important products all around the house



Gira Tectiv 220°
Protected from wind and weather under a watertight dome, the Gira Tectiv 220° monitors the area and switches the outdoor lighting on immediately when movement is detected. As a result, it ensures that light is always on as soon as it's required, and burglars are deterred off by the sudden brightness.



Gira Observer 70
As soon as someone enters its detection field at twilight or in the dark, the Gira observer 70 switches on the outside lighting. With its narrow detection field, it is especially wellsuited for small properties, e.g. as is the case with terraced houses.



Gira LED orientation light TX_44
Illuminates stairs and dark corners outdoors and ensures better orientation. Also available with white or orange LEDs.



Gira socket outlet with hinged cover
For safety reasons, water-protected socket outlets with a hinged cover must be used all around the house. For flush-mounted installation outdoors, it is advisable to use the Gira TX_44 switch range with its especially rugged water-protected socket outlets.



Gira push switch
The push switch from the Gira TX_44 switch range is recommended as an outdoor light switch. With a reinforced cover frame, rugged material and a theft and water-protected installation, it meets the most demanding requirements for outdoor use.



Busch USB charging station
Socket outlet inserts
SCHUKO® USB socket outlet
Shuttered.

With screwless terminals.
Shuttered.
DP (2 P + E)
For supply and support of mobile devices via USB-cable.
With USB female connector type A.
With electronic short-circuit protection.
With electronic overload protection.
Simultaneous charging via USB connection and use of the SCHUKO® socket outlet.

Rated voltage: 250 V~, Secondary: 5 V-, +5 % / -5 %, Rated frequency: 50 Hz, Power dissipation: 0.1 W,
Suitable for: SCHUKO® socket outlet, Rated current: 16 A, Suitable for: USB connection, Rated current: 700 mA
Protection class (Device): IP 20, SELV, Temperature range (Device): 5 °C to 35 °C,
Dimensions: (L x W x D): 71 mm x 71 mm x 53 mm, Mounting depth: 35 mm,
Connecting terminals approved in accordance with VDE 0620-1 as connectors. , No data transfer., Use the dust cover when cleaning the device.

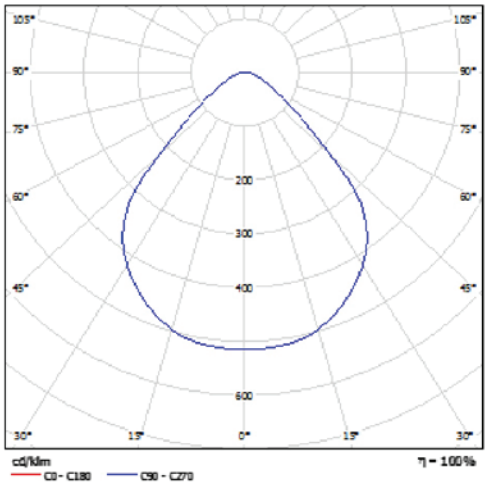
Order Code : 2011-0-6184
Article No. : 20 EUCBUSB-866-500
EAN: 4011395164631

Operator
Telephone
Fax
e-Mail

PHILIPS BBS562 1xLED35S/830 AC-MLO-C / Luminaire Data Sheet



Luminous emittance 1:



Luminaire classification according to CIE: 100
CIE flux code: 68 93 98 100 100

DayZone – innovative design meets sustainability
For general office lighting, customers want to capture the benefits LED technology has to offer – sustainability and fresh, high-impact design, without
compromising visual comfort
Our DayZone recessed LED luminaire delivers high-quality functional lighting

with an energy efficiency that matches or even outperforms traditional fluorescent systems. But what makes DayZone really shine is its impressive visual comfort. Our innovative use of LED technology has created a luminaire
that breaks away from fluorescent lighting designs of the past to offer a striking appearance and light effect. Glare control and color consistency are compliant with future office norms

Luminous emittance 1:

Glare Evaluation According to UGR

ρ Ceiling		70	70	50	50	30	70	70	50	50	30
ρ Walls		50	30	50	30	30	50	30	50	30	30
ρ Floor		20	20	20	20	20	20	20	20	20	20
Room Size X	Y	Viewing direction at right angles to lamp axis					Viewing direction parallel to lamp axis				
2H	2H	14.8	15.3	14.8	15.7	16.0	14.8	15.3	14.8	15.7	16.0
	3H	14.8	15.2	15.1	16.0	16.3	14.8	15.2	15.1	16.0	16.3
	4H	15.0	15.3	15.3	16.1	16.4	15.0	15.3	15.3	16.1	16.4
	6H	15.1	15.3	15.3	16.2	16.5	15.1	15.3	15.3	16.2	16.5
	8H	15.2	15.3	15.3	16.3	16.6	15.2	15.3	15.3	16.3	16.6
	12H	15.3	15.3	15.3	16.3	16.7	15.3	15.3	15.3	16.3	16.7
4H	2H	14.8	15.3	14.9	15.7	16.0	14.8	15.3	14.9	15.7	16.0
	3H	15.1	15.3	15.4	16.1	16.4	15.1	15.3	15.4	16.1	16.4
	4H	15.3	15.3	15.4	16.3	16.7	15.3	15.3	15.4	16.3	16.7
	6H	15.5	15.3	15.5	16.5	16.9	15.5	15.3	15.5	16.5	16.9
	8H	15.7	15.3	15.5	16.6	17.0	15.7	15.3	15.5	16.6	17.0
	12H	15.9	15.3	15.5	16.7	17.1	15.9	15.3	15.5	16.7	17.1
8H	4H	15.4	15.3	15.5	16.5	16.7	15.4	15.3	15.5	16.5	16.7
	6H	15.8	15.3	15.5	16.6	17.1	15.8	15.3	15.5	16.6	17.1
	8H	16.0	15.3	15.5	16.6	17.3	16.0	15.3	15.5	16.6	17.3
	12H	16.2	15.3	15.7	17.0	17.5	16.2	15.3	15.7	17.0	17.5
12H	4H	15.4	15.3	15.5	16.5	16.7	15.4	15.3	15.5	16.5	16.7
	6H	15.8	15.3	15.5	16.6	17.1	15.8	15.3	15.5	16.6	17.1
	8H	16.1	15.3	15.5	16.6	17.3	16.1	15.3	15.5	16.6	17.3

Variation of the observer position for the luminaire distances S

S = 1.0H	+0.5 / -1.1	+0.5 / -1.1
S = 1.5H	+1.9 / -1.9	+1.9 / -1.9
S = 2.0H	+3.5 / -2.4	+3.5 / -2.4
Standard table	BK03	BK03
Correction Summand	-1.6	-1.6

Corrected Glare Indices referring to 2000lm Total Luminous Flux


DYKA-PVC-U-KEMA-KEUR
3/4" 8 27 08 2013 23:37
"PVC HET HERGEBRUIK GARANTIE"





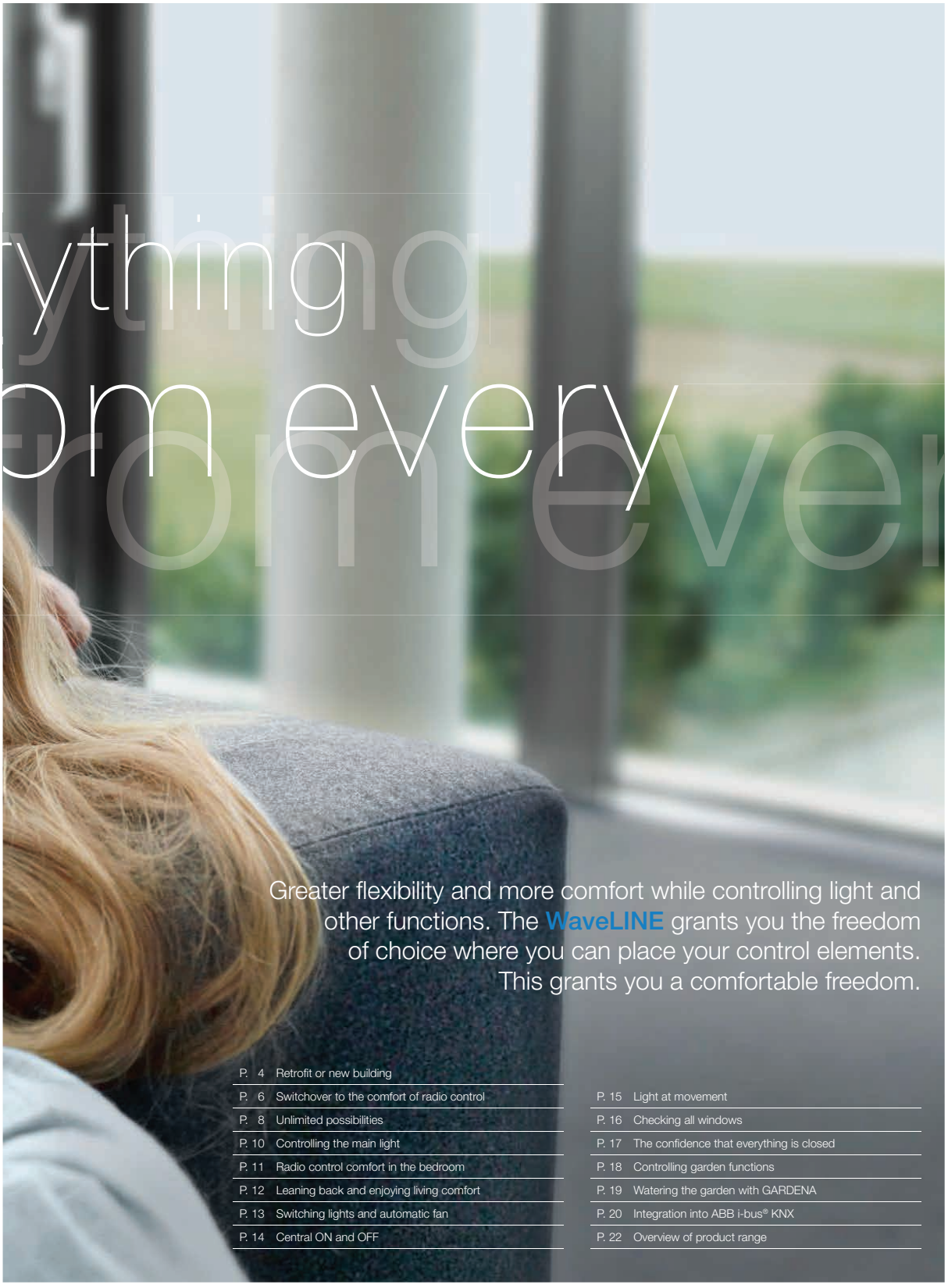
19mm2 channeling used for the electrical installation. Cables are drawn into conduits in that way. Pret-a-Loger proposes to use the same type of channeling for the instrumentation and monitoring lines instead of the 25mm2 that is requested.



The new switching freedom.
WaveLINE RF solutions.

Power and productivity
for a better world™


Control ever
fr
room



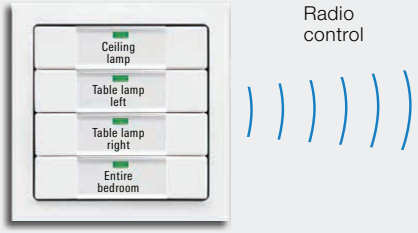
rything
om every

Greater flexibility and more comfort while controlling light and other functions. The **WaveLINE** grants you the freedom of choice where you can place your control elements. This grants you a comfortable freedom.

P. 4 Retrofit or new building
P. 6 Switchover to the comfort of radio control
P. 8 Unlimited possibilities
P. 10 Controlling the main light
P. 11 Radio control comfort in the bedroom
P. 12 Leaning back and enjoying living comfort
P. 13 Switching lights and automatic fan
P. 14 Central ON and OFF
P. 15 Light at movement
P. 16 Checking all windows
P. 17 The confidence that everything is closed
P. 18 Controlling garden functions
P. 19 Watering the garden with GARDENA
P. 20 Integration into ABB i-bus® KNX
P. 22 Overview of product range

Upgrade, renovation or a new building: Radio control comfort for all situations.





›› Multi-talent: The 4gang WaveLINE control elements
›› Various functions under control via radio signal

WaveLINE is a new wireless control system using the radio frequency technology. With our new wall mounted control elements “transmitters” you will be able to control Light, blinds and other functions in your house, along with movement detectors or window contacts which can create a perfect integration for a reliable safety and functionality.

New possibilities for older buildings.

When renovating an existing house, or simply rearranging the furniture, the switches are often no longer where they are. Or you may be missing a few additional switching options for greater comfort. Often this means: making new holes in the wall, laying cables, re-plastering, painting or wallpapering. This involves additional expenditure and generates unavoidable dirt and rubbish.

With the WaveLINE you save on the associated expenditure, but not on the comfort. The radio signal bridges the distances for you. The associated switches are simply glued on and control the actuator via radio. For safety, for example, the sensors signal whether a window is open or closed. And they can be retrofitted quickly and easily. With radio control instead of cables.

* An actuator is a switch or a dimmer



Easy...Right from the beginning – with radio control in new buildings.

Also in new buildings it does not always have to be cables! Use the WaveLINE radio control system right from the start, for example, to switch lights from several positions in the room, or even from a different room, in addition to the main switch. The same applies to blinds and entire light scenes. The wireless operating comfort equally applies to outdoor areas; for switching lights in the garden and the pool from the house, for example.

Also automatic or preprogrammed functions can be integrated via the WaveLINE radio control system. Movement detectors switch lights via radio signal, actuators lower the heating when an open window is signaled – the possibilities of the WaveLINE are as numerous as the desires for comfort and safety. And, if a desired function has been forgotten: no problem – the WaveLINE is ideally suited for easy retrofitting.

Switchover to the comfort of radio control. Actuator or transmitter both are ready.

WaveLINE actuators

It's this simple: position the switch actuator in close proximity to your consumer. This could be a lamp or a blind. Then exchange the existing switch for one or several wall-mounted transmitters.

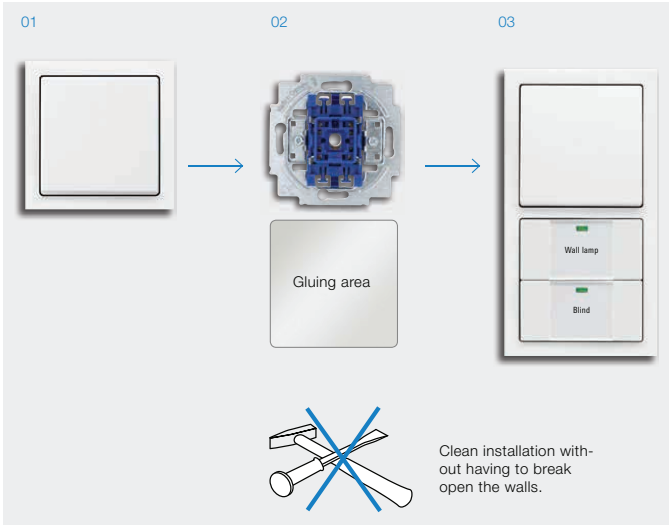


Why functionality over comfort while you can get both! Operating blinds, dimming lights, switching devices – with the WaveLINE from the position that is the most practical for you. Apart from the special actuator you only need the radio wall-mounted transmitters which are simply glued at the desired position. No cable connections, no flush-mounted wall box, no construction headaches. Elegant right from the time of installation.

The WaveLINE actuators take over the control and switching function – e.g. for one lamp or entire light scenes. They are equipped with a radio receiver, which means that they can be activated via wall-mounted transmitters that can be installed almost anywhere and remotely operated. They are easy to install and their reception is outstanding. Depending on the model, they are multi-functional with operating mode selector switch, programmable or specially designed for certain tasks, such as timer functions.

It is the wall-mounted transmitters in the WaveLINE system that make the difference in comfort. You have always wanted to control the blinds remotely without having to get up from your armchair, yet the switch is located next to the window at the other end of the room. The WaveLINE is the solution to the problem. An appropriate WaveLINE actuator is installed in the blind box and a wall-mounted transmitter is installed at the desired location without any structural alterations and you are ready to control the blind remotely via radio.





Radio control comfort for retrofitting.
Small cause – large effect: with the WaveLINE the comfort of remote control is easily retrofitted. Clean and without a separate cable. The old switch is replaced with a switch combination that is glued on and a separately mounted actuator is ready to be remote controlled.

01	Conventional switch / push-button
02	Remove the rocker and 1gang cover frame and glue the mounting plate to the wall
03	Install the new 2gang cover frame and control elements

Unlimited possibilities.
Greater living comfort.





Remote control

The WaveLINE manual transmitter:
mains-independent, versatile, elegant.

Living requires freedom.
WaveLINE is not only surprisingly easy to install. The system is also extremely versatile. Switching, controlling blinds and calling up entire light scenes and main functions with a press of a button: the WaveLINE makes your living space a little more comfortable. You will quickly get used to the everyday advantages of comfort that practical remote radio control provides and will not want to miss it. You may even get additional ideas about other functions that you would like to easily and without great effort convert to radio control.

Greater comfort: remote control with the manual transmitter.
A special feature of the WaveLINE system is that the switching flexibility is increased with radio wall-mounted transmitters and that one has a radio switch where it is regularly needed. Of course, also the classical manual transmitter has its place in the WaveLINE system – with group selection keys for all the important applications. For switching, dimming, raising and lowering of blinds or calling up scenes. With the elegant transmitter you have everything under control right where you are.



01 Switching

Even loads that are not permanently mounted can be switched via radio control and a radio-controllable socket outlet. This allows you, for example, to switch off the bedside table lamp or the radio with the wall-mounted transmitter next to the door when you leave the room.

02 Dimming

Create the right atmosphere with light with the continuously variable dimming function. With the appropriate dimming actuator of the WaveLINE system and the matching wall-mounted transmitter you fix precisely from where you would like to dim the lighting.

03 Blind

Why get up to adjust the blind when you can do it comfortably from the couch! The WaveLINE makes it possible. Via manual transmitter or wall-mounted switch. And to operate the screen, the beamer lifter, the garage door or the exterior lighting is just as easy.

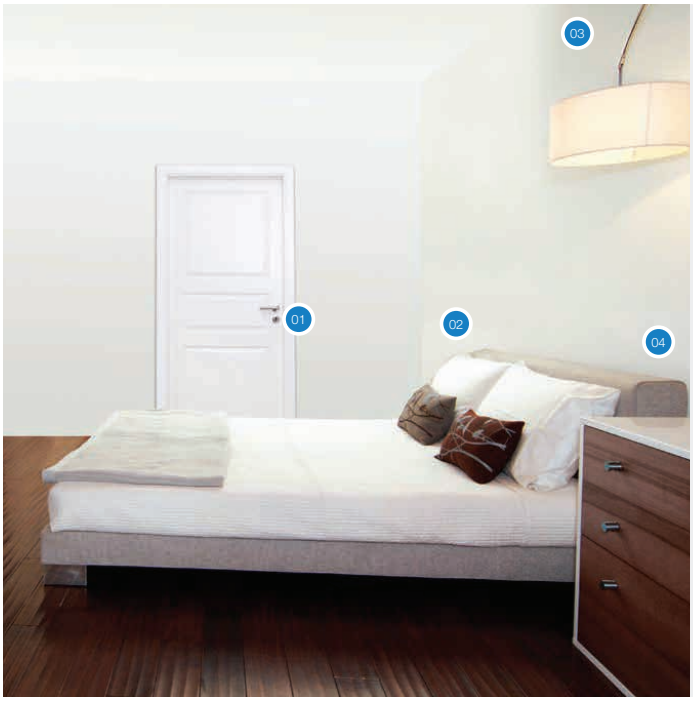
04 Central functions

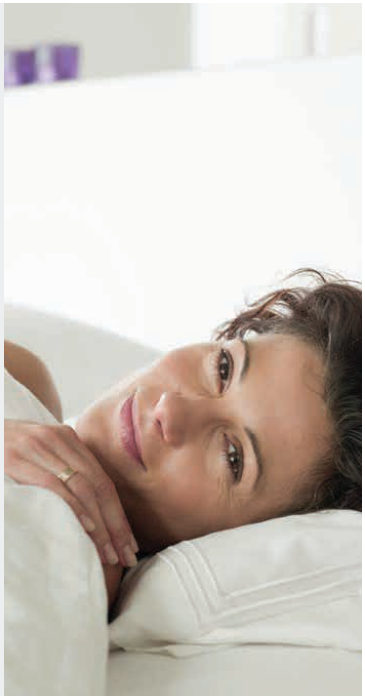
Are all the lights off when you leave the house? With the WaveLINE and the central function a press of a button suffices to switch off the lights in the entire house. Comfortable – and extremely useful for daily life.

05 Light scenes

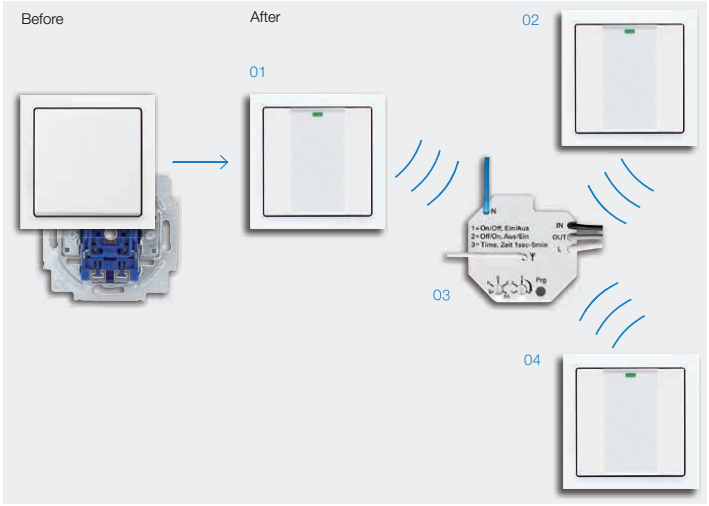
With WaveLINE you can operate individual light sources or store entire lighting scenes, which can then be recalled at the press of a button. Create the individual atmosphere with light for the evening meal, for watching television, for reading – with just one radio signal from the WaveLINE.

Controlling the main light.
Without getting up.





Retrofitting a cross connection: the clever way, so that the ceiling light in the bedroom can be operated from both sides of the bed. For this the existing switch, mostly located at the door, is replaced by a wall-mounted transmitter. Two wall-mounted transmitters, that are linked via radio signal instead of cables, are also glued to the wall next to the bed. The light can now be remotely controlled via the separately mounted actuator.

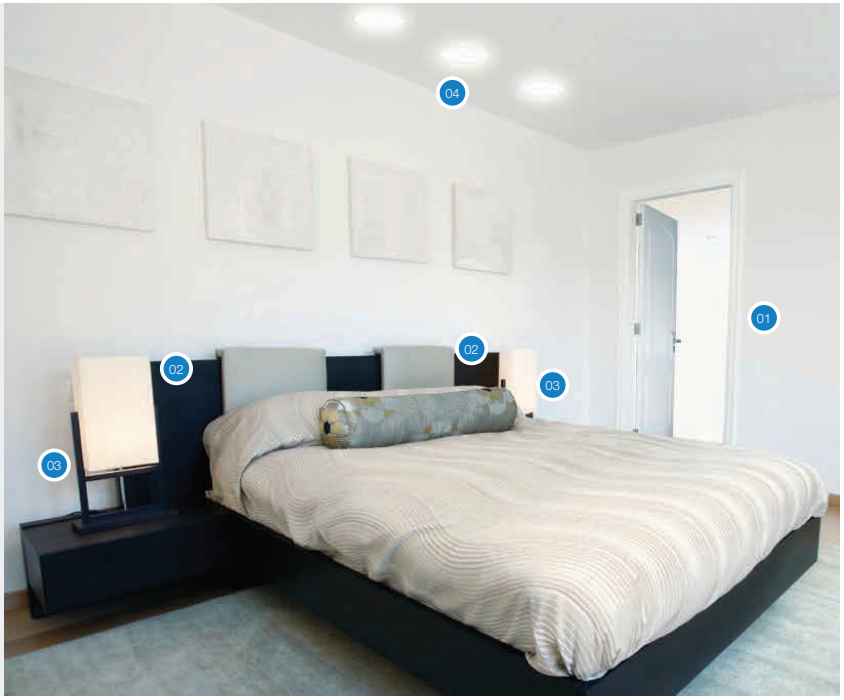


01	WaveLINE wall-mounted transmitter, 1 channel, article no. 6731-84
02	WaveLINE wall-mounted transmitter, 1 channel, article no. 6731-84
03	WaveLINE switch actuator, article no. 6702
04	WaveLINE wall-mounted transmitter, 1 channel, article no. 6731-84

Complete and flexible.
Radio control comfort in the bedroom.

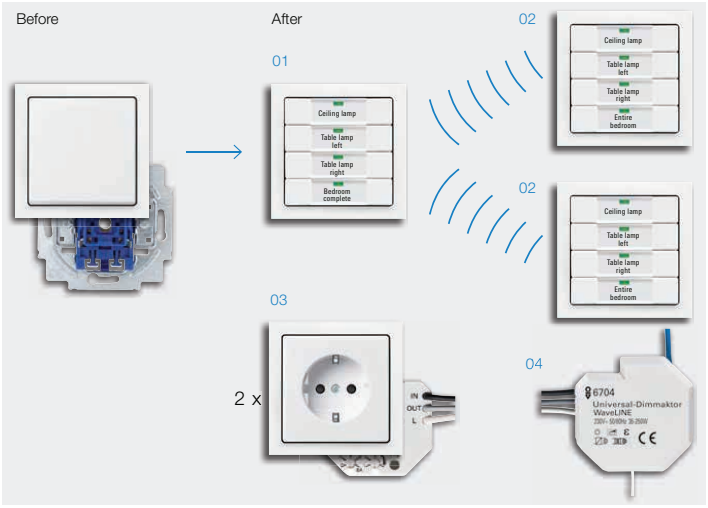
Rocker assignment of 4-channel wall-mounted transmitter:

- ›› ceiling lamp
- ›› Table lamp left
- ›› Table lamp right
- ›› Bedroom complete

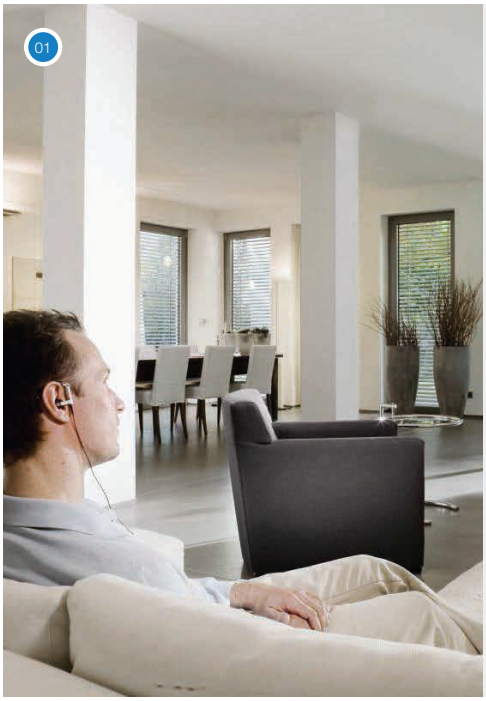


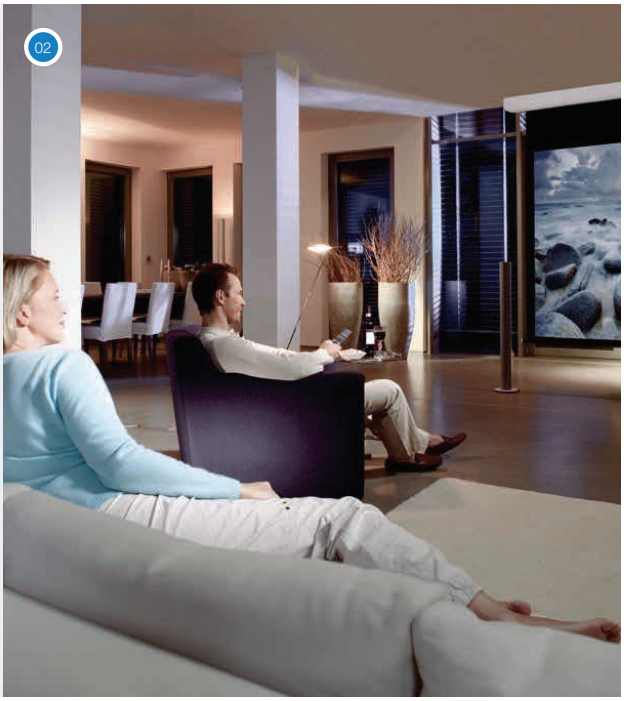
For even greater comfort in the bedroom, additional functions can be retrofitted together with a cross connection: switching and dimming the main light additionally from both sides of the bed and switching of two bedside table lamps from all positions. Added to this is the integration of a central function with which all lamps can be switched off with the press of a button when leaving the room. Essential here are the WaveLINE 4-channel wall-mounted transmitters that are installed in place of the light switch and simply glued at the side of the beds.

01	WaveLINE wall-mounted transmitter, 4 channel, article no. 6733-84
02	2 x WaveLINE wall-mounted transmitters, 4 channel, article no. 6733-84
03	2 x WaveLINE switch actuators, article no. 6702 2 x SCHUKO® socket outlet inserts, article no. 20 EUC-84
04	WaveLINE universal dimming actuator, article no. 6704

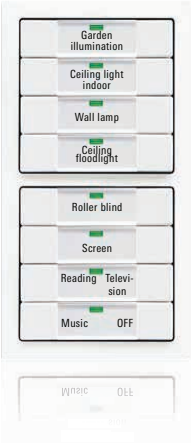


Leaning back and enjoying living comfort.
Multitude of functions well combined.





Everything comfortably under control.
Discover the numerous possibilities to integrate and enjoy radio control comfort in your living room. Indoor and outdoor illumination, blinds and additional equipment such as the screen for the television viewing event at home: the WaveLINE makes their operation easy. From the position that is most comfortable for you. Either with the manual transmitter or with the wall-mounted transmitters of the WaveLINE radio control system. The touch rockers can be assigned individually, which makes available numerous functions as a single control combination for you. These are advantages which make the living room even more cosy.



01 Also complete light scenes – for reading, for example – can be called up centrally.

02 Television viewing comfort with all the functions and the right light atmosphere is available at the press of a button.

2 x WaveLINE switch actuators, article no. 6702, wall lamp, switchable socket outlet with ceiling floodlight

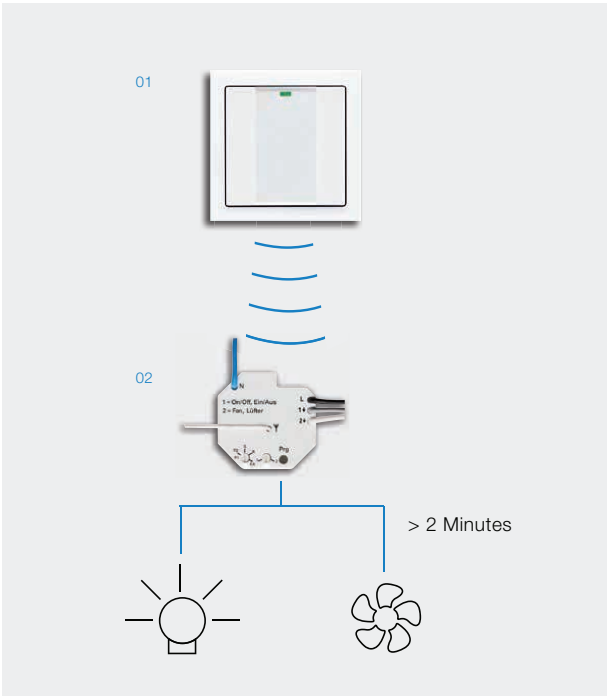
2 x WaveLINE universal dimming actuators, article no. 6704, 2 light circuits in the ceiling

2 x WaveLINE blind actuators, article no. 6705, screen and roller blind

6 x WaveLINE wall-mounted transmitters, 4 channel, article no. 6733-84

1 x WaveLINE manual transmitter, article no. 6780

Switching lights and ventilation.
Perfect for a bathroom or a kitchen.





Practical and energy-saving.
The WaveLINE wall-mounted transmitter switches the light on or off in the bathroom or the WC for guests via a series actuator – and also the fan/ventilation via its second output. The actuator also has an automatic switch-on and switch-off delay. If the light is switched on for briefly washing the hands, the fan remains off. If you remain longer than 2 minutes the fan switches on automatically. After the light is switched off, the fan remains on for a further 5 minutes.

01 WaveLINE wall-mounted transmitter, 1 channel, article no. 6731-84 switches on the lighting and the fan

02 WaveLINE series switch actuator, article no. 6703, channel 1: lighting, channel 2: fan

Central ON and OFF.
A good feeling.



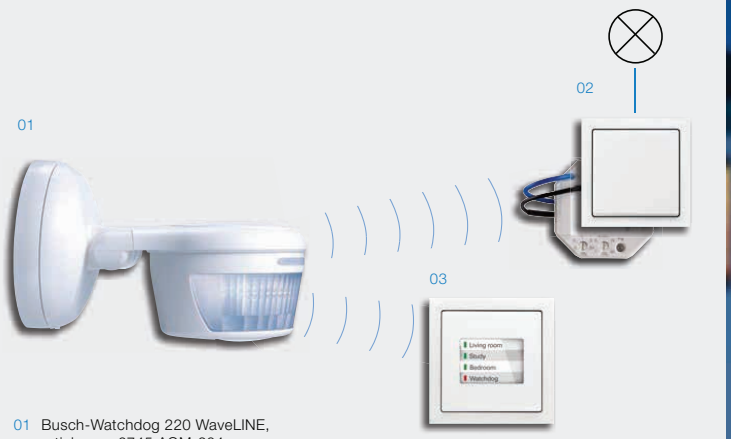
Everything is bright. Everythings is OK.
With the WaveLINE you have a central switch directly next to your bed to switch on the entire lighting at once via radio signal, and that without extensive installation work. In security technology this function is known as a panic button. If you have an uneasy feeling during the night that something is wrong, just a press of the button and everything is bright and clear. The sudden light will drive away any unwelcome guests.

One wall-mounted transmitter for the light in the entire house.
Perhaps this has happened to you: you have left the house in a hurry and are then not sure whether you have turned off all the lights. Or you simply don't want to turn off or check each single light. The WaveLINE handles this task with the central Off function. A wall-mounted transmitter is installed at the front door without any great effort, which controls the corresponding actuators via radio. For you this means: one press of the button and everything is off.

01 WaveLINE wall-mounted transmitter, 1 channel, article no. 6731-84

02 WaveLINE wall-mounted transmitter, 1 channel, article no. 6731-84

Movement equals light.
For safety and quality of living.

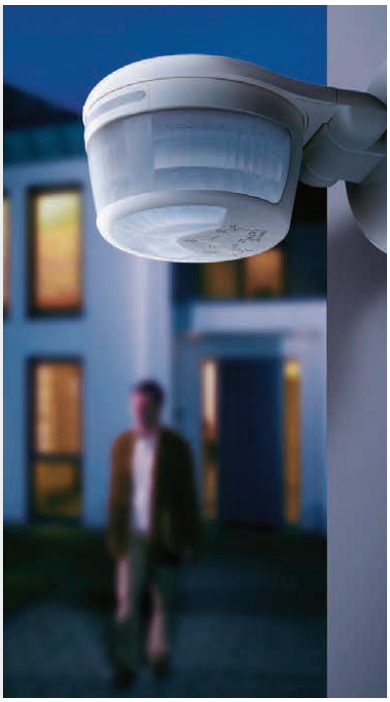


01 Busch-Watchdog 220 WaveLINE, article no.: 6745 AGM-204

02 WaveLINE built-in receiver, article no. 6701

03 WaveLINE LED display, article no.: 6730-xx on 6404 U

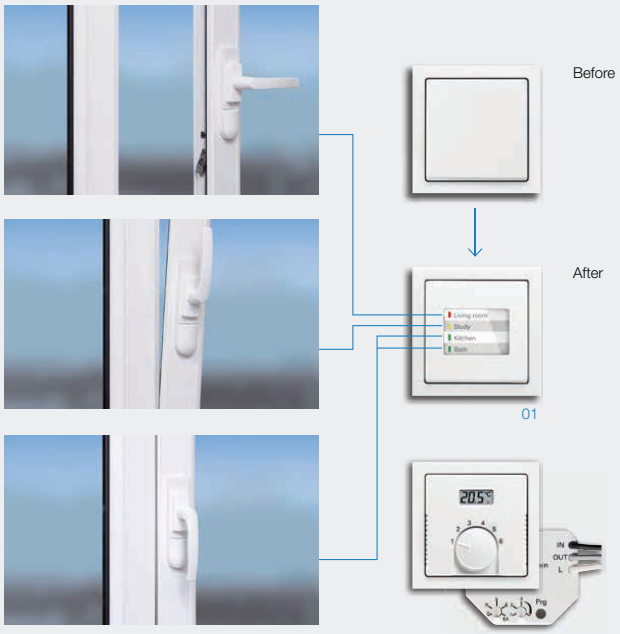
It is possible to display the detection of a movement using an LED on the Busch-Watchdog.



Easy to install – powerful effect

The distribution of the sensor and actuator function to 2 devices opens up totally new possibilities for application with this Busch-Watchdog. The sensor can be freely placed wherever it can optimally monitor the entire detection range. It is extremely energy-saving so that the high-performance batteries (iron (II) disulphide) last for up to 10 years. If it detects a movement, it then transfers the switch-on signal to the built-in actuator, which can even be installed in a deep flush-mounted socket outlet underneath a push-switch near the lamp. In addition, it is possible to assign several sensors to a single actuator and thus reliably monitor even angled areas. The installation of the WaveLINE Watchdog could not be easier. Battery operation eliminates all need for wiring. The wall connection socket is quickly attached to the wall with only a single fastening screw.A rubber absorber provides perfect equalisation in case of an uneven foundation. Adapters for mounting to house corners or downpipes are also available. The sensor itself is then connected to the wall connection socket via a bayonet joint and can be turned by 30°, for example, for the equalisation of slopes. The batteries can be tested directly on the device.

Checking all windows.
At a glance.



01 It's this easy. Where a light switch or dimmer was installed before, you can now also use the message system function. The original switching or dimming function is retained. 1 x WaveLINE window sensor, article no. 6720-84, for example

1 x Universal relay insert, article no. 6404 U, insert for LED display for switching the hall lighting

1 x LED display, article no. 6730-84, display with local control for lighting

1 x WaveLINE switch actuator, article no. 6702

1 x Room thermostat, article no.1094 UTA, RTR with terminal for nighttime temperature reduction

Open, closed or locked: unmistakable information.
Where conventional systems only check whether the window is in contact with the frame, WaveLINE goes a decisive step further. It signals the position of the window handle and thus provides information as to whether the window is locked.
Window sensors monitor and transmit the position of the window handle – this is indicated by means of a coloured LED on the easy-to-view display, which can be individually labelled.
In addition, the nighttime temperature reduction of the room thermostat can be activated via a switch actuator when the window is open. This prevents the heating from being switched on immediately, especially when the temperature outside is low.

The associated window sensors mounted between the handle and the frame are available in black, white, and stainless steel optics and thus well-suited for all conventional window frames and window handles. To save costs, the existing handles can continue to be used.

02 03 04



02 WaveLINE window sensor, white matt 6720-64

03 WaveLINE window sensor, stainless steel 6720-66

04 WaveLINE window sensor, basalt black 6720-65

The confidence that everything is closed. Even the cellar door.



The two channels of the universal detector can be transferred and displayed separately via the LED display. You are thus always informed as to whether the cellar door is closed and locked.

Instead of a tour of inspection: an inspection glance.
Where window sensors cannot be installed, the WaveLINE universal detectors are used. Often it is good to know that the cellar door is closed – when small children are in the house or as protection against uninvited guests, for example. The signalling channels of the universal detectors operate independent from each other. The first channel is triggered by the reed channel, while the second channel is firmly wired to a floating contact. This is practical for later installation: If the LED display is combined with the universal relay insert, which replaces the existing switch, the switching function can, for example, be retained for the hall light.

01 02

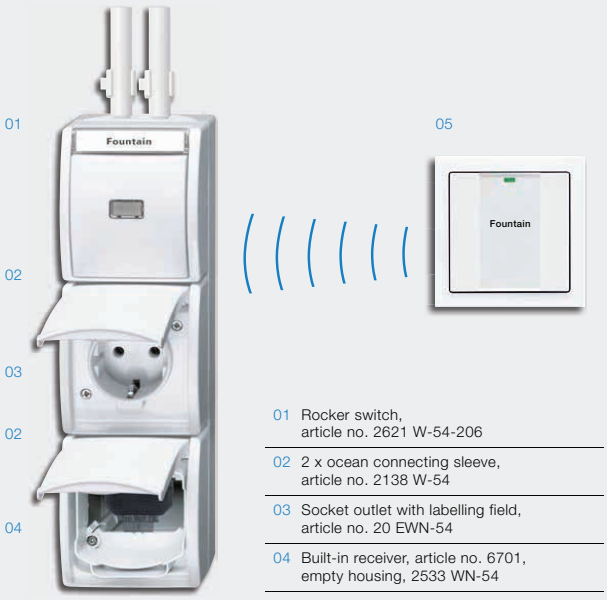


01 WaveLINE universal detector, 6721-64

02 WaveLINE universal detector, 6721-65

Controlling garden functions.
From the house.



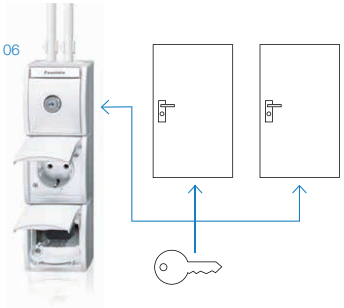


01	Rocker switch, article no. 2621 W-54-206
02	2 x ocean connecting sleeve, article no. 2138 W-54
03	Socket outlet with labelling field, article no. 20 EWN-54
04	Built-in receiver, article no. 6701, empty housing, 2533 WN-54
05	Wall-mounted transmitter, 1gang, article no. 6731-84

Fountain and garden illumination under control with radio control.

The garden can also be enjoyed from the house. Especially when functions such as the fountain, garden illumination or the swimming pool cover can be easily operated from indoors with the WaveLINE wall-mounted transmitter.

One possible outdoor combination of the ocean® range consists of three single elements: switch, socket outlet and empty cover box for the actuator. With the switch the radio control can be blocked when necessary, such as in the winter. Tip: The consumers can also be connected directly by the electrician, instead of the socket outlet.

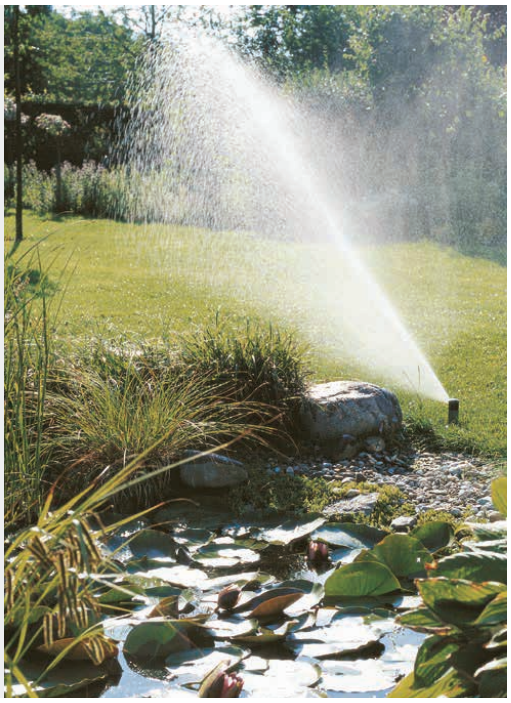


The key switch prevents unauthorized operation. The profile half cylinders of an existing locking system can be used. This makes additional keys unnecessary.

06	Key switch, article no. 2733 SLW-54
››	3gang combination as above, only the switch needs to be replaced with the key switch.

Watering the garden with GARDENA.
Its fun with the comfort of radio control.





01 WaveLINE wall-mounted transmitter, 1 channel, article no. 6731-84

02 WaveLINE switch actuator, article no. 6702

›› GARDENA irrigation valve with a 24V power supply and sprinklersystem

Watering the easy way.

Permanently installed irrigation systems make watering the garden with a watering can or hose obsolete. The WaveLINE provides even more comfort. The irrigation system can be switched on or off from the kitchen or any other room in the house. For this, a irrigation valve, from GARDENA, for example, which can be connected to each switch combination, needs to be integrated. It is also possible to automatically switch the garden irrigation system on briefly with the Busch-Watchdog movement detector, to chase away small animals from your property. All you need to water your garden via radio signal is a wall-mounted transmitter, switch actuator, valve and system from GARDENA!

GARDENA®
Live your garden

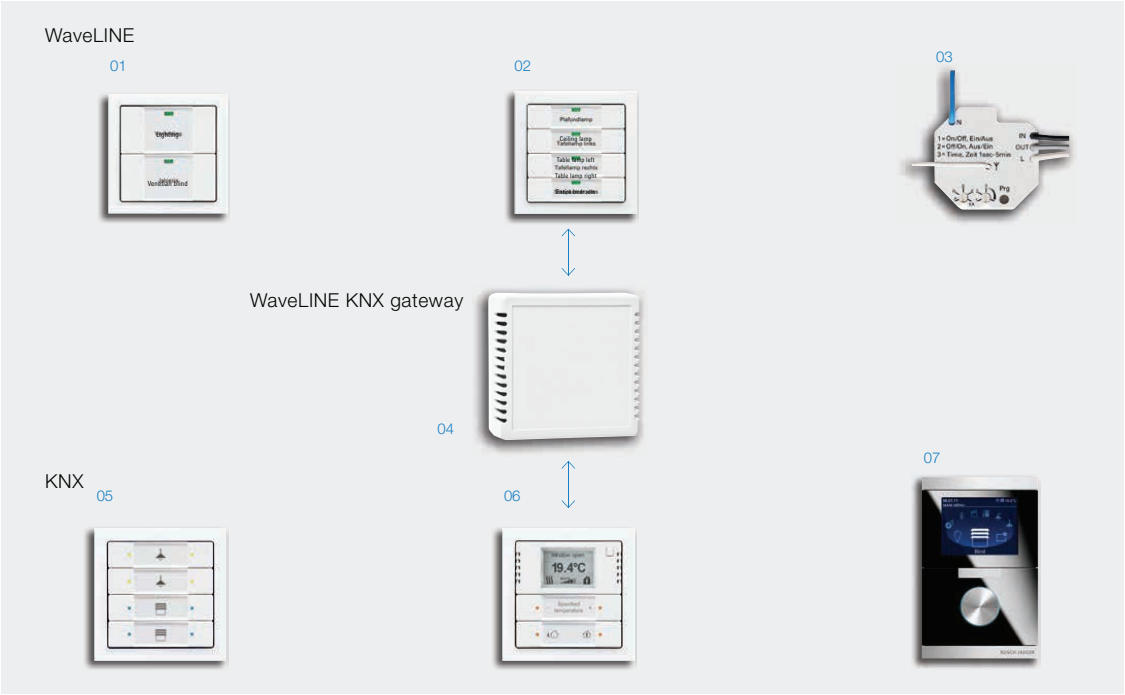
ABB i-bus® KNX.
Easy extension of networked home technology.



KNX radio control intelligently linked.

The light in the house is perfect for every situation, the living room is comfortably heated at just the right time and the movement of the blinds adjusts to the weather or the time of day – with networked home technology via the ABB i-bus® KNX the house adapts itself to your wishes. Aside from the power lines, also a KNX network is installed with which actuators and sensors comprehensively interact. Even though a KNX installation is carefully planned, it could be that individual functions may have to be added later.

The WaveLINE makes this possible without having to structurally extend the KNX network. Signals between the two systems can be exchanged via the WaveLINE TP-RF media converter. Here an example: the temperature sensor in the KNX network measures a specific temperature in the living room, the corresponding command is signaled via the media converter and triggers the radio signal in the WaveLINE system for lowering the blind.



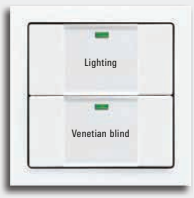
01	WaveLINE wall-mounted transmitter, 2 channel, article no. 6732-84(-500)
02	WaveLINE wall-mounted transmitter, 4 channel, article no. 6733-84(-500)
03	WaveLINE switch actuator, article no. 6702(-500)
04	WaveLINE KNX gateway, article no. 6770(-500)
05	Control element, 4/8gang, article no. 6127/02-884
06	Room thermostat, article no. 6124/01-84
07	Busch-priOn® 8.89 cm-(3.5“-) TFT colour display with rotary control element, article no. 6344-825-101

The complete range.
At a glance.

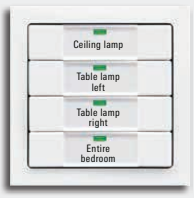
01



02



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08



01 WaveLINE wall-mounted transmitter, 1 channel, article no. 6731-84

02 WaveLINE wall-mounted transmitter, 2 channel, article no. 6732-84

03 WaveLINE wall-mounted transmitter, 4 channel, article no. 6733-84

04 WaveLINE LED display, 4gang with switching function, article no. 6730-84

05 WaveLINE Busch-Watchdog 220, article no. 6745 AGM-204

06 WaveLINE window sensor, article no. 6720-64

07 WaveLINE universal detector, article no. 6721-64

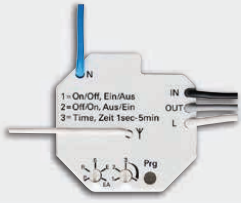
08 WaveLINE manual transmitter, article no. 6780

Including a variety of designs.

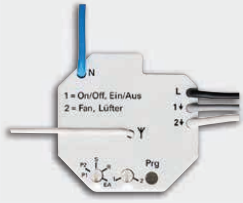
The wall-mounted transmitters of the WaveLINE system are available in the switch ranges carat®, pure stainless steel, solo®, Busch-axcent® and future® linear. Wall-mounted transmitters with a 1 and 2 channel function are available in programs Busch-Duro 2000® SI and Reflex S. All for radio comfort in individual design.



01



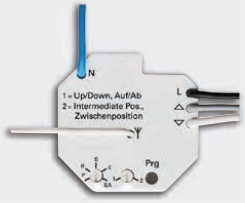
02



03



04



05



06



01 WaveLINE switch actuator, article no. 6702

02 WaveLINE series switching actuator, article no. 6703

03 WaveLINE universal dimming actuator, article no. 6704

04 WaveLINE blind actuator, article no. 6705

05 WaveLINE built-in receiver, article no. 6701

06 WaveLINE KNX gateway, article no 6770

Easy to install. Also behind the socket outlet.

The WaveLINE actuators fit into the flush-mounted wall box. For the option of remotely controlling consumers connected to socket outlets, such as floor lamps, the corresponding actuator is simply installed behind the socket outlet.

Interfaces for smooth integration.

The WaveLINE stands for flexibility due to the simple extension of operating options in and around the house. The smooth embedment into overall systems via made-to-measure interfaces, ABB i-bus® KNX or SmartEnergy systems, for example, is a decisive advantage.

Contact us

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of the ABB Group

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info.bje@de.abb.com

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BJE 0001-0-1334/2.12/0502-D, dpi 406097

Power and productivity
for a better world™



Busch-Watchdog
Surface-mounted devices
Built-in wireless receiver





3 wire connection (neutral conductor required).
For wireless switching of electrical loads.
Functions: constant On/ Off via Auxilliary Input, time delay or light scenes.
For Busch Watchdog® WaveLINE.
For WaveLINE 6721-xx universal signalling unit.
Compatible with WaveLINE KNX gateway TP-RF 6770.
Switch-off delay: 60 to 30 min., adjustable.
Repeater function can be activated for extended range.
Operation also possible via conventional push buttons (2020 US, 2021/6 UK).
For universal attachment or installation.
For installation in (deep) flush-mounted boxes to German Standard DIN 49073, Part 1.
Controllable up to 48 transmission addresses.
Send/receive frequency: 868 MHz.
Range in free field: approx.100 m

Control element: Adjustable potentiometerDisplay elements: Status indication of output via LED.
Rated voltage: 230 V~, +10 % / -10 %Rated frequency: 50 Hz - 60 Hz
Inputs: 1Polling voltage: 230 V~, Sensing pulse, L-wire
Outputs: 1 Normally open contactSuitable for: Resistive loadRated current: 10 AOutput voltage: 230 V~Rated power: 2300 WSuitable for: capacitiveRated current: 10 AXOutput voltage: 230 V~Rated power: 2300 VASuitable for: inductiveRated current: 10 A, cos φ0.6Output voltage: 230 V~Rated power: 2300 VA
Protection class (Device): IP 20Temperature range (Device): -25 °C - 55 °C
Dimensions: (L x W x D): 47 mm x 48 mm x 30 mmMounting depth: 30 mm
Please check locally if the frequency 868 MHz is permitted to use in your country.

Order Code : 6700-0-0022
Article No. : 6701
EAN: 4011395085561



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Product zoeken

Soort licht
- Small
- Medium
- Large

Type product
- Integrated
- Solitary
- Wall
- Spot
- Transformers
- Cables
- Accessories
- Sets

Type lichtbron
- LED
- Halogen
- Bulb

Producten





SENTINA WALL

Wandarmatuur in donkergrijs gecoat aluminium met binnenwerk in warm zilver. Geeft een Warm White licht. Met los verkrijgbare 10W transformator (CB-010E) ook geschikt voor aansluiting op het lichtnet.

SPECIFICATIES

Soort licht	:	Medium
Productgroep	:	Wall
Afmetingen	:	Ø 80 mm, hoogte 235 mm, diepte 115 mm
Materiaal	:	Aluminium behuizing, slagvast polycarbonaat lens
Kleur	:	Charcoal/Rosé Silver
Vermogen	:	12V/3,5W
Lichtbron	:	LED
Lichtkleur	:	Warm White
Lichtbereik	:	3 meter
Toepassing	:	Wandarmatuur te plaatsen bij de voor-, achterdeur, schuur, schutting, etc.
Verwerking	:	Bevestiging middels bijgeleverde schroeven en pluggen.

VERKOOPGEGEVENS

Verpakkingseenheid	:	1/ST
EAN code	:	8717051002618

zoeken

MAGAZINE LITE MATTERS



Lite Matters voorjaar 2013 al gezien? Lees hem hier online en abonneer je gratis op het volgende nummer.
Verder

NIEUWSBRIEF

Op de hoogte blijven?
Meld je aan voor onze digitale nieuwsbrief.

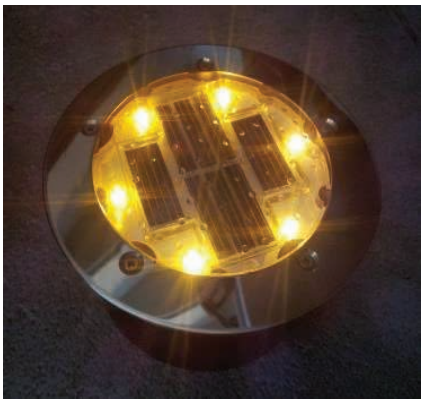
e-mailadres
Aanmelden

Fijen TMLE
Wilhelminastraat 32
4271 AV Dussen
tel:+31(0)416-759401
Email:2sales@fijenbv.com

Fijen TMLE

DATA SHEET

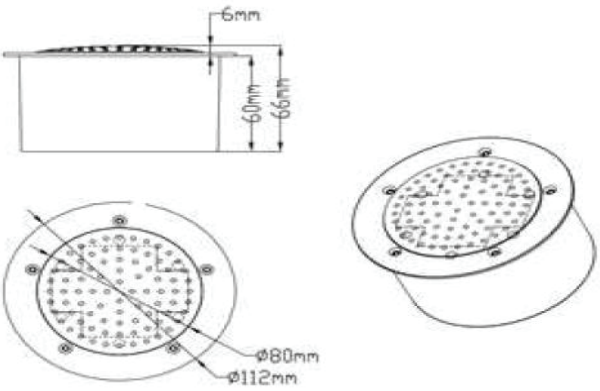
Specification	Item	Solar ground lights
	Type	FRS-311
Size	Weight	635g
	Dia.112mm Height:61mm	
Solar panel	Power	0.32W
	Voltage	2.5V
	Material	Mono-crystalline silicon
LED	Type	5mm high-luminance LED
	Quantity	6pcs
	Color	Yellow/white/red/blue/green
Shell	PC ,Die cast aluminum alloy,stainless stee	
Power storage	Ni-MH battery 1.2V 1600mAh	
	Capacitor 2.3V 120F*3	
Working environment	Temperature	-40 to 75 ℃
	Waterproof	IP68
Visibility	Over 500m	
Certification	CE	
Packing list	G.W.	17 kgs/carton
	Carton size	37*25*34cm
	Quantity	24 pcs/carton
Work in dark	14 hours after a standard luminous intensity day.36 hours when battery is charged fu	
Delivery time	1-8 weeks for 100-5000pcs	



Description

1、Unique appearance
2、Charge in day time and discharge at night automaticall
3、The life time is up to 10 years for capacitor type
4、Easy to install, no maintenance is necessary





Hengdian Group DMEGC Magnetics Co., Ltd

Hengdian Industrial Area

Dongyang，Zhejiang 322118

P. R. China

TEL: +86 579 8658 8825

FAX: +86 579 8655 4845

Date: Mar.03, 2014

Subject: Declaration of Conformity

To whom it may concern,

As the manufacturer of the Photovoltaic modules, We Hengdian Group DMEGC Magnetics Co., Ltd hereby declare that our below produced Photovoltaic modules:

Double Glass Module M156-48
Double Glass Module M156-42

are complying with EN 61215: 2005.

Should you have any questions, pls. let us know.

Yours faithfully,

Hengdian Group DMEGC Magnetics Co., Ltd

DMEGC Solar Energy

A Division of Hengdian Group DMEGC Magnetics Co.,Ltd.

Model Type	DM175-M156-42
Rated Max Power (Pmax)	175W
Output Tolerance	±5%
Current at Pmax (Imp)	8.14A
Voltage at Pmax (Vmp)	21.5V
Short-Current (Isc)	8.61A
Open-Circuit Voltage (Voc)	26.5V
Normal Operating Cell Temp (NOCT)	45±2℃

Weight	35kg
Dimension	1388×1183×8.8(mm)
Max System Voltage	1000VDC
Maximum Series Fuse	15A
Application Class A	

STC:1000W/m^2 AM 1.5 25℃
Operating Temp: -40℃ To +85℃
Mechanical load: 5400Pa

Fire Rating Class C

Field wiring Copper only 12 AWG min.
Insulated for 90℃ min

APPROVED PRODUCT MCS BABT
Certificate Number BABT 8586

ADD:Hengdian Industrial Zone, Dongyang, zhejiang China 322118
TEL:+86-579-86588601/86554950
Email:solar@dmegc.com.cn
Web:www.dmegcsolar.com

Made In China

DMEGC Solar Energy

A Division of Hengdian Group DMEGC Magnetics Co.,Ltd.

Model Type	DM200-M156-48
Rated Max Power (Pmax)	200W
Output Tolerance	±5%
Current at Pmax (Imp)	8.14A
Voltage at Pmax (Vmp)	24.6V
Short-Current (Isc)	8.61A
Open-Circuit Voltage (Voc)	30.3V
Normal Operating Cell Temp (NOCT)	45±2℃

Weight	38kg
Dimension	1497×1183×8.8(mm)
Max System Voltage	1000VDC
Maximum Series Fuse	15A
Application Class A	

STC:1000W/m^2 AM 1.5 25℃
Operating Temp: -40℃ To +85℃
Mechanical load: 5400Pa

Fire Rating Class C

Field wiring Copper only 12 AWG min.
Insulated for 90℃ min

APPROVED PRODUCT MCS BABT Certificate Number BABT 8586

ADD:Hengdian Industrial Zone, Dongyang, zhejiang China 322118
TEL:+86-579-86588601/86554950
Email:solar@dmegc.com.cn
Web:www.dmegcsolar.com

Made In China

date	GlobHor W/m2	T Amb °C	WindVel m/s	E_Grid Wh
30-06-90 0:00	0	18.32	1.3	0
30-06-90 1:00	0	17.9	1.8	0
30-06-90 2:00	0	17.47	1.1	0
30-06-90 3:00	0	17.05	0.9	0
30-06-90 4:00	0	16.63	1.6	0
30-06-90 5:00	14.97	17.06	0.9	8.427
30-06-90 6:00	51.76	17.59	2.1	122.2
30-06-90 7:00	102.1	18.27	2.1	285.1
30-06-90 8:00	152	18.98	2.3	475.2
30-06-90 9:00	164.9	19.47	2.8	540.6
30-06-90 10:00	231.3	20.13	1.8	795.6
30-06-90 11:00	202	20.46	2.1	706.2
30-06-90 12:00	234.7	20.83	2.1	843.2
30-06-90 13:00	221.9	21.06	1.9	807
30-06-90 14:00	208.9	21.2	1.6	765
30-06-90 15:00	172.8	21.21	0.9	627.1
30-06-90 16:00	144.7	21.12	1.3	517.3
30-06-90 17:00	131	20.97	1.5	465.6
30-06-90 18:00	75.46	20.64	0.7999	239.7
30-06-90 19:00	30.8	20.19	0.9	65.9
30-06-90 20:00	5.823	19.71	0.7999	0
30-06-90 21:00	0	19.06	1.2	0
30-06-90 22:00	0	18.41	1.3	0
30-06-90 23:00	0	17.77	2.4	0
01-07-90 0:00	0	19.09	2.9	0
01-07-90 1:00	0	18.08	2.5	0
01-07-90 2:00	0	17.07	3.1	0
01-07-90 3:00	0	16.05	1.6	0
01-07-90 4:00	0	15.04	1.4	0
01-07-90 5:00	13.76	15.42	0.9	7.857
01-07-90 6:00	38.52	15.75	0.9	90.78
01-07-90 7:00	70.3	16.15	0.7	204.5
01-07-90 8:00	121.9	16.72	0.7	395.6
01-07-90 9:00	162.4	17.29	0.5999	548.8
01-07-90 10:00	195	17.83	0.1001	674.1
01-07-90 11:00	195.3	18.19	0.4	680.3
01-07-90 12:00	216.8	18.54	0.7	765.3
01-07-90 13:00	266.6	18.97	0.5999	956.7
01-07-90 14:00	258	19.27	0.3001	928.7
01-07-90 15:00	266	19.54	0.4	969.3
01-07-90 16:00	195.2	19.57	0.3001	696.3
01-07-90 17:00	168.7	19.52	0.4	597.4
01-07-90 18:00	68.62	19.11	0.7	200.1
01-07-90 19:00	33.96	18.63	0.4	72.59
01-07-90 20:00	10.8	18.12	0.3001	0
01-07-90 21:00	0	17.99	0.1001	0
01-07-90 22:00	0	17.85	0.2	0

01-07-90 23:00	0	17.72	0.4	0
02-07-90 0:00	0	17.88	0.4	0
02-07-90 1:00	0	18.05	0.5999	0
02-07-90 2:00	0	18.21	0.5999	0
02-07-90 3:00	0	18.37	0.5999	0
02-07-90 4:00	0	18.54	0.3001	0
02-07-90 5:00	4.023	18.67	0.2	0
02-07-90 6:00	17.86	18.88	0.3001	21.43
02-07-90 7:00	103.3	19.75	0.7999	310.6
02-07-90 8:00	90.78	20.11	0.5001	275.3
02-07-90 9:00	284.4	21.42	0.7999	938.3
02-07-90 10:00	421.5	22.93	0.7	1408
02-07-90 11:00	343.2	23.71	0.7	1191
02-07-90 12:00	327.8	24.24	1.1	1136
02-07-90 13:00	361.2	24.76	1	1297
02-07-90 14:00	390.3	25.26	0.9	1419
02-07-90 15:00	329.8	25.52	1	1213
02-07-90 16:00	186.6	25.31	1	638.1
02-07-90 17:00	78.64	24.75	0.5001	227.2
02-07-90 18:00	36.54	24.12	0.4	76.56
02-07-90 19:00	40.16	23.6	0.5999	90.71
02-07-90 20:00	14.76	23.06	0.7	9.218
02-07-90 21:00	0	22.73	0.9	0
02-07-90 22:00	0	22.39	1.3	0
02-07-90 23:00	0	22.05	0.9	0
03-07-90 0:00	0	21.59	0.7999	0
03-07-90 1:00	0	21.14	0.9	0
03-07-90 2:00	0	20.69	1.4	0
03-07-90 3:00	0	20.24	1.2	0
03-07-90 4:00	0	19.78	1.5	0
03-07-90 5:00	8.153	20.02	1.1	0
03-07-90 6:00	19.01	20.18	1.8	24.6
03-07-90 7:00	40.42	20.44	2.1	94.71
03-07-90 8:00	90.62	20.95	4.1	273
03-07-90 9:00	120.4	21.43	4.5	382.8
03-07-90 10:00	145.7	21.87	3.3	477.8
03-07-90 11:00	160.5	22.25	4.1	534.4
03-07-90 12:00	161.3	22.54	4.9	540
03-07-90 13:00	177.8	22.82	4.9	603.4
03-07-90 14:00	176.6	23.03	4.7	600.2
03-07-90 15:00	157.2	23.15	4.1	528.7
03-07-90 16:00	110.3	23.13	3.1	349.7
03-07-90 17:00	89.63	23.02	4.1	272
03-07-90 18:00	56.07	22.81	3.3	147
03-07-90 19:00	27.51	22.52	2.6	47.89
03-07-90 20:00	5.173	22.2	4.9	0
03-07-90 21:00	0	21.34	3.5	0
03-07-90 22:00	0	20.48	4	0
03-07-90 23:00	0	19.62	4.1	0
04-07-90 0:00	0	18.33	3.8	0



04-07-90 1:00	0	17.04	2.6	0
04-07-90 2:00	0	15.75	3.3	0
04-07-90 3:00	0	14.46	4	0
04-07-90 4:00	0	13.17	4.7	0
04-07-90 5:00	38.51	14.25	4.5	50.08
04-07-90 6:00	139.5	15.69	5.7	190.7
04-07-90 7:00	299	17.72	2.9	420.1
04-07-90 8:00	389.5	19.38	2.5	1012
04-07-90 9:00	531.4	21.19	3.5	1572
04-07-90 10:00	581.1	22.63	3.3	1866
04-07-90 11:00	688.5	24.1	3.8	2248
04-07-90 12:00	763.9	25.46	4	2525
04-07-90 13:00	832.7	26.73	5.3	2734
04-07-90 14:00	769.7	27.55	4.9	2675
04-07-90 15:00	671.4	27.94	4.1	2487
04-07-90 16:00	506	27.82	3.3	2035
04-07-90 17:00	338.1	27.05	2.9	1377
04-07-90 18:00	255.3	26.07	3.3	1162
04-07-90 19:00	112.2	24.74	3.3	494.8
04-07-90 20:00	22.98	23.27	2.9	37.47
04-07-90 21:00	0	21.55	4.5	0
04-07-90 22:00	0	19.82	6.2	0
04-07-90 23:00	0	18.1	4.9	0
05-07-90 0:00	0	16.61	5.7	0
05-07-90 1:00	0	15.13	3.8	0
05-07-90 2:00	0	13.64	3.8	0
05-07-90 3:00	0	12.15	1.8	0
05-07-90 4:00	0	10.67	2.5	0
05-07-90 5:00	48.34	11.99	2.3	56.94
05-07-90 6:00	187.5	13.97	1.6	173.6
05-07-90 7:00	343.3	16.12	1.1	334.3
05-07-90 8:00	564	18.81	1.1	1282
05-07-90 9:00	671.7	21.02	2.3	1858
05-07-90 10:00	709.6	22.64	2.6	2187
05-07-90 11:00	463.9	22.67	2.3	1599
05-07-90 12:00	486.8	22.74	2.1	1719
05-07-90 13:00	339.8	22.03	2.5	1242
05-07-90 14:00	379.2	21.64	2.6	1414
05-07-90 15:00	453.4	21.64	3.1	1774
05-07-90 16:00	543.4	22.01	3.8	2258
05-07-90 17:00	346.1	21.5	4.3	1511
05-07-90 18:00	232.5	20.62	4.5	1052
05-07-90 19:00	158.7	19.58	4.5	754.6
05-07-90 20:00	33.14	18.24	3.5	90.43
05-07-90 21:00	0	17.11	5.3	0
05-07-90 22:00	0	15.98	3.5	0
05-07-90 23:00	0	14.85	3.8	0
06-07-90 0:00	0	14.63	5.3	0
06-07-90 1:00	0	14.42	5.3	0
06-07-90 2:00	0	14.2	3.5	0

06-07-90 3:00	0	13.98	3.8	0
06-07-90 4:00	0	13.76	4.5	0
06-07-90 5:00	18.41	14.33	4	21.85
06-07-90 6:00	59.9	14.98	4	161.2
06-07-90 7:00	157.2	16.22	4.9	455.2
06-07-90 8:00	210.4	17.25	3.8	692.2
06-07-90 9:00	252	18.14	5.3	859.9
06-07-90 10:00	304.2	18.99	8	1060
06-07-90 11:00	344.6	19.79	7	1226
06-07-90 12:00	389	20.56	6.4	1406
06-07-90 13:00	436.9	21.32	5.7	1596
06-07-90 14:00	479.2	22.06	7	1817
06-07-90 15:00	538.8	22.84	6.4	2105
06-07-90 16:00	377.5	23.06	6.4	1509
06-07-90 17:00	317.9	23.1	9.7	1308
06-07-90 18:00	214	22.76	9.7	899.5
06-07-90 19:00	121.5	22.12	9.4	557.9
06-07-90 20:00	30.25	21.26	10.6	77.04
06-07-90 21:00	0	19.99	11	0
06-07-90 22:00	0	18.71	13.8	0
06-07-90 23:00	0	17.44	12.5	0
07-07-90 0:00	0	16.14	11.9	0
07-07-90 1:00	0	14.84	11.5	0
07-07-90 2:00	0	13.54	10.6	0
07-07-90 3:00	0	12.24	9.4	0
07-07-90 4:00	0	10.94	8.6	0
07-07-90 5:00	38.22	11.95	7.7	48.13
07-07-90 6:00	145.1	13.4	4.7	167.4
07-07-90 7:00	300.1	15.32	4.5	356.7
07-07-90 8:00	404.5	17	5.7	1026
07-07-90 9:00	519.1	18.63	6.2	1571
07-07-90 10:00	729.8	20.7	6.7	2257
07-07-90 11:00	817.9	22.52	6.7	2594
07-07-90 12:00	781.6	23.73	6.2	2598
07-07-90 13:00	668.7	24.28	8.4	2359
07-07-90 14:00	575.1	24.42	9.1	2116
07-07-90 15:00	471.3	24.19	9.4	1807
07-07-90 16:00	413.5	23.75	8.8	1652
07-07-90 17:00	342	23.08	9.1	1420
07-07-90 18:00	186.3	21.95	7.4	762.1
07-07-90 19:00	82.21	20.6	7	286.2
07-07-90 20:00	20.07	19.22	7.4	28.96
07-07-90 21:00	0	18.94	6.7	0
07-07-90 22:00	0	18.66	3.8	0
07-07-90 23:00	0	18.38	3.8	0
08-07-90 0:00	0	18.69	5.3	0
08-07-90 1:00	0	18.99	4.7	0
08-07-90 2:00	0	19.29	6.2	0
08-07-90 3:00	0	19.6	5.7	0
08-07-90 4:00	0	19.9	3.1	0



08-07-90 5:00	33.79	20.9	2.9	44.38
08-07-90 6:00	114.2	22.09	3.1	237.5
08-07-90 7:00	240.2	23.74	3.5	512.8
08-07-90 8:00	377.5	25.6	2.9	941
08-07-90 9:00	514.6	27.53	1.4	1473
08-07-90 10:00	562.9	29.05	1.1	1742
08-07-90 11:00	651.1	30.51	1.3	2056
08-07-90 12:00	734.3	31.92	1.8	2339
08-07-90 13:00	725.6	32.97	1.8	2382
08-07-90 14:00	667.1	33.64	1.6	2268
08-07-90 15:00	648.8	34.12	1.8	2314
08-07-90 16:00	595.6	34.38	1.4	2266
08-07-90 17:00	434.3	34.14	1.9	1795
08-07-90 18:00	214.2	33.11	1.9	853.4
08-07-90 19:00	103.3	31.83	1.3	378.7
08-07-90 20:00	19.68	30.44	1.8	22.95
08-07-90 21:00	0	29.7	1.2	0
08-07-90 22:00	0	28.96	1.4	0
08-07-90 23:00	0	28.22	1.8	0
09-07-90 0:00	0	27.54	2.3	0
09-07-90 1:00	0	26.86	1.9	0
09-07-90 2:00	0	26.18	2.1	0
09-07-90 3:00	0	25.5	2.1	0
09-07-90 4:00	0	24.82	2.9	0
09-07-90 5:00	5.052	24.91	3.3	0
09-07-90 6:00	48.01	25.66	2.3	111
09-07-90 7:00	158.4	27.33	2.9	404.8
09-07-90 8:00	133.4	27.84	2.9	404
09-07-90 9:00	392.8	30.22	2.9	1171
09-07-90 10:00	397.3	31.79	2.6	1259
09-07-90 11:00	268.6	32.13	3.3	870
09-07-90 12:00	440.9	33.23	3.8	1459
09-07-90 13:00	555.1	34.58	5.7	1858
09-07-90 14:00	482.1	35.33	4.1	1671
09-07-90 15:00	375.5	35.53	5.3	1298
09-07-90 16:00	357	35.62	7	1313
09-07-90 17:00	380.2	35.74	7	1520
09-07-90 18:00	211.7	35.15	7.4	858.2
09-07-90 19:00	152	34.34	4.7	656.9
09-07-90 20:00	23.75	33.07	4.3	36.01
09-07-90 21:00	0	30.41	3.5	0
09-07-90 22:00	0	27.75	3.8	0
09-07-90 23:00	0	25.1	2.9	0
10-07-90 0:00	0	23.08	4.1	0
10-07-90 1:00	0	21.06	4.9	0
10-07-90 2:00	0	19.03	4.9	0
10-07-90 3:00	0	17.01	4.9	0
10-07-90 4:00	0	14.99	3.8	0
10-07-90 5:00	5.596	15.07	3.5	0
10-07-90 6:00	153.7	17.03	5.3	145.4

10-07-90 7:00	279.6	18.78	5.7	400.1
10-07-90 8:00	560.4	21.54	5.3	1247
10-07-90 9:00	695.9	23.9	3.1	1878
10-07-90 10:00	582.1	24.94	2.5	1842
10-07-90 11:00	468.9	25.22	1.9	1603
10-07-90 12:00	80.36	23.33	2.1	235.9
10-07-90 13:00	80.04	21.85	2.2	237.9
10-07-90 14:00	261.5	21.49	2.6	967.5
10-07-90 15:00	513.6	22.25	2.6	1999
10-07-90 16:00	507.7	22.85	2.2	2079
10-07-90 17:00	222.2	22.32	1.8	855.9
10-07-90 18:00	253.3	21.97	1.2	1186
10-07-90 19:00	108.9	21.2	1	498.6
10-07-90 20:00	18.51	20.26	0.9	23.18
10-07-90 21:00	0	19.66	1.3	0
10-07-90 22:00	0	19.05	0.7999	0
10-07-90 23:00	0	18.45	0.9	0
11-07-90 0:00	0	18.23	1.1	0
11-07-90 1:00	0	18	1.2	0
11-07-90 2:00	0	17.78	2.1	0
11-07-90 3:00	0	17.55	1.4	0
11-07-90 4:00	0	17.32	1.5	0
11-07-90 5:00	40.46	18.35	2.6	48.7
11-07-90 6:00	172.6	20.05	1.8	165.9
11-07-90 7:00	354.5	22.19	2.1	346.1
11-07-90 8:00	545.6	24.5	1.8	1161
11-07-90 9:00	721.7	26.8	1.8	1882
11-07-90 10:00	865.9	28.95	1.6	2409
11-07-90 11:00	480.2	29.02	1.3	1597
11-07-90 12:00	544.7	29.28	1.6	1845
11-07-90 13:00	479.5	29.27	1.5	1663
11-07-90 14:00	376.1	28.82	1.5	1338
11-07-90 15:00	307.9	28.17	1.5	1073
11-07-90 16:00	264.3	27.45	1.4	967.3
11-07-90 17:00	196.9	26.61	1.6	687
11-07-90 18:00	108.5	25.59	2.2	345.1
11-07-90 19:00	42.32	24.51	1.2	97.93
11-07-90 20:00	9.348	23.46	1.5	0
11-07-90 21:00	0	22.81	1.3	0
11-07-90 22:00	0	22.16	1.4	0
11-07-90 23:00	0	21.5	1.8	0

POWER OPTIMIZERS

SolarEdge Power Optimizer

Module Add-On

OP250-LV / OP300-MV / OP400-MV / OP400-EV



PV power optimization at the module-level

- Up to 25% more energy
- Superior efficiency (99.5%)
- Mitigates all types of modules mismatch-loss, from manufacturing tolerance to partial shading
- Flexible system design for maximum space utilization
- Next generation maintenance with module level monitoring
- Module-level voltage shutdown for installer and firefighter safety

USA - GERMANY - ITALY - FRANCE - JAPAN - CHINA - AUSTRALIA - ISRAEL

www.solaredge.com

SolarEdge Power Optimizer Module Add-On

OP250-LV / OP300-MV / OP400-MV / OP400-EV

	OP250-LV	OP300-MV	OP400-MV	OP400-EV	
INPUT					
Rated Input DC Power*	250	300	400	400	W
Absolute Maximum Input Voltage (Voc)	55	75	75	125	Vdc
MPPT Operating Range	5 - 55	5 - 75	5 - 75	15 - 125	Vdc
Maximum Continuous Input Current (Isc)	10	10	10	7	Adc
Maximum Efficiency	99.5				%
Weighted Efficiency	98.8				%
Overvoltage Category	II				
OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING INVERTER)					
Maximum Output Current	15				Adc
Operating Output Voltage	5 - 60				Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM INVERTER OR INVERTER OFF)					
Safety Output Voltage per Power Optimizer	1				Vdc
STANDARD COMPLIANCE					
EMC	FCC Part15 Class B, IEC61000-6-2, IEC61000-6-3				
Safety	IEC62109-1 (class II safety), UL1741				
Material	UL-94 (5-VA), UV Resistant				
RoHS	Yes				
INSTALLATION SPECIFICATIONS					
Maximum Allowed System Voltage	1000				Vdc
Dimensions (W x L x H)	143 x 210 x 45 / 5.63 x 8.26 x 1.75				mm / in
Weight	450 / 1.0				gr / lb
Input Connector	MC4 / Tyco / H+S / Amphenol				
Output Wire Type	6mm^2; MC4				
Output Wire Length	0.95 / 3.0		1.2 / 3.9	1.6 / 5.25	m / ft
Operating Temperature Range	-40 - +65 / -40 - +150				˚C / ˚F
Protection Rating	IP65 / NEMA4				
Relative Humidity	0 - 100				%

* Rated STC power of the module. Module of up to +5% power tolerance allowed.

PV SYSTEM DESIGN USING A SOLAREDGE INVERTER	SINGLE PHASE	THREE PHASE	
Minimum String Length (Power Optimizers)	8	16	
Maximum String Length (Power Optimizers)	25	50	
Maximum Power per String	5250	11250	W
Parallel Strings of Different Lengths or Orientations	Yes		

CE

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U.I. Lapp GmbH	PRODUCT INFORMATION	LAPP GROUP
	ÖLFLEX® SOLAR XLR-R	**29.11.2013**

Electron beam cross-linked solar cables with reduced diameters - TÜV type approved
Reduced outer diameters enable space and weight saving installation
Reduction of flame propagation and of toxic combustion gases in the event of fire
Robust against mechanical impacts
Extruded colour stripe serves as reverse polarity protection during installation.
Exact quantity control during installation by meter marking on the cable sheath



Suitable for outdoor use

Halogen-free

Cold-resistant

Solar Energy

Temperature-resistant

UV-resistant

Info
Optimised cable design -thin, light and robust
TÜV Type approved (2PfG 1169/08.07)According to DKE specification PV1-F
New version with coloured stripe

Application range
For the cabling between the solar modules and as extension cable between the module strings and the DC/AC inverter
Gable and flat roof photovoltaic systems
Photovoltaic plants and solar parks
Flexible or building-integrated PV systems

Design
Fine-wire, tinned-copper conductor
Core insulation made of electron beam cross-linked copolymer
Colour of core insulation: white
Outer sheath made of electron beam cross-linked copolymer
Outer sheath colour: black respectively black with red or blue stripe

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Photographs are not to scale and do not represent detailed images of the respective products.

Norm references / Approvals
PV1-F (TÜV type approved according to2 PfG 1169/08.2007)

Product features
Weather/UV-resistant acc. to HD 605/A1
Ozone-resistant according to EN 50396
Halogen-free and flame-retardant
Good notch and abrasion resistance
XLR-R = X-Linked Radiated-ReducedProven electron beam cross-linked quality

Remark
Unless specified otherwise, the shown product values are nominal values. Detailed values (e.g. tolerances) are available upon request.
Copper price basis: EUR 150/100kg. Refer to catalogue appendix T17 for the definition and calculation of copper-related surcharges.
Please find our standard lengths at: www.lappkabel.de/en/cable-standardlengths
Packaging size: Coil 100 m; Drum (500; 1000) m
Photographs are not to scale and do not represent detailed images of the respective products.

Technical Data

Classification:	ETIM 5.0 Class-ID: EC001578 ETIM 5.0 Class-Description: Flexible cable
Conductor stranding:	Fine wire according to VDE 0295, class 5/IEC 60228 class 5
Minimum bending radius:	Fixed installation: 4 x outer diameter
Nominal voltage:	AC U_0/U : 600/1000 V DC U_0/U : 900/1500 V Max. permissible operating voltage: DC 1,8 kV (Conductor-conductor, non earthed system)
Test voltage:	AC 6500 B
Current rating:	Im compliance with TÜV requirements spec. 2 PfG 1169/08.2007 table 1
Temperature range:	-40°C to +120°C max. conductor temperature based on EN 60216-1 Ambient temperature range according to TÜV 2 PfG 1169/08.07: -40°C to +90°C

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Part number	Conductor cross-section (mm²)	Outer diameter (mm)	Copper index (kg/km)	Weight (kg/km)
ÖLFLEX® SOLAR XLR-RCore insulation: white / Outer sheath: black				
0023175	1.5	4.4	14.4	34
0023176	2.5	4.8	24.0	46
0023177	4	5.2	38.4	63
0023178	6	5.8	57.6	86
0023179	10	7.0	96.0	132
0023180	16	8.3	153.6	197
Core insulation: white / Outer sheath: black with red stripe				
0023360	2.5	4.8	24.0	46
0023361	4	5.2	38.4	63
0023362	6	5.8	57.6	86
0023363	10	7.0	96.0	132
0023364	16	8.3	153.6	197
Core insulation: white / Outer sheath: black with blue stripe				
0023370	2.5	4.8	24.0	46
0023371	4	5.2	38.4	63
0023372	6	5.8	57.6	86
0023373	10	7.0	96.0	132
0023374	16	8.3	153.6	197

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Photographs are not to scale and do not represent detailed images of the respective products.

Bureau Veritas Consumer Products Services Germany GmbH
Businesspark A96
86842 Türkheim
Germany
+ 49 (0) 4074041-0
cps-tuerkheim@de.bureauveritas.com

Certificate of compliance

Applicant: **SolarEdge Technologies Ltd.**
6 HeHarash St.
Hod Hasharon 45240
Israel

Product: **Automatic disconnection device between a generator and the public low-voltage grid**

Model: **SE5K; SE7K; SE8K; SE9K; SE10K; SE10,5K; SE12K; SE12,5K; SE15K; SE16K; SE17K**

Use in accordance with regulations:

Automatic disconnection device with three-phase mains surveillance in accordance with DIN V VDE V 0126-1-1:2006-02 for photovoltaic systems with a three-phase parallel coupling via an inverter in the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverter. This serves as a replacement for the disconnection device with insulating function which the distribution network provider can access at any time.

Applied rules and standards:

DIN V VDE V 0126-1-1 (VDE V 0126-1-1):2006-02 and „Generator at the public low-voltage grid, 4th edition 2001, guideline for connection and parallel operation of generators in the public low-voltage grid" with VDN additions (2005) from the German Electricity Association (VDEW) and Association of network operator (VDN).

The safety concept of an aforementioned representative product corresponds at the time of issue of this certificate to the valid safety specifications for the specified use in accordance with regulations.

Report number: **10TH0222-VDE0126**
Certificate number: **U12-0976**
Date of issue: **2012-11-06** **Valid until:** **2015-05-07**

Achim Hänchen

CE Declaration of conformity

This is to declare that the following products including the required accessories have been manufactured according to the

EU low-voltage directive 2006/95/EG

and

EU EMC directive 2004/108/EG.

Product:	Solar Inverter
Manufacturer:	**SolarEdge Technologies Ltd.** Abba Eban 1° Hertzlia 46725 **Israel**
Type:	SE2200,SE3000, SE3300, SE3500, SE4000, SE5000, SE6000

The following standards had been applied according to the low-voltage directive 2006/95/EG:

EN 50178:1997
DIN EN 50178:1998

The following standards had been applied according to the EMC directive 2004/108/EG:

EN 61000-6-2:2005
EN 61000-6-3:2007
EN-61000-3-11:2000
EN-61000-3-12:2005

Hod Hasharon, Israel	19/7/2012	סולראדג' טכנולוגיות בע"מ ח.פ. 513865329
(Place)	(Date)	(Meir Adest)

SolarEdge Technologies

US: 2225 East Bayshore Rd., Suite 200, Palo Alto, CA 94303

Germany: Königstr. 5, 01097 Dresden

Japan: B-9 Ariake Frontier Building, 3-7-26 Ariake, Koto-Ku, Tokyo, 135-0063

Israel: 6 Ha'Harash St., P.O.Box 7349, Neve Ne'eman, Hod Hasharon 45240

E202/63R

Print View..
Print to Pdf..

General Information

Extended Product Type:	E202/63R
Product ID:	2CDE282001R0063
EAN:	4016779645904
Catalog Description:	Isolator E202/63r
Long Description:	These devices are suitable for commanding loads and they are realized according EN 60947-3 and EN 60669-1 respectively. Fast removal without dismantling of the busbar. Captive screws with recessed/slotted head. Pozidrive size 2. Add-on of up to 3 auxiliary contact S2C-H6R possible Integrated lay-on edge for labeling system ILS. Locking device as accessories for unauthorized ON/OFF. Approval: VDE, CCC, KEMA



< 1 2 3 >

Categories

Products » Low Voltage Products and Systems » Modular DIN Rail Products » Modular DIN Rail Components MDRCs » Command Devices

Ordering

EAN:	4016779645904
Minimum Order Quantity:	1 piece
Customs Tariff Number:	85365080

Dimensions

Product Net Width:	35.0 mm
Product Net Height:	85.0 mm
Product Net Depth:	69.0 mm
Product Net Weight:	0.190 kg

Container Information

Package Level 1 Units:	5 piece
Package Level 1 Width:	92.0 mm
Package Level 1 Height:	80.0 mm
Package Level 1 Length:	183.0 mm
Package Level 1 Gross Weight:	0.995 kg
Package Level 1 EAN:	4016779668828
Package Level 2 Units:	60 piece
Package Level 2 Width:	275.0 mm
Package Level 2 Height:	210.0 mm
Package Level 2 Length:	395.0 mm
Package Level 2 Gross Weight:	12.340 kg

Package Level 2 EAN:	4016779865708

Environmental

RoHS Status:	Following EU Directive 2002/95/EC August 18, 2005 and amendment

Additional Information

Product Main Type:	E200
Product Name:	Switch Disconnector
Product Range:	Switch-disconnector E202
RoHS Date:	0016
Standards:	IEC/EN 60947-3

Certificates and Declarations (Document Number)

Declaration of Conformity - CE:	2CDK441011D0401

Classifications

ETIM 4.0:	EC000216 - Switch disconnector
ETIM 5.0:	EC000216 - Switch disconnector
Object Classification Code:	Q



OTDC16F3

General Information

Extended Product Type:	OTDC16F3
Product ID:	1SCA121457R1001
EAN:	6417019526126
Catalog Description:	OTDC16F3 Switch-disconnector
Long Description:	Types OTDC16...32 include protected terminal clamps, IP 20. Shafts and handles need to be ordered separetely. The type and the ordering numbers are for one piece.

Categories

Products » Low Voltage Products and Systems » Switches » Switch Disconnectors

Ordering

EAN:	6417019526126
Minimum Order Quantity:	1 piece
Customs Tariff Number:	85365080

Dimensions

Product Net Width:	52.5 mm
Product Net Height:	89 mm
Product Net Depth:	78 mm
Product Net Weight:	0.18 kg

Container Information

Package Level 1 Units:	1 piece
Package Level 1 Width:	64 mm
Package Level 1 Height:	100 mm
Package Level 1 Length:	100 mm
Package Level 1 Gross Weight:	0.2 kg

Environmental

RoHS Status:	Planned to follow EU Directive 2002/95/EC August 18, 2005 and amendment after 2009 Q3

Additional Information

Cable Cross-Section:	2.5…16 mm²
Conventional Free-air Thermal Current (I_{th}):	q=40°C 25 A
Conventional Thermal Current (I_{the}):	Fully Enclosed 25 A
IIT Publishing Status:	Level 0 - Information enabled
Number of Poles:	3
Operating Mechanism:	Mechanism on top of the switch
Pollution Degree:	2
Position of Line Terminals:	Top in - bottom out
Power Loss:	Per Pole 0.15 W
Product Main Type:	OT16E_16F
Product Name:	Switch-disconnector
Rated Impulse Withstand Voltage (U_{imp}):	8 kV
Rated Insulation Voltage (U_i):	1250 V
Rated Operational Current DC-21B (I_e):	(1000V) 16 A
Rated Operational Voltage (U_e):	1000 V
Rated Short-time Withstand Current (I_{cw}):	for 1.0s 0.4 kiloampere rms

Certificates and Declarations (Document Number)

Declaration of Conformity - CE:	1SCC340047D0201;

Classifications

E-nummer:	3134017
ETIM 5.0:	EC000216 - Switch disconnector
Object Classification Code:	Q



Data Sheet

System pro *M* compact®
Miniature Circuit Breaker S 200/S 200 M





The miniature circuit breakers of the System pro *M* compact® series S 200 and S 200 M provide state-of-the-art safety and comfort. They stand out due to their high performance and the wide range of accessories and approvals.

Features

- Clear contact position indication in red/green (“real CPI”)
- Unique, patented twin terminal with captive screws and an increased opening for cables up to max. 35 mm^2, finger-proof (IP20)
- Busbar slot in the back for best visibility during installation
- High performance at an increased rated voltage for marine and industrial applications: 10 kA/15 kA at U_e = 440 V AC acc. to IEC/EN 60947-2
- Individual product identification code
- Approved acc. to IEC/EN 60898-1, IEC/EN 60947-2 and UL 1077/CSA 22.2 No. 235 for global use

Power and productivity
for a better world™

Miniature Circuit Breaker S 200/S 200 M
Technical data

	S 200	S 200 M
General Data		
Standards	IEC/EN 60898-1, IEC/EN 60947-2 UL 1077	IEC/EN 60898-1, IEC/EN 60947-2 UL 1077, CSA 22.2 No. 235
Poles	1P, 2P, 3P, 4P, 1P+N, 3P+N	
Tripping Characteristics	B, C, D, K, Z	
Rated current I_n	0.5 up to 63 A	
Rated frequency	50/60 Hz	
Rated insulation voltage U_i	250 V AC (phase to ground), 500 V AC (phase to phase)	
Overvoltage Category	III	
Pollution Degree	3	
IEC/EN 60898-1		
Rated operational voltage U_n	1P: 230/400 V AC; 1P+N: 230 V AC; 2P, 3P, 4P: 400 V AC; 3P+N: 400 V AC	
Max. power frequency recovery voltage U_{max}	1P: 253 V AC; 1P+N: 253 V AC; 2P, 3P, 4P: 440 V AC; 3P+N: 440 V AC; 1P: 72 V DC; 2P: 125 V DC	
Min. operating voltage	12 V AC, 12 V DC	
Rated short-circuit capacity I_{cn}	6 kA	10 kA
Energy limiting class (B, C up to 40 A)	3	
Rated impulse withstand voltage U_{imp} (1.2/50 µs)	4 kV (test voltage 6.2 kV at sea level, 5 kV at 2,000 m)	
Dielectric test voltage	2.0 kV (50/60 Hz, 1 min)	
Reference temperature for tripping characteristics	B, C, D: 30 °C	
Electrical endurance	I_n < 32 A: 20,000 ops. (AC), 1,000 ops. (DC); one cycle 2 s - ON, 13 s - OFF I_n ≥ 32 A: 10,000 ops. (AC), 1,000 ops. (DC); one cycle 2 s - ON, 28 s - OFF	
IEC/EN 60947-2		
Rated operational voltage U_e	1P: 230 V AC; 1P+N: 230 V AC; 2P, 3P, 4P: 440 V AC; 3P+N: 440 V AC	
Max. power frequency recovery voltage U_{max}	1P: 253 V AC; 1P+N: 253 V AC; 2P, 3P,4P: 462 V AC; 3P+N: 462 V AC; 1P: 72 V DC; 2P: 125 V DC	
Min. operating voltage	12 V AC, 12 V DC	
Rated ultimate short-circuit breaking capacity I_{cu}	10 kA	15 kA
Rated service short-circuit breaking capacity I_{cs}	7.5 kA	≤ 40 A: 11.25 kA 50, 63 A: 7.5 kA
Rated impulse withstand voltage U_{imp} (1.2/50 µs)	4 kV (test voltage 6.2 kV at sea level, 5 kV at 2,000 m)	
Dielectric test voltage	2.0 kV (50/60 Hz, 1 min)	
Reference temperature for tripping characteristics	B, C, D: 55 °C; K, Z: 20 °C	
Electrical endurance	I_n < 32 A: 20,000 ops. (AC), 1,000 ops. (DC); one cycle 2 s - ON, 13 s - OFF I_n ≥ 32 A: 10,000 ops. (AC), 1,000 ops. (DC); one cycle 2 s - ON, 28 s - OFF	
UL/CSA		
Rated voltage	1P: 277 V AC, 60 V DC 2...4P: 480 Y/277 V AC, 110 V DC	1P: 277 V AC, 60 V DC 2...4P: 480 Y/277 V AC, 125 V DC
Rated interrupting capacity	6 kA (AC), 10 kA (DC)	
Application	Suppl. prot. for general use. Application Codes: TC2, OL0, SC: U1	
Reference temperature for tripping characteristic	B, C, D, K, Z: 25 °C	
Electrical endurance	6,000 ops. (AC), 6,000 ops. (DC); one cycle 1 s - ON, 9 s - OFF	
Mechanical data		
Housing	Insulation group II, RAL 7035	Insulation group I, RAL 7035
Toggle	Insulation group II, black, sealable	
Contact position indication	Marking on toggle (I ON/0 OFF), Real CPI (red ON/green OFF)	
Protection degree acc. to EN 60529	IP20[1)], IP40 in enclosure with cover	
Mechanical endurance	20,000 ops.	
Shock resistance acc. to IEC/EN 60068-2-27	25 g, 2 shocks, 13 ms	
Vibration resistance acc. to IEC/EN 60068-2-6	5 g, 20 cycles at 5...150...5 Hz with load 0.8 I_n	
Environmental conditions acc. to IEC/EN 60068-2-30	28 cycles with 55 °C/90-96 % and 25 °C/95-100 %	
Ambient temperature	-25 ... +55 °C	
Storage temperature	-40 ... +70 °C	

[1)] Also fulfilling the requirements acc. to the protection degree IPXXB

Miniature Circuit Breaker S 200/S 200 M
Technical data and tripping characteristics

	S 200	S 200 M
Installation		
Terminal	Failsafe bi-directional cylinder-lift terminal	
Cross-section of conductors (top/bottom)	solid, stranded: 35 mm² / 35 mm²	
	flexible: 25 mm² / 25 mm²	
	14 – 4 AWG[1]	
Cross-section of busbars (top/bottom)	10 mm² / 10 mm²	
	14 – 8 AWG[2]	
Torque	2.8 Nm	
	18 in-lbs.	
Screwdriver	No. 2 Pozidrive	
Mounting	On DIN rail 35 mm acc. to EN 60715 by fast clip	
Mounting position	any	
Supply	optional	
Dimensions and weight		
Mounting dimensions acc. to DIN 43880	Mounting dimension 1	
Pole dimensions (H x D x W)	88 x 69 x 17.5	
Pole weight	approx. 115 g	
Combination with auxiliary elements		
Auxiliary contact	Yes	
Signal/auxiliary contact	Yes	
Shunt trip	Yes	
Undervoltage release	Yes	
Motor Operating Device	Yes	

[1] AWG 18 – 4 acc. to UL 486A – 486B [2] AWG 18 – 8 acc. to UL 486A – 486B

Tripping characteristics

Acc. to	Tripping characte-ristics	Rated current	Thermal release [3]			Electromagnetic release [4]		
			Currents: conventional non-tripping current	conventional tripping current	Tripping time	Range of instantaneous tripping		Tripping time
		I_n	I_1	I_2				
IEC/EN 60898-1	B	6 to 63 A	$1.13 \cdot I_n$		> 1 h	$3 \cdot I_n$		0.1 ... 45 s ($I_n \leq 32$ A)/0.1 ... 90 s ($I_n > 32$ A)
				$1.45 \cdot I_n$	< 1 h [5]		$5 \cdot I_n$	< 0.1 s
	C	0.5 to 63 A	$1.13 \cdot I_n$		> 1 h	$5 \cdot I_n$		0.1 ... 15 s ($I_n \leq 32$ A)/0.1 ... 30 s ($I_n > 32$ A)
				$1.45 \cdot I_n$	< 1 h [5]		$10 \cdot I_n$	< 0.1 s
	D	0.5 to 63 A	$1.13 \cdot I_n$		> 1 h	$10 \cdot I_n$		0.1 ... 4 s ($I_n \leq 32$ A)/0.1 ... 8 s ($I_n > 32$ A)
				$1.45 \cdot I_n$	< 1 h [5]		$20 \cdot I_n$	< 0.1 s
IEC/EN 60947-2	K	0.5 to 63 A	$1.05 \cdot I_n$		> 1 h	$10 \cdot I_n$		> 0.2 s
				$1.2 \cdot I_n$	< 1 h [5]		$14 \cdot I_n$	< 0.2 s
	Z	0.5 to 63 A	$1.05 \cdot I_n$		> 1 h	$2 \cdot I_n$		> 0.2 s
				$1.2 \cdot I_n$	< 1 h [5]		$3 \cdot I_n$	< 0.2 s

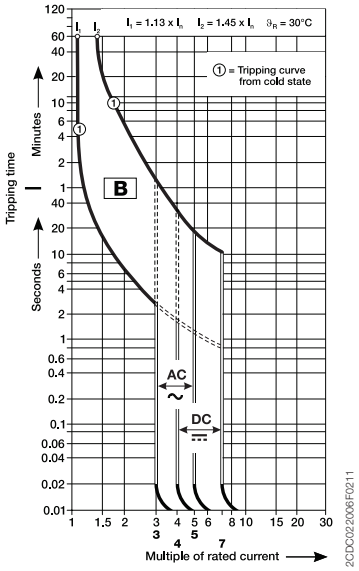
[3] The thermal releases are calibrated to a nominal reference ambient temperature; for B, C, D the reference value is 30 °C, for K and Z the reference value is 20 °C. In the case of higher ambient temperatures, the current values fall by approx. 6 % for each 10 K temperature rise.

[4] The indicated tripping values of electromagnetic tripping devices apply to a frequency of 50/60 Hz. The thermal release operates independent of frequency.

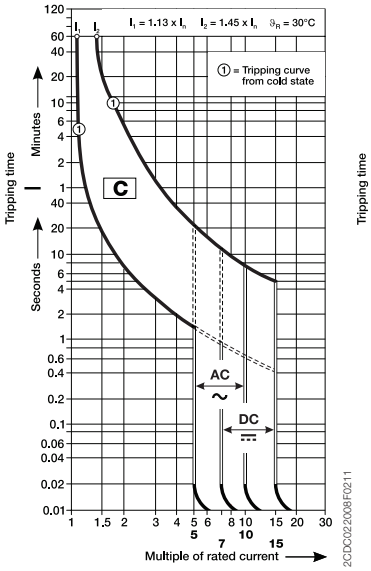
[5] As from operating temperature (after I_1 > 1h)

Miniature Circuit Breaker S 200/S 200 M
Tripping characteristics

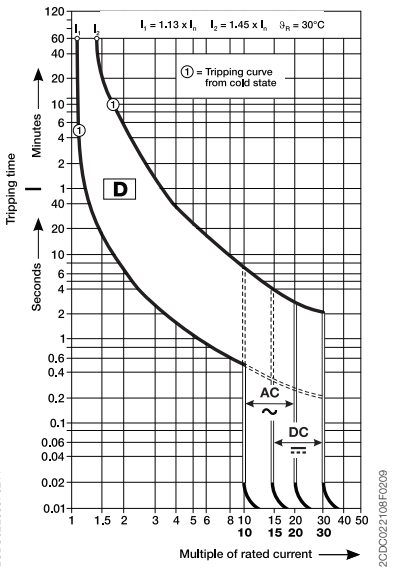
B characteristic



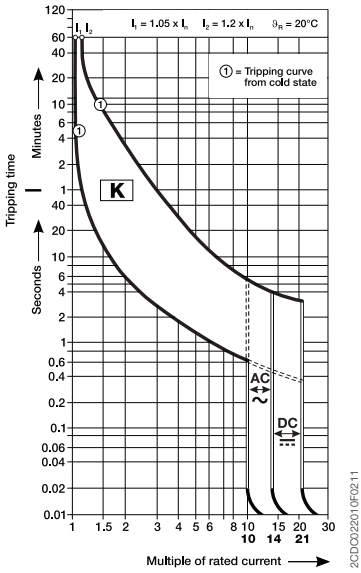
C characteristic



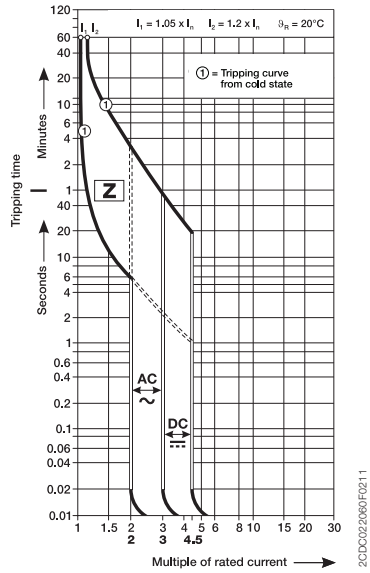
D characteristic



K characteristic



Z characteristic



Miniature Circuit Breaker S 200/S 200 M
Derating

Deviating ambient temperature

For installations of miniature circuit breakers at other temperatures than the reference value derating factors have to be considered.
The rated value of the current of a miniature circuit breaker refers to a reference ambient temperature of 30 °C for circuit breakers with the characteristics B, C and D and 20 °C for circuit breakers with the characteristics K and Z. The following table contains the derating of the load capability at ambient temperatures from -40 °C to 70 °C for the characteristics B, C, D, K and Z.

Tripping characteristics	Rated current I_n A	Maximum operating current at ambient temperature T A											
		- 40 °C	- 30 °C	- 20 °C	- 10 °C	0 °C	10 °C	20 °C	30 °C	40 °C	50 °C	60 °C	70 °C
B, C, D	0.5	0.67	0.65	0.62	0.60	0.58	0.55	0.53	0.50	0.47	0.44	0.41	0.37
	1.0	1.33	1.29	1.25	1.20	1.15	1.11	1.05	1.00	0.94	0.88	0.82	0.75
	1.6	2.13	2.07	2.00	1.92	1.85	1.77	1.69	1.60	1.51	1.41	1.31	1.19
	2.0	2.67	2.58	2.49	2.40	2.31	2.21	2.11	2.00	1.89	1.76	1.63	1.49
	3.0	4.0	3.9	3.7	3.6	3.5	3.3	3.2	3.0	2.8	2.6	2.4	2.2
	4.0	5.3	5.2	5.0	4.8	4.6	4.4	4.2	4.0	3.8	3.5	3.3	3.0
	6.0	8.0	7.7	7.5	7.2	6.9	6.6	6.3	6.0	5.7	5.3	4.9	4.5
	8.0	10.7	10.3	10.0	9.6	9.2	8.8	8.4	8.0	7.5	7.1	6.5	6.0
	10.0	13.3	12.9	12.5	12.0	11.5	11.1	10.5	10.0	9.4	8.8	8.2	7.5
	13.0	17.3	16.8	16.2	15.6	15.0	14.4	13.7	13.0	12.3	11.5	10.6	9.7
	16.0	21.3	20.7	20.0	19.2	18.5	17.7	16.9	16.0	15.1	14.1	13.1	11.9
	20.0	26.7	25.8	24.9	24.0	23.1	22.1	21.1	20.0	18.9	17.6	16.3	14.9
	25.0	33.3	32.3	31.2	30.0	28.9	27.6	26.4	25.0	23.6	22.0	20.4	18.6
	32.0	42.7	41.3	39.9	38.5	37.0	35.4	33.7	32.0	30.2	28.2	26.1	23.9
	40.0	53.3	51.6	49.9	48.1	46.2	44.2	42.2	40.0	37.7	35.3	32.7	29.8
	50.0	66.7	64.5	62.4	60.1	57.7	55.3	52.7	50.0	47.1	44.1	40.8	37.3
	63.0	84.0	81.3	78.6	75.7	72.7	69.6	66.4	63.0	59.4	55.6	51.4	47.0
K, Z	0.5	0.66	0.64	0.61	0.59	0.56	0.53	0.50	0.47	0.43	0.40	0.35	0.31
	1.0	1.32	1.27	1.22	1.17	1.12	1.06	1.00	0.94	0.87	0.79	0.71	0.61
	1.6	2.12	2.04	1.96	1.88	1.79	1.70	1.60	1.50	1.39	1.26	1.13	0.98
	2.0	2.65	2.55	2.45	2.35	2.24	2.12	2.00	1.87	1.73	1.58	1.41	1.22
	3.0	4.0	3.8	3.7	3.5	3.4	3.2	3.0	2.8	2.6	2.4	2.1	1.8
	4.0	5.3	5.1	4.9	4.7	4.5	4.2	4.0	3.7	3.5	3.2	2.8	2.4
	6.0	7.9	7.6	7.3	7.0	6.7	6.4	6.0	5.6	5.2	4.7	4.2	3.7
	8.0	10.8	10.2	9.8	9.4	8.9	8.5	8.0	7.5	6.9	6.3	5.7	4.9
	10.0	13.2	12.7	12.2	11.7	11.2	10.6	10.0	9.4	8.7	7.9	7.1	6.1
	13.0	17.2	16.6	15.9	15.2	14.5	13.8	13.0	12.2	11.3	10.3	9.2	8.0
	16.0	21.2	20.4	19.6	18.8	17.9	17.0	16.0	15.0	13.9	12.6	11.3	9.8
	20.0	26.5	25.5	24.5	23.5	22.4	21.2	20.0	18.7	17.3	15.8	14.1	12.2
	25.0	33.1	31.9	30.6	29.3	28.0	26.5	25.0	23.4	21.7	19.8	17.7	15.3
	32.0	42.3	40.8	39.2	37.5	35.8	33.9	32.0	29.9	27.7	25.3	22.6	19.6
	40.0	52.9	51.0	49.0	46.9	44.7	42.4	40.0	37.4	34.6	31.6	28.3	24.5
	50.0	66.1	63.7	61.2	58.6	55.9	53.0	50.0	46.8	43.3	39.5	35.4	30.6
	63.0	83.3	80.3	77.2	73.9	70.4	66.8	63.0	58.9	54.6	49.8	44.5	38.6

Influence of adjacent devices

If several miniature circuit breakers are installed directly side by side with high load on all poles, a correction factor has to be applied to the rated current (see table). If distance pieces are used, the factor is not to be considered.

No. of adjacent devices	Factor F
1	1
2, 3	0.9
4, 5	0.8
≥ 6	0.75

Example

Installation of 8 adjacent miniature circuit breakers S201-C16 at 40 °C ambient temperature

Rated current I_n = 16 A

Max. operating current at 40 °C = 15,.1 A (see table above)

Factor F = 0.75 (see left table)

I_n = 15.1 A x 0.75 = 11.33 A

Result: The operating current can only add up to max. 11.33 A

Miniature Circuit Breaker S 200/S 200 M
Internal resistance and power loss

Internal resistance and power loss per pole

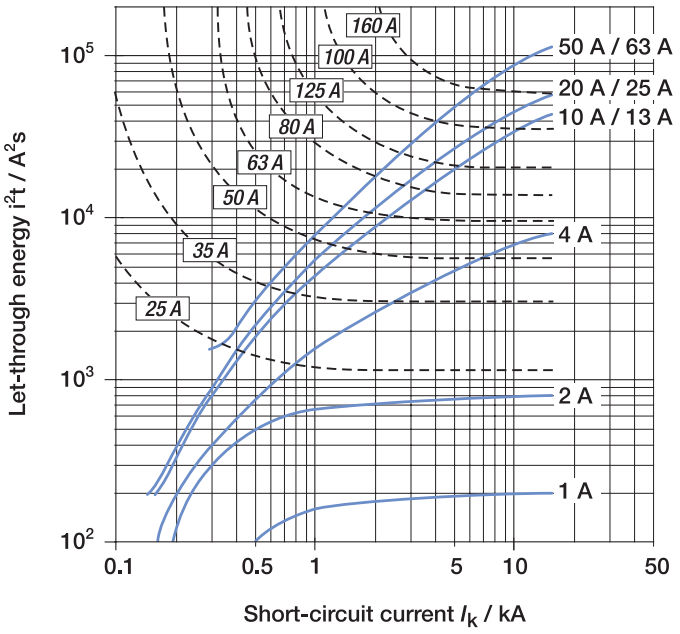
Rated current	Tripping characteristic							
	B, C[1]		D		K		Z	
	Internal resistance	Power loss	Internal resistance	Power loss	Internal resistance	Power loss	Internal resistance	Power loss
I_n	R_i	P_v	R_i	P_v	R_i	P_v	R_i	P_v
A	mΩ	W	mΩ	W	mΩ	W	mΩ	W
0.5	5500	1.4	4300	1.1	4300	1.1	8100	2.4
1.0	1440	1.4	1250	1.25	1250	1.25	2100	2.3
1.6	630	1.6	600	1.5	600	1.5	1000	2.8
2.0	460	1.8	410	1.6	410	1.65	619	2.5
3.0	150	1.3	130	1.2	130	1.2	235	2.4
4.0	110	1.8	105	1.7	105	1.7	149	2.4
6.0	55	2.0	52	1.9	52	1.9	75	3.2
8.0	23	1.5	24	1.5	24	1.5	27	2.0
10.0	19	2.1	16	1.6	13.5	1.4	24	2.7
13.0	14	2.3	14	2.2	13.5	1.4	–	–
16.0	8.5	2.5	8.5	2.5	7.7	2.0	10.9	2.8
20.0	6.25	2.5	6.1	2.3	6.7	2.7	6.0	2.4
25.0	5.0	3.2	4.3	3.1	4.6	2.9	4.5	3.3
32.0	3.6	3.7	3.5	3.6	3.5	3.6	3.5	3.6
40.0	3.0	4.8	2.2	4.2	2.2	4.2	2.5	4.1
50.0	1.3	3.25	1.25	2.9	1.25	3.1	1.5	4.1
63.0	1.2	4.8	1.2	4.8	1.0	4.4	1.3	5.2

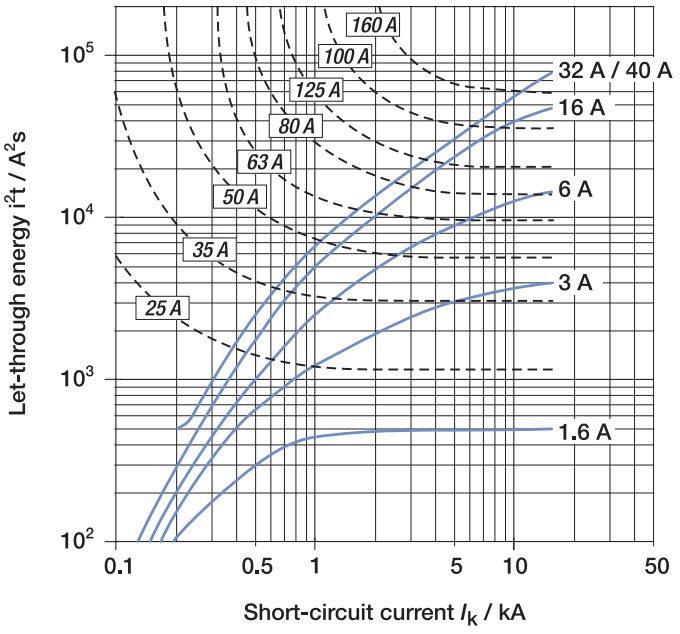
[1] Current ratings 0.5 – 4 A, 8 A apply to C characteristic only

Internal resistances are subject to application-specific and environment-specific conditions and are therefore to be considered as typical values.



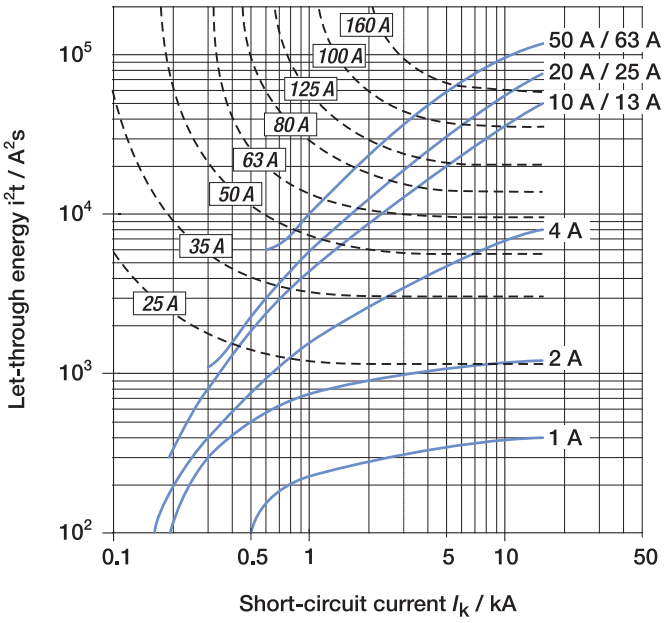
Characteristics B, C - 230/400 V let-through energy

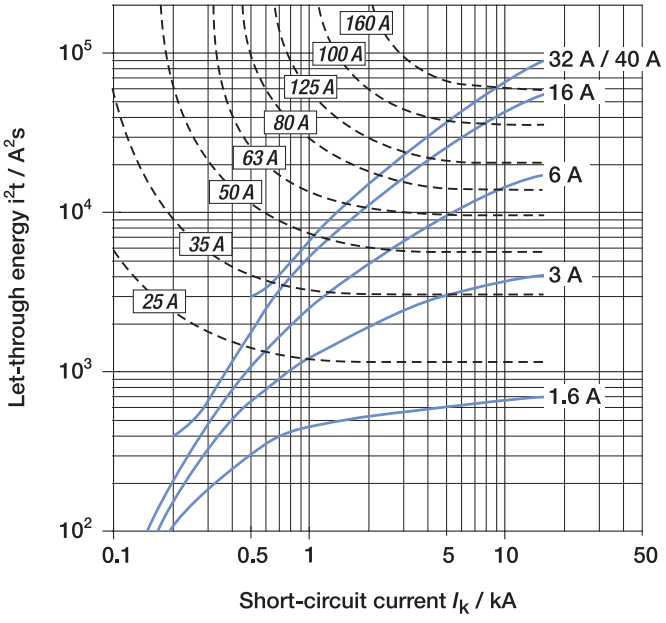




Let-through energy I^2t

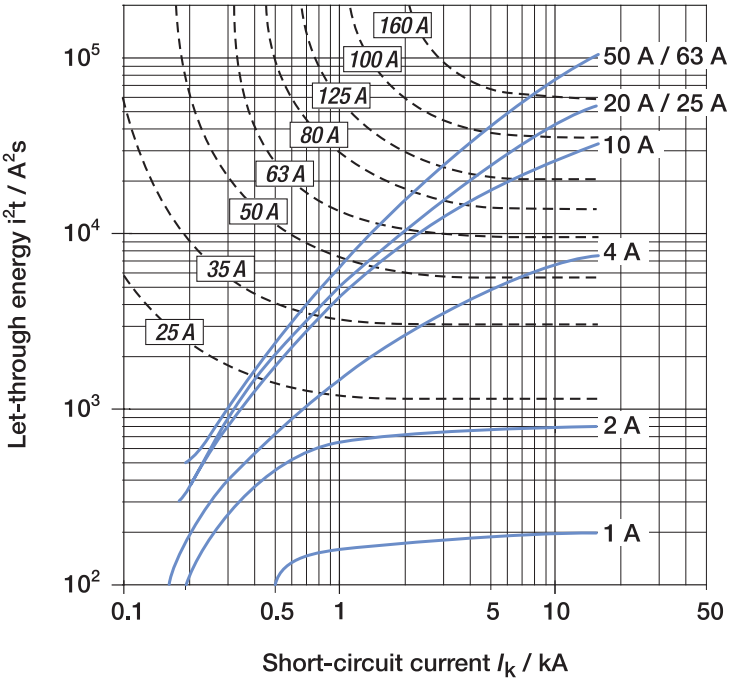
Characteristics D, K - 230/400 V let-through energy

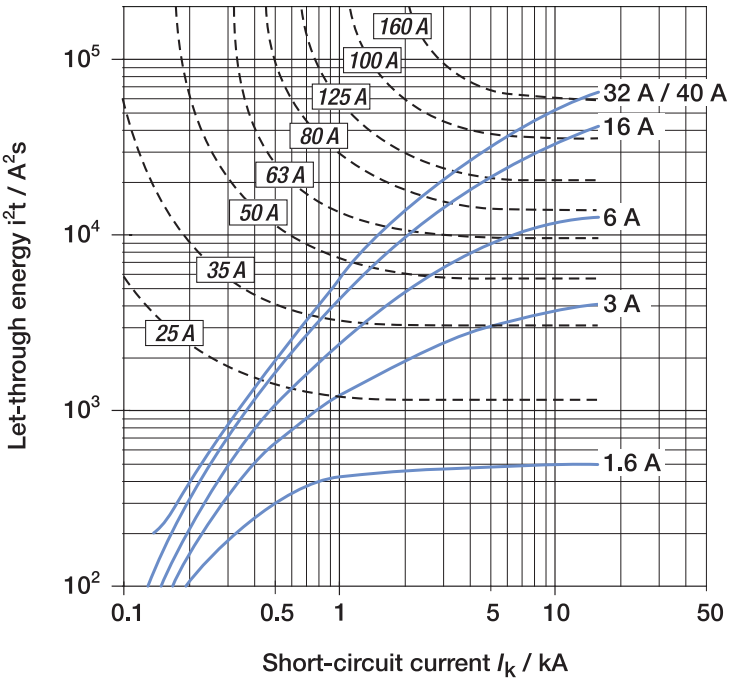




Miniature Circuit Breaker S 200/S 200 M
Let-through energy I^2t

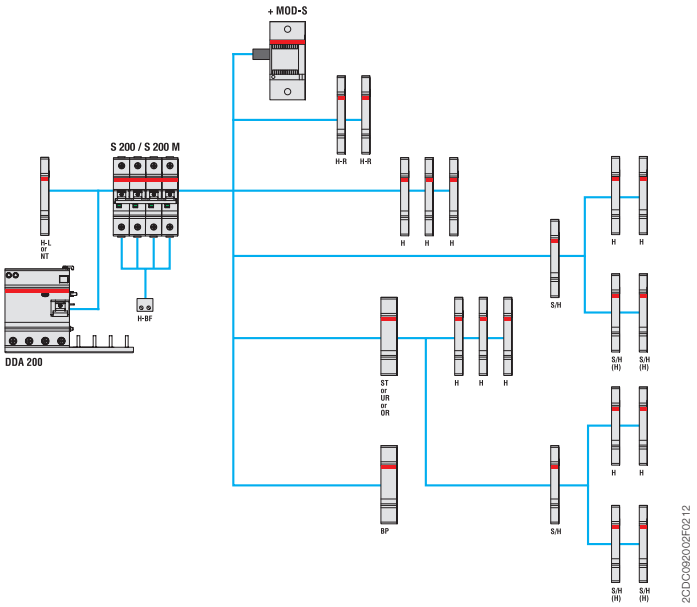
Characteristic Z - 230/400 V let-through energy





Miniature Circuit Breaker S 200/S 200 M
Accessories and dimensional drawing

Accessory overview

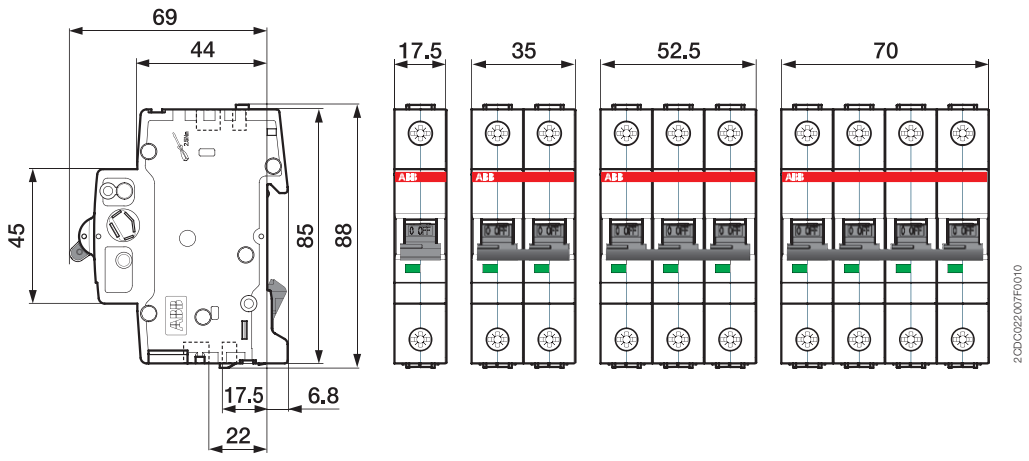


H	Auxiliary contact (change-over contact)	S2C-H6R
H-R	Auxiliary contact	S2C-H6-...R
S/H	Signal/Auxiliary contact	S2C-S/H6R
S/H (H)	Signal/Auxiliary contact used as auxiliary contact	S2C-S/H6R
ST	Shunt trip	S2C-A...
UR	Undervoltage release	S2C-UA
OR	Overvoltage release	S2C-OVP

H-L	Auxiliary contact	S2C-H...L
H-BF	Auxiliary contact for bottom fitting (1 per pole)	S2C-H01 S2C-H10
BP	Mechanical tripping device	S2C-BP
NT	Neutral disconnector	S2C-Nt
MOD-S[1]	Motor operating device	S2C-CM
DDA 200	RCD-block	DDA 20...

[1] In case of using S 200/S 200 M coupled with DDA 200, MOD-S does not operate in case of earth-leakage fault.

Dimensional drawing



Miniature Circuit Breaker S 200/S 200 M
Approvals

Country approvals

Approval mark	Description	Country
	RCM	Australia
	ÖVE	Austria
	CEBEC	Belgium
	CSA	Canada (S 200 M only)
	CCC	China
	EZU	Czech Republic
	DEMKO	Denmark
	FIMKO	Finland
	NF	France
	VDE	Germany
	IMQ	Italy
	SIRIM	Malaysia
	KEMA	Netherlands
	NEMKO	Norway
	BBJ	Poland
	CERTIF	Portugal
	GOST	Russia
	GOST Fire	
	HDB	Singapore
	SIQ	Slovenia
	AENOR	Spain
	SEMKO	Sweden
	S+	Switzerland
	UL1077	USA

Ship approvals

Approval mark	Description	Country
	BV	France
	GL	Germany
	RINA	Italy
	ABS	USA

Not all approvals are printed on the MCBs.

The indicated approvals generally cover all available approvals worldwide. To verify the approval status in your country please get in touch with your ABB contact person.

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-> Low Voltage Products and Systems

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Brochure number 2CDC002157D0202 (08/12-0.5-ZVD)

Power and productivity
for a better world™



S802PV-S20

ABB contact for Netherlands

General Information

Extended Product Type:	S802PV-S20
Product ID:	2CCP842001R1209
EAN:	7612271210960
Catalog Description:	S802PV-S20 2 Pole S Characteristic 20A 5kA 800VDC
Long Description:	S802PV-S20 2 Pole S Characteristic 20A 5kA 800VDC PV String protection

Categories

Products » Low Voltage Products and Systems » Modular DIN Rail Products » High Performance Circuit Breakers HPCBs

Ordering

EAN:	7612271210960
Minimum Order Quantity:	1 piece
Customs Tariff Number:	85362020

Dimensions

Product Net Width:	82.5 mm
Product Net Depth:	54 mm
Product Net Height:	95 mm
Product Net Weight:	0.49 kg

Container Information

Package Level 1 Units:	1 piece
Package Level 1 Width:	54 mm
Package Level 1 Length:	102 mm
Package Level 1 Height:	92 mm
Package Level 1 Gross Weight:	0.51 kg

Environmental

RoHS Status:	Following EU Directive 2002/95/EC August 18, 2005 and amendment

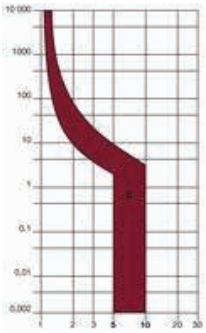
Technical

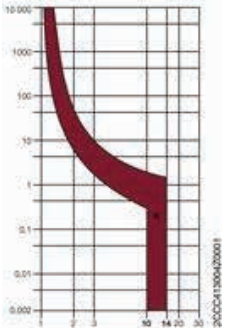
Standards:	IEC 60947-2
Tripping Characteristic:	DC
Rated Current (I_n):	20
Rated Operational Voltage (U_e):	800 V DC
Power Loss:	3.5 W
Rated Ultimate Short-Circuit Breaking Capacity (I_{cu}):	5 kA

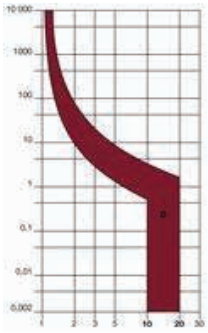
Certificates and Declarations (Document Number)

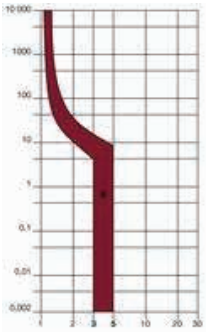
Declaration of Conformity - CE: 2CCC413009D0201













Residual Current Devices (RCD)

Product Overview

The “Earthed Fault Current” is the flow of electricity from the power supply leaking towards the earth, under faulty electrical condition. Its degree of danger depends on the amount of leakage and the surrounding conditions.

Users of leaking equipment may get electrical shock. If this current persists for a long time, fire hazard may be caused. A residual current operated circuit breaker can be installed on the distribution system in order to detect the leakage and cut off the circuit before any damaged occurs.

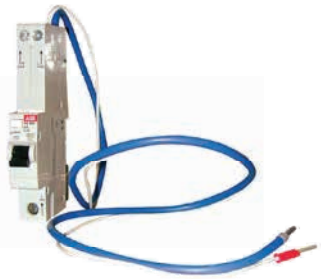
ABB’s offer both residual current operated breaker with (the RCBO) and without (the RCCB) integral over-current protection. Both breakers employ zero current transformer (ZCT) and permanent electro-magnet or electronic tripping mechanism, giving a high sensitivity for detecting and cutting off faulty current.



GS250S - electronic RCBO

The earthed protection devices GS250S series protects users against leakage current. The rated leakage current to activate these devices can be chosen from 10mA, 30mA or 300mA.

The series adopts a specially designed residual current detection CMOS chips with anti-jamming capability. The device conforms to the IEC61000-4 electromagnetic compatibility (EMC) requirements.



DS251 & DS271 - electronic RCBO

Besides protection against earthed faults, the DS251 & DS271 series electronic RCBO also protect the single-phase circuits from overloading or short circuit.



DS9 - electromagnetic RCBO

The electromagnetic RCBO series DS9 offers a complete protection for single-phase circuit. The series has innovative two-colour operation lever (red and green), which enables users to check the status of the device in a distance. Also the tripping status can be observed on the front indicator window of the device.

The rated leakage current to activate these devices can be chosen from 30mA. The breaking current capacities according to IEC 61009 are 4.5kA (DS941 type), 6kA (DS951 type) and 10kA (DS971 type).



FH200 and F200 - RCCB

RCCBs are only sensitive to current leakage to earth. They must be used in series with an MCB or fuse which protects them from the potentially damaging thermal and dynamic stresses of any overcurrents.

These devices are used in systems already equipped with MCBs which preferably limit the specific energy passing through, also acting as the main disconnecting switches upstream of any derived MCBs (e.g. domestic consumer unit).

Residual Current Devices (RCD)

Technical Data



Type	GS250S		DS251	DS271	DS9	FH200 / F200
Standards	IEC61009		IEC61009, BSEN 61009-2-2		IEC61009	IEC61008
Pole	1 + NA	2, 3, 4	1 + NA	1 + NA	1 + NA	2, 4
Tripping Characteristics	C	C、D	C	B、C	C	-
Tripping Type	Electronic Type				Electro-Magnetic Type	
Rated breaking capacity Icu	6kA	6kA (6-40A) 4.5kA (50, 63A)	6kA	10kA	10kA (DS971) 6kA (DS951) 4.5kA (DS941)	-
Rated current In	6 - 40A	6 - 63A	6 - 32A	6 - 32A	6 - 40A	25 - 63A (FH200) 80 - 100A (F200)
Rated voltage Un / AC	230V	230 / 400V	230 / 240V	230 / 240V	230V	230 / 400V
Type	AC	AC, A	AC	AC	AC	AC
Rated sensitivity	0.01, 0.03	0.01, 0.03, 0.3	0.03	0.01, 0.03, 0.1	0.03	0.03, 0.1, 0.3
Frequency Hz	50 - 60					
Mechanical Life no. of operation	20,000					
Protection degree Terminals Housing	IP20 IP40					
Ambient temperature Operating Temperature °C Storage Temperature °C	-25...+55 -40...+70		-25...+55 -25...+70		-25...+55 -35...+70	
Tropicalization (IEC 60068-2) constant climate conditions [°C/RH] variable climate conditions [°C/RH]	23/83, 40/93, 55/20 25/95, 40/93					
Terminal Size mm²	0.75 - 16		1 - 25 (Line side) 1 - 10 (Load side)		1 - 16	1 - 25
Tightening Torque Nm	2		2 (Line side) 1.2 (Load side)		2	

Residual Current Devices (RCD)

Order Information

Type Designation

GS2☐ ☐ S - ☐ ☐ / ☐

- Rated residual current：0.03A or 0.01A
- Rated current：6、10、16、20、25、32、40、50、63A
- Tripping Characteristics：C、D
- Pole：1 + NA、2、3、4
- Type（Electronic Type）



GS250S (RCBO)

C Characteristic

Rated current (A)	Rated residual current (mA)	AC (Tripping time：Instantaneous)			
		1 Pole + NA	2 Poles	3 Poles	4 Poles
6	10	-	GS252S-C6 / 0.01	GS253S-C6 / 0.01	GS254S-C6 / 0.01
10		-	GS252S-C10 / 0.01	GS253S-C10 / 0.01	GS254S-C10 / 0.01
16		-	GS252S-C16 / 0.01	GS253S-C16 / 0.01	GS254S-C16 / 0.01
20		-	GS252S-C20 / 0.01	GS253S-C20 / 0.01	GS254S-C20 / 0.01
25		-	GS252S-C25 / 0.01	GS253S-C25 / 0.01	GS254S-C25 / 0.01
32		-	GS252S-C32 / 0.01	GS253S-C32 / 0.01	GS254S-C32 / 0.01
40		-	GS252S-C40 / 0.01	GS253S-C40 / 0.01	GS254S-C40 / 0.01
50		-	GS252S-C50 / 0.01	GS253S-C50 / 0.01	GS254S-C50 / 0.01
63		-	GS252S-C63 / 0.01	GS253S-C63 / 0.01	GS254S-C63 / 0.01
6	30	GS251S-C6 / 0.03	GS252S-C6 / 0.03	GS253S-C6 / 0.03	GS254S-C6 / 0.03
10		GS251S-C10 / 0.03	GS252S-C10 / 0.03	GS253S-C10 / 0.03	GS254S-C10 / 0.03
16		GS251S-C16 / 0.03	GS252S-C16 / 0.03	GS253S-C16 / 0.03	GS254S-C16 / 0.03
20		GS251S-C20 / 0.03	GS252S-C20 / 0.03	GS253S-C20 / 0.03	GS254S-C20 / 0.03
25		GS251S-C25 / 0.03	GS252S-C25 / 0.03	GS253S-C25 / 0.03	GS254S-C25 / 0.03
32		GS251S-C32 / 0.03	GS252S-C32 / 0.03	GS253S-C32 / 0.03	GS254S-C32 / 0.03
40		GS251S-C40 / 0.03	GS252S-C40 / 0.03	GS253S-C40 / 0.03	GS254S-C40 / 0.03
50		-	GS252S-C50 / 0.03	GS253S-C50 / 0.03	GS254S-C50 / 0.03
63		-	GS252S-C63 / 0.03	GS253S-C63 / 0.03	GS254S-C63 / 0.03

D Characteristic

Rated current (A)	Rated residual current (mA)	AC (Tripping time：Instantaneous)		
		2 Poles	3 Poles	4 Poles
6	10	GS252S-D6 / 0.01	GS253S-D6 / 0.01	GS254S-D6 / 0.01
10		GS252S-D10 / 0.01	GS253S-D10 / 0.01	GS254S-D10 / 0.01
16		GS252S-D16 / 0.01	GS253S-D16 / 0.01	GS254S-D16 / 0.01
20		GS252S-D20 / 0.01	GS253S-D20 / 0.01	GS254S-D20 / 0.01
25		GS252S-D25 / 0.01	GS253S-D25 / 0.01	GS254S-D25 / 0.01
32		GS252S-D32 / 0.01	GS253S-D32 / 0.01	GS254S-D32 / 0.01
40		GS252S-D40 / 0.01	GS253S-D40 / 0.01	GS254S-D40 / 0.01
50		GS252S-D50 / 0.01	GS253S-D50 / 0.01	GS254S-D50 / 0.01
63		GS252S-D63 / 0.01	GS253S-D63 / 0.01	GS254S-D63 / 0.01
6	30	GS252S-D6 / 0.03	GS253S-D6 / 0.03	GS254S-D6 / 0.03
10		GS252S-D10 / 0.03	GS253S-D10 / 0.03	GS254S-D10 / 0.03
16		GS252S-D16 / 0.03	GS253S-D16 / 0.03	GS254S-D16 / 0.03
20		GS252S-D20 / 0.03	GS253S-D20 / 0.03	GS254S-D20 / 0.03
25		GS252S-D25 / 0.03	GS253S-D25 / 0.03	GS254S-D25 / 0.03
32		GS252S-D32 / 0.03	GS253S-D32 / 0.03	GS254S-D32 / 0.03
40		GS252S-D40 / 0.03	GS253S-D40 / 0.03	GS254S-D40 / 0.03
50		GS252S-D50 / 0.03	GS253S-D50 / 0.03	GS254S-D50 / 0.03
63		GS252S-D63 / 0.03	GS253S-D63 / 0.03	GS254S-D63 / 0.03

SolarEdge Single Phase Inverters

SE2200 - SE6000



Specifically designed to work with power optimizers

- Superior efficiency (97.6%)
- Small, lightweight and easy to install
- Built-in module-level monitoring
- Internet connection through Ethernet or Wireless
- IP65 – Outdoor and indoor installation
- Fixed voltage inverter, DC/AC conversion only

USA - GERMANY - ITALY - FRANCE - JAPAN - CHINA - AUSTRALIA - ISRAEL

www.solaredge.com

Single Phase Inverters

SE2200 - SE6000

	SE2200	SE3000	SE3500	SE4000	SE5000	SE6000	
OUTPUT							
Rated AC Power Output	2200	3000	3500	4000	5000	6000	VA
Maximum AC Power Output	2200	3000	3500	4000	5000	6000	VA
AC Output Voltage (Nominal)	220 /230						Vac
AC Output Voltage Range	184 - 264.5						Vac
AC Frequency (Nominal)	50 / 60 ± 5						Hz
Maximum Continuous Output Current	12	16.5*	19.5*	22*	27	27	A
Residual Current Detector / Residual Current Step Detector	300 / 30						mA
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes						
INPUT							
Recommended Maximum DC Power** (Module STC)	2400	3300	3900	4400	5500	6600	W
Transformer-less, Ungrounded	Yes						
Maximum Input Voltage	500						Vdc
Nominal DC Input Voltage	350						Vdc
Maximum Input Current	8.5	11.5	13.5	15.5	19.5	23	Adc
Reverse-Polarity Protection	Yes						
Ground-Fault Isolation Detection	600kΩ Sensitivity						
Maximum Inverter Efficiency	97.6						%
European Weighted Efficiency	97.6	97.6	97.5	97.5	97.4	97.4	%
Nighttime Power Consumption	< 2.5						W
ADDITIONAL FEATURES							
Supported Communication Interfaces	RS485, RS232, Ethernet, Zigbee (optional)						
STANDARD COMPLIANCE							
Safety	IEC-62103 (EN50178), IEC-62109						
Grid Connection Standards	VDE 0126-1-1, VDE-AR-N-4105, AS-4777, RD-1663 , DK 5940						
Emissions	IEC61000-6-2, IEC61000-6-3, IEC61000-3-11, IEC61000-3-12, FCC part15 class B						
RoHS	Yes						
INSTALLATION SPECIFICATIONS							
AC Output	Cable Gland - diameter 9-16						mm
DC Input	1 MC4 pair			2 MC4 pairs			
Dimensions (HxWxD)	540 x 315 x 172			540 x 315 x 191			mm
Weight	20.2			21.7			kg
Cooling	Natural Convection						
Noise	< 50						dBA
Operating Temperature Range	-20 - +50 (M40 version -40 - +50)						˚C
Protection Rating	IP65 - Outdoor and Indoor						
Bracket Mounted (Bracket Provided)							

* For inverters with an AC current limit of 16A please refer to the "SE3000-4000-16A Inverter" datasheet.

** Higher input DC power may be installed; analyze yearly AC performance.

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TECHNICAL FEATURES		Type 1 OVR T1 ▢ 25 ▢ TS					
Technology		Triggered spark-gap					
Electrical features							
Standard		IEC 61643-1 / EN 61643-11					
Type / test class		1 / I					
Poles		1P ▢	1P ▢ 2P 2L	3P 3L	4P 4L	1P+N 1N	3P+N 3N
Types of networks		IT - TT	TT*-TNS-TNC	TNC	TNS	TT - TNS	TT - TNS
Type of current		A.C.					
Nominal voltage Un (L-N/L-L)	V	400	230	230/400		230	230/400
Max. cont. operating voltage Uc	V	440	255			-	-
Max. cont. operating voltage Uc (L-N / N-⏚)	V	-	-			255 / 255	255 / 255
Impulse current limp (10/350) per pole	kA	25	25			-	-
Impulse current limp (10/350) (L-N / N-⏚)	kA	-	-			25 / 50	25 / 100
Imax discharge current (8/20) per pole (Imax)	kA	-	-			-	-
Imax discharge current (8/20) (L-N/N-terre) (Imax)	kA	-	-			-	-
Nominal discharge current In (8/20) per pole	kA	25	25			-	-
Nominal discharge current In (8/20 (L-N / N-⏚)	kA		-			25 / 50	25 / 100
Voltage protection level Up	kV	2	2.5			-	-
Voltage protection level Up (L-N / N-⏚)	kV	-	-			2.5 / 2	2.5 / 2
Follow current interrupting rating If_i	kArms	50	50			-	-
Follow current interrupting rating If_i (L-N / N-⏚)	kArms	-	-			50 / 0.1	50 / 0.1
TOV (Temporary overvoltage) withstand U_T (5s.)	V	690	400			-	-
TOV (Temporary overvoltage) withstand U_T (L-N: 5s. / N-⏚ : 200ms.)	V	-	-			400 / 1200	400 / 1200
Continuous operating current Ic	mA	None					
Short-circuit withstand capability	kArms	50					
Load current I_{load} (for V-wiring)	A	125					
Maximum back-up fuse gG/gL		-					
Parallel Connection	A	≤125					
Serial Connection (V-wiring)	A	≤125					
Mechanical features							
Stocking and operating temperature	°C	-40 to +80					
Degree of protection		IP 20					
Fire resistance according to UL 94		V0					
Colour of Housing		Polyarylamide grey RAL 7035					
State indicator		Option (with TS)					
TS remote indicator		Option (TS)					
Installation							
Wire range (L, N, ⏚)							
solid wire	mm^2	2.5 ... 50					
stranded wire	mm^2	2.5 ... 35					
Stripping length (L, N, ⏚)	mm	15					
Tightening torque (L, N, ⏚)	Nm	3.5					

TECHNICAL FEATURES OF THE INTEGRATED AUXILIARY CONTACT (TS)

Electrical features		
Contact complement		1NO (1 normally open contact), +1NC (1 normally closed contact)
Min. load		6 V D.C. - 10 mA
Max. load		250 V A.C. - 5 A
Continuous operating current	mA	10
Installation		
Connection cross-section	mm^2	1.5

TT* : in TT network for L/N protection only

Technical features

OVR Surge Protective Devices - Type 1 & Type 1+2






	Type 1 OVR T1 ☐ 25 255-7 Triggered spark-gap		Type1+2 OVR T1+2 25 255 TS Triggered spark-gap/varistor	Type 1+2 OVR T1+2 ☐ 15 255-7 Triggered spark-gap		Type 1+2 OVR T1+2 ☐ 7 275 s P Varistor				
	IEC 61643-1 / EN 61643-11		IEC 61643-1 / EN 61643-11	IEC 61643-1 / EN 61643-11		IEC 61643-1 / EN 61643-11				
	1 / I		1/ I	1 / I		1 / I				
	1P -	3P+N 3N		1P -	3P+N 3N	1P -	3P 3L	4P 4L	1P+N 1N	3P+N 3N
	TT*-TNS-TNC	TT - TNS	TT* - TNS - TNC	TT*-TNS-TNC	TT - TNS	TT*-TNS-TNC	TNC	TNS	TT - TNS	TT - TNS
	A.C.		A.C.	A.C.		A.C.				
	230	230/400	230	230	230/400	230	230/400		230	230/400
	255	-	255	255	-	275			275	275 / 255
	-	255 / 255	-	-	255 / 255					
	25	-	25	15	-	7			-	-
	-	25 / 100	-	-	15 / 50	-			7 / 12	7 / 12
	-	-	40	60	-	70			-	-
	-	-	-	-	60/60	-			70/70	70/70
	25	-	25	15	-	6			-	-
	-	25 / 100	-	-	15 / 50	-			6	6
	2.5	-	1.5	1.5	-	0.9			-	-
	-	2.5 / 1.5	-	-	1.5 / 1.5	-			0.9 / 1.4	0.9 / 1.5
	7	-	15	7	-	NA			-	-
	-	7 / 0.1	-	-	7 / 0.1	-			NA / 0.1	NA / 0.1
	650	-	334	650	-	334			-	-
	-	650 / 1200	-	-	650 / 1200	-			334 / 1200	
	< 2 (LED)		< 1 (Varistor leakage)	< 2 (LED)		< 1				
	50		50	50		50				
	-		125	-		-				
	≤125		≤125	≤125		≤50				
	NA		125	NA		NA				
	-40 to +80		-40 to +80	-40 to +80		-40 to +80				
	IP 20		IP 20	IP 20		IP 20				
	V0		V0	V0		V0				
	Polyarylamide grey RAL 7035		Polyarylamide grey RAL 7035	Polyarylamide grey RAL 7035		PC grey RAL 7035				
	Yes		Yes	Yes		Yes				
	No		Yes	No		No				
	2.5 ... 50		2.5 ... 50	2.5 ... 50		2.5 ... 25				
	2.5 ... 35		2.5 ... 35	2.5 ... 35		2.5 ... 16				
	15		15	15		12.5				
	3.5		3.5	3.5		2.8				
	-		1NO (1 normally open contact),	-		-				
	-		+1NC (1 normally closed contact)							
	-		12V D.C. - 10 mA	-		-				
	-		250V A.C. - 1 A	-		-				
	-		None	-		-				
	-		1.5	-		-				

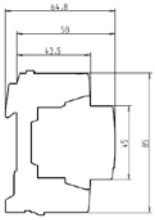
TT* : in TT network for L/N protection only

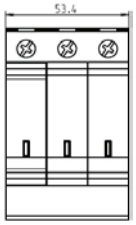
Surface Protective Device
Parafoudre

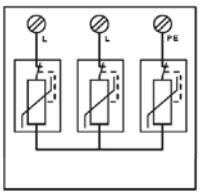
Type : **OVR PV 40-1000 P**
Part : 2CTB803953R6400
EAN : 3 660 308 51653 4
FR : 395364

Pluggable Unit
Produit débrochable









Electrical characteristics
Caractéristiques électriques

Types of networks *Régime de neutre*		Photovoltaic Systems - D.C Side
Type / test class *Type / Classe*		T2 / II
Number of poles / Type of current *Nombre de pôles / Type de courant*		3 / D.C
Protection mode *Type de protection*		Common and differential
Short circuit current Iscwpv *Courant de court circuit Iscwpv*	A	100
Maximal continuous operating voltage Ucpv (+/-) *Tension maximale permanente Uc (L-PE)*	V	1000
Voltage protection level Up at In (+/-) / (+/-)-PE *Niveau de protection en tension Up à In (+/-) / (+/-)-PE*	kV	3.8 / 3.8
Nominal discharge current In (8/20) *Courant nominal de décharge In (8/20)*	kA	20
Maximal discharge current Imax (8/20) *Courant maximal de décharge Imax (8/20)*	kA	40
Operating current Ic *Courant de fonctionnement Ic*	mA	< 0.1
Response Time *Temps de réponse*	ns	< 25
Follow current If *Courant de suite If*	A	None
Integrated thermal disconnector *Déconnecteur thermique intégré*		Yes / Oui
State indicator *Indicateur d'état*		Yes / Oui
Safety reserve *Réserve de sécurité*		-
TS remote indicator *Télésignalisation (TS)*		No / Non
Disconnector * *Protection contre les surintensités à monter en série **		
Curve B or C Circuit breaker *Disjoncteur courbe B ou C*	A	-
gG - gL fuse *Fusible gG - gL*	A	-

** If Iscwpv > 100A, should install fuse ≤10 A Gr*

Mechanical characteristics
Caratéristiques mécaniques

Wire range (L/N) : Solid wire *Section des conducteurs (L/N) : Fil rigide*	mm²	2.5…25
Wire range (L/N) : Stranded wire *Section des conducteurs (L/N) : Fil souple*	mm²	2.5…16
Stripping length (L/N) *Longueur de dénudage des conducteurs (L/N)*	mm	12.5
Tightening torque (L/N) *Couple de serrage des bornes (L/N)*	Nm	2.8
Wire range (PE) : Solid wire *Section des conducteurs (PE) : Fil rigide*	mm²	2.5…25
Wire range (PE) : Stranded wire *Section des conducteurs (PE) : Fil souple*	mm²	2.5…16
Stripping length (PE) *Longueur de dénudage des conducteurs (PE)*	mm	12.5
Tightening torque (PE) *Couple de serrage des bornes (PE)*	Nm	2.8
Degree of protection *Indice de protection*		IP 20

TS remote indicator
Télésignalisation (TS)

Contact complement *Type de contact*		-
Minimal load *Charge mini*		-
Maximal load *Charge maxi*		-
Connection cross section *Section des conducteurs*	mm²	-

Miscellaneous characteristics
Caractéristiques diverses

Stocking temperature / Operating temperature *Température de stockage / Température de fonctionnement*	°C	- 40 to +80 / - 40 to +70
Maximal altitude *Altitude maxi*	m	2000
Weight *Poids*	g	350
Compliance to *Conforme à*		UTE C61-740-51
Reference standards *Normes de référence*		IEC 61643-1 / EN 61643-11

Replacement cartridges
Cartouches de remplacement

Phase / Product ID *Phase / Code produit*	OVR PV 40-1000 C / 2CTB803950R0100
Neutral / Product ID *Neutre / Code produit*	- / -

ÖLFLEX® CLASSIC 110

DB 1119752
valid from: 2014-01-27

Application

ÖLFLEX® CLASSIC 110 cables are VDE approved power and control cables for occasional flexible use and fixed installation for normal mechanical stresses. They are among others designed for use in dry, damp and wet rooms. Outdoor use: They may only be installed with UV protection and considering the temperature range. At room temperature they are widely resistant to acids, alkali-resistant and resistant to certain oils. They are suitable for free and limited continuously recurring movement without tensile load or compulsory guidance.

Application range:
As power and connecting cable for control systems in machine tools, plant engineering and construction, industrial machinery, conveyor systems, production and assembly lines as well as in measuring and control technology and data processing systems.
This cable is suitable for torsion application in wind turbines (WTG). The torsional load is limited to applications, as they typically occur in the loop of a wind turbine.

Design

Design	based on EN 50525-2-51/VDE 0285-525-2-51/HD 21.13 S1+A1/VDE 0281-13
Approval	VDE REG.-Nr. 7030 limited to following dimension range: 0.5 mm² - 2.5 mm² 2 - 65 cores 4 mm² - 16 mm² 2 - 7 cores 25 mm² - 120 mm² 2 - 5 cores
Conductor	fine wire strands of bare copper, acc. to IEC 60228 resp. VDE 0295, Class 5
Core insulation	LAPP special PVC compound P8/1 TI2 acc. to EN 50363-3 resp. VDE 0207-363-3 with increased requirements
Core identification	acc. to VDE 0293-1, with or without GN/YE ground conductor black cores with white numbers acc. to DIN EN 50334 resp. VDE 0293-334
Outer sheath	PVC compound TM2 acc. to EN 50363-4-1 resp. VDE 0207-363-4-1 with increased requirements acc. to LAPP specification colour: Silver Grey, similar RAL 7001

Electrical properties

Nominal voltage	300 / 500 V
Test voltage	4000 V AC

Mechanical and thermal properties

Min. bending radius	occasional flexing: fixed installation:	10 x cable Ø 4 x cable Ø
Temperature range	occasional flexing: fixed installation:	-15 °C up to +70 °C max. conductor temp. -40 °C up to +80 °C max. conductor temp.

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ÖLFLEX® CLASSIC 110

DB 1119752
valid from: 2014-01-27

Power chain	limited to 2-7 cores and 0.5 – 2.5 mm² min. bending radius 15 x cable Ø temperature range -5 °C up to +70 °C max. conductor temp. travelling distance up to 5 m 0.2 ... 1 million bending cycles
Torsion movement in WTG	TW-0 (5000 cycles at ≥ +5°C) TW-1 (2000 cycles at ≥ -20°C) ± 150 °/m at 1 revolution per minute
Flammability	flame retardant in acc. with IEC 60332-1-2 resp. VDE 0482-332-1-2
Oil resistance	acc. to DIN EN 50290-2-22 bzw. VDE 0819-102, TM54
Tests	acc. to IEC 60811, EN 50395, EN 50396
EC-Directives	This cable is conform to the EC-Directives 2006/95/EC (Low Voltage Directive) and 2002/95/EC and 2011/65/EC (RoHS, Restriction of the use of certain hazardous substances).

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OLFLEX® Classic 110/ 110 CY

Flexible Control Cable
Number Coded

OLFLEX® Classic 110 is a multi-conductor, flexible control cable designed for use in all electrical equipment in dry, damp and wet conditions.

OLFLEX® Classic 110 CY is a shielded multi-conductor, flexible control cable designed for use in all electrical equipment in dry, damp and wet conditions. An overall tinned copper braid is recommended whenever electrical interference distorts signal transmission, or when EMI emissions need to be suppressed.

Recommended applications include machine tools, assembly lines, control systems, data processing equipment, connections between control panels and machines, CNC machining centers, grinding machines and bottling equipment.

OLFLEX® Classic 110 Construction:

Finely stranded bare copper conductors; PVC insulation; conductors cabled with non-wicking fillers; dry lubricant; gray PVC jacket.



OLFLEX® Classic 110 CY Construction:

Finely stranded bare copper conductors; PVC insulation; conductors cabled with non-wicking fillers; dry lubricant; gray PVC inner jacket, tinned copper braid (85% coverage); transparent PVC jacket.



Cable Attributes

OR-01	FR-02	FL-01	MP-01

Technical Data:

- Minimum Bend Radius:
  - for installation: 4 x cable diameter
  - with shield: 6 x cable diameter
- Temperature Range:
  - OLFLEX® Classic 110: -40°C to +80°C
  - OLFLEX® Classic 110 CY: -30°C to +80°C
- Nominal Voltage: 300/500V
- Test Voltage: 4000V
- Conductor Stranding: Fine wire, VDE 0295, Class 5
- Color Code: Black with white numbers, plus green/yellow ground
- Approvals: Based on VDE specifications

Conforms to CE Low Voltage Directive

OLFLEX® Classic 110: Flexible Control Cable

Part Number	Number of Conductors includes ground	Nominal Outer Diameter inches	mm	Approx. Weight lbs/mft	kg/km	Part Number	Number of Conductors includes ground	Nominal Outer Diameter inches	mm	Approx. Weight lbs/mft	kg/km
21 AWG (16/32) 0.50 mm²						1119018	18	.413	10.5	126	188
1119752	2	.189	4.8	24	35	1119025	25	.488	12.4	175	261
1119003	3	.201	5.1	28	42	1119035	35	.571	14.5	239	356
1119004	4	.224	5.7	36	54	1119052	52	.681	17.3	347	517
1119005	5	.244	6.2	42	63	1119065	65	.772	19.6	433	644
1119007	7	.264	6.7	54	81	1119080	80	.831	21.1	524	780
1119012	12	.350	8.9	88	131	1119100	100	.929	23.6	655	975

* Additional configurations are available, please call your Lapp representative for more information.

OLFLEX® Classic 110/ 110 CY

Flexible Control Cable
Number Coded

CE

OLFLEX® Classic 110: Flexible Control Cable

Part Number	Number of Conductors includes ground	Nominal Outer Diameter inches	mm	Approx. Weight lbs/mft	kg/km
18 AWG (32/32) 1.00 mm²					
1119852	2	.224	5.7	36	53
1119203	3	.236	6.0	44	65
1119204	4	.256	6.5	53	79
1119205	5	.280	7.1	63	94
1119207	7	.315	8.0	85	126
1119212	12	.413	10.5	138	205
1119218	18	.500	12.7	202	300
1119225	25	.579	14.7	274	408
1119240	34	.673	17.1	370	551
1119241	41	.740	18.8	444	661
1119250	50	.811	20.6	536	797
1119265	65	.929	23.6	694	1033
1119280	80	.996	25.3	844	1251
1119300	100	1.114	28.3	1048	1560
16 AWG (30/30) 1.50 mm²					
1119902	2	.248	6.3	46	68
1119303	3	.264	6.7	56	84
1119304	4	.283	7.2	70	104
1119305	5	.319	8.1	86	128
1119307	7	.350	8.9	112	166
1119312	12	.472	12.0	188	279
1119318	18	.567	14.4	274	407
1119325	25	.665	16.9	376	560
1119334	34	.764	19.4	501	746
1119341	41	.839	21.3	602	895
1119350	50	.925	23.5	732	1089
1119365	65	1.051	26.7	940	1398
1119380	80	1.134	28.8	1148	1708

Part Number	Number of Conductors includes ground	Nominal Outer Diameter inches	mm	Approx. Weight lbs/mft	kg/km
14 AWG (50/30) 2.50 mm²					
1119952	2	.295	7.5	68	101
1119403	3	.319	8.1	89	132
1119404	4	.350	8.9	110	163
1119405	5	.394	10.0	134	200
1119407	7	.437	11.1	179	267
1119412	12	.583	14.8	299	445
1119418	18	.701	17.8	436	648
1119425	25	.819	20.8	598	890
1119434	34	.961	24.4	812	1208
1119450	50	1.157	29.4	1179	1754
12 AWG (56/28) 4 mm²					
1119503	3	.390	9.9	135	201
1119504	4	.425	10.8	167	249
1119505	5	.476	12.1	205	305
1119507	7	.528	13.4	274	407
1119511	11	.693	17.6	426	634
10 AWG (84/28) 6 mm²					
1119603	3	.461	11.7	194	289
1119604	4	.512	13.0	245	365
1119605	5	.571	14.5	300	447
1119607	7	.630	16.0	403	600
8 AWG (80/26) 10 mm²					
1119614	4	.638	16.2	397	590
6 AWG (128/26) 16 mm²					
1119624	4	.740	18.8	731	1087
4 AWG (200/26) 25 mm²					
1119634	4	.925	23.5	1063	1582
2 AWG (280/26) 35 mm²					
1119644	4	1.039	26.4	1415	2106
1119645	5	1.185	30.1	1771	2635

OLFLEX® Classic 110 CY: Shielded Flexible Control Cable

Part Number	Number of Conductors includes ground	Nominal Outer Diameter inches	mm	Approx. Weight lbs/mft	kg/km
21 AWG (16/32) 0.50 mm²					
1135752	2	.276	7.0	50	75
1135003	3	.287	7.3	56	83
1135004	4	.311	7.9	67	99
1135005	5	.331	8.4	75	112
1135007	7	.350	8.9	89	132
1135012	12	.445	11.3	136	202
1135018	18	.524	13.3	194	289
1135025	25	.598	15.2	254	378
18 AWG (32/32) 1.00 mm²					
1135852	2	.311	7.9	66	98
1135203	3	.323	8.2	75	111
1135204	4	.343	8.7	87	130
1135205	5	.374	9.5	103	153
1135207	7	.402	10.2	124	185
1135212	12	.524	13.3	206	307
1135218	18	.610	15.5	288	418
1135225	25	.689	17.5	366	544
16 AWG (30/30) 1.50 mm²					
1135902	2	.335	8.5	79	117
1135303	3	.350	8.9	91	136

Part Number	Number of Conductors includes ground	Nominal Outer Diameter inches	mm	Approx. Weight lbs/mft	kg/km
1135304	4	.378	9.6	110	163
1135305	5	.406	10.3	126	188
1135307	7	.445	11.3	159	237
1135312	12	.583	14.8	264	393
1135318	18	.677	17.2	362	538
1135325	25	.791	20.1	501	745
14 AWG (50/30) 2.50 mm²					
1135403	3	.406	10.3	129	192
1135404	4	.445	11.3	157	233
1135405	5	.496	12.6	190	283
1135407	7	.547	13.9	249	371
12 AWG (56/28) 4 mm²					
1135504	4	.528	13.4	233	347
1135505	5	.579	14.7	278	413
10 AWG (84/28) 6 mm²					
1135604	4	.622	15.8	326	485
8 AWG (80/26) 10 mm²					
1135614	4	.748	19.0	494	735
6 AWG (128/26) 16 mm²					
1135624	4	.874	22.2	934	1395

* Additional configurations are available, please call your Lapp representative for more information.



Low Voltage Products

Solar energy
Protecting and isolating PV systems

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Low voltage products for renewable energy
Guide to the UK industry

The UK Government have introduced a new initiative aimed at encouraging the nationwide adoption of renewable energy technologies.

Called the Feed-in Tariff, this initiative will see owners of renewable energy equipment being paid not only for the energy they use but also the amount of surplus energy they supply to the UK National Grid.

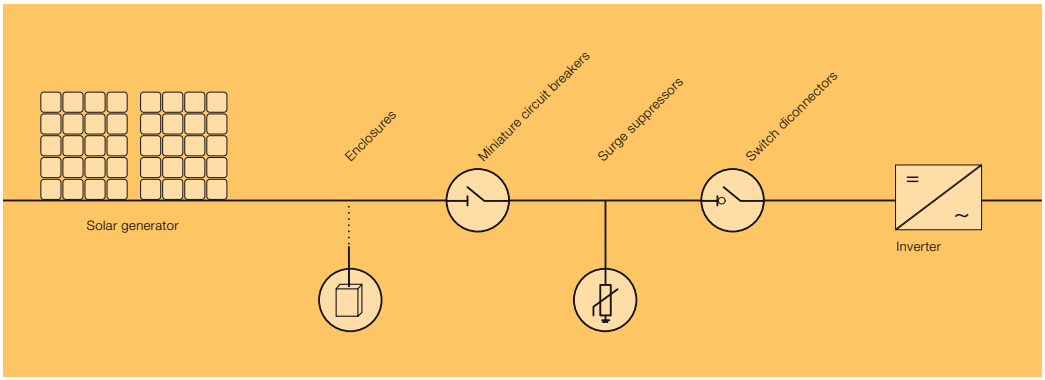
Inspired by similar schemes already operating in continental Europe, the UK Feed-in Tariff initiative is aimed at residential, commercial and industrial users of renewable energy sources. A table of the technologies covered are listed below.

How does the Feed-in Tariff Work?

The Feed-in Tariff is based on the amount of energy produced by a renewable energy source, plus where surplus energy is produced, a bonus to cover energy exported to the National Grid. By effectively paying producers more for the energy they don't use, the system is also aimed at encouraging energy efficiency.

To cover periods when the renewable energy source may be not producing sufficient electricity to cover demand, additional energy may be imported from the National Grid, with the user paying their electricity supplier for the amount consumed.

Technology	Tariff amount (pence per kWh) for installation fitted periods:		
	April 2010 - March 2011	April 2011 - March 2012	April 2012 - March 2013
Solar photovoltaic <4 kW (new)	36.1	36.1	36.1
Solar photovoltaic <4 kW (retrofit)	41.3	41.3	41.3
Solar photovoltaic >4 - 10kW	36.1	36.1	33.0
Solar photovoltaic >10 - 100 kW	31.4	31.4	28.7
Solar photovoltaic >100 - 5MW	29.3	29.3	26.8



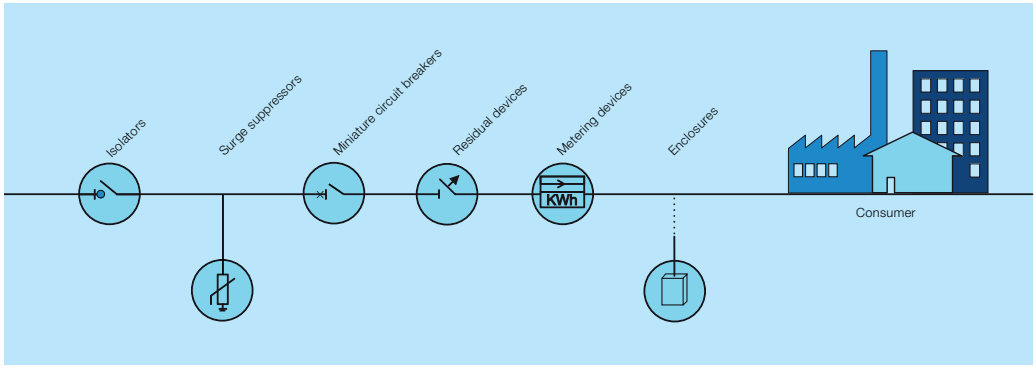
DC Side

The components of photovoltaic systems
The efficiency and quality of a system are measured by the efficiency and quality of each individual component

An accurate choice of components, especially the modules and inverters, is of fundamental importance if a photovoltaic system is to be a success. Before it can be considered a good investment, a photovoltaic system must be able to function efficiently for at least 20 years in all weathers and under the blazing sun.

What is commonly called the “BOS” (Balance of System), i.e. the “rest of the system” (electromechanical equipment for protection, control and isolation purposes, cables), undoubtedly plays an important role in ensuring that people and the buildings connected to the system are properly protected, and that there is an adequate production of energy over the years. From an economic viewpoint, it is even more important for each individual component of a photovoltaic system to be chosen on the basis of the warranties provided by the product and by its manufacturer than it is for a normal electric system. This is because the operating specifications of each device must remain unchanged throughout the entire life cycle of the system and the relative investment.

Always ready to meet any new demand from the market, ABB has developed a whole range of reliable products dedicated to photovoltaic applications and able to meet all installation requirements, from the string on the direct current side through to the alternate current grid connection point. ABB’s products include string boxes, miniature circuit breakers, switch-disconnectors, residual current-operated circuit breakers, interface relays, energy meters, fuse disconnecting switches and fuses, surge arresters, consumer units and enclosures suitable for outdoor installation, all specially designed for these applications. ABB can also provide a series of “plug & operate” solutions, i.e. finished, wired and certified switchgear able to suit the requirements of a vast range of installations: from the individual string for domestic use to the large solar park.



AC Side

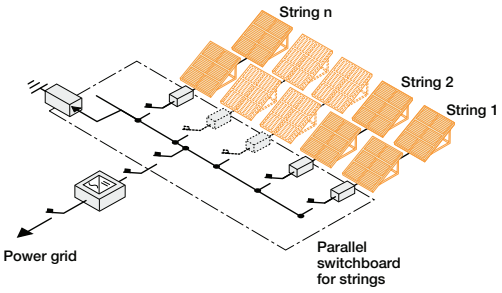
Protection on the d.c. side

The direct current section of a typical photovoltaic system consists of a generator formed by the parallel of the strings of solar panels connected in series.

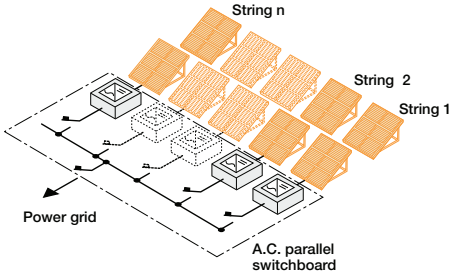
Along with the specific characteristic of the solar modules (inability to shut off the voltage other than by obscuring the solar panels and generation, by the strings, of short-circuit currents with values very near to those produced in normal conditions), the presence of voltage as high as 300-600 V d.c. and beyond requires a very careful assessment of the protection and isolating devices, which must be able to suppress direct fault currents under high voltages within a very short time.

In accordance with the provisions established by Standard IEC 64-8 (article 712), protection against overcurrents must be provided when the carrying capacity of the cable is less than 1.25 times the calculated fault current in any point.
This means that in the majority of small systems or when several inverters have been installed, it is sufficient to install a switch-disconnector which, as established by Guide 82-25, must be of the DC21 class at least.
Guide 82-25 also specifies that it is advisable to install an isolating device on each string to allow this latter to be inspected or serviced without having to shut down other parts of the system.
The exposed conductive parts of all the equipment must be earthed by means of the protection conductor to as to protect persons from indirect contacts. The PV generator can only be earthed if it is separated from the low voltage distribution network by a transformer.

Various different methods can be used to connect the strings in parallel in a photovoltaic system connected to the power grid.



Centralized conversion

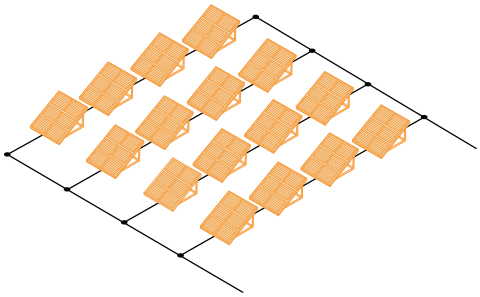


Distributed conversion

String protection against reverse currents

When the installation layout includes centralized conversion with the use of a single inverter, the strings must be protected against reverse current. This could circulate after faults or temporary unbalances in the system due, for example, to certain of the solar modules being partially in the shade or covered by snow, leaves, etc.

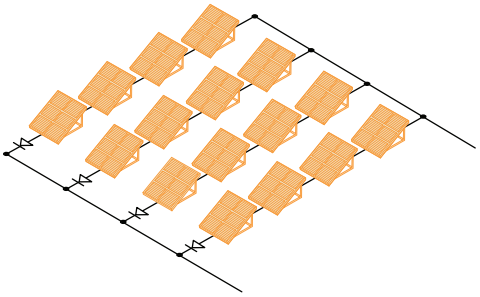
Recirculated current can reach extremely high values, especially when there are a large number of strings.
The modules are unable to withstand this sort of current and, in the absence of protection devices, they develop faults within a very short time.
There are different methods for connecting the strings of solar modules in parallel in safe conditions: if there are only a few strings (1 or 2), obviously formed by the same number of modules, the parallel connection can be made without danger, otherwise protection devices must be installed in series with each string.



Protection for the parallel connection of the strings of photo-voltaic modules. Simple parallel.
Advantages: simple to make
Disadvantages: the strings are liable to power reversals; can only be used for a very small number of strings

Reverse cut-off diode

This solution is inadvisable since not everyone considers it suitable for protecting the strings. It is not a substitute for over current protections (IEC TS 62257-7-1) as the blocking diode may not function correctly and could be short-circuited. Moreover, diodes lead to a power loss owing to the effect of the voltage drop on junction, a loss that can be reduced by using Schottky diodes with a 0.4 V drop instead of the 0.7 V drop created by conventional diodes.
If reverse cut-off diodes are chosen, their maximum reverse voltage (according to IEC 60364-7-712 standards) must be at least twice the open circuit UOC string voltage in STC conditions.
The direct over current must be higher than the short-circuit current ISC of the individual modules, with 1.25 ISC minimum value.



Protection for the parallel connection of the strings of photovoltaicmodules. Reverse cut-off diodes.
Advantages: Prevent power reversal
Disadvantages: They are not considered to be protection devices.
They lead to a power loss in the circuit.

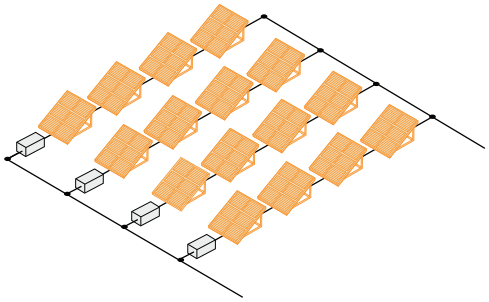
String protection against reverse currents

Fuses

Fuses are the string protection most widely used by designers since, unlike diodes, they disconnect the circuit if faults occur. However, although fuses are simple to use, the utmost care must be taken when they are sized and chosen as certain fundamantal requirements must be considered:

- they must possess trip characteristic gR, suitable for protecting circuits with semi-conductors;
- they must be sized for current values of no less than 1.25 IS and no more than the value indicated by the manufacturer for module protection. In the absence of specific indications, consider a value must be 2.0 IS or less;
- they must be installed in dedicated fuse-disconnectors able to dissipate the power that develops in the worst operating conditions.

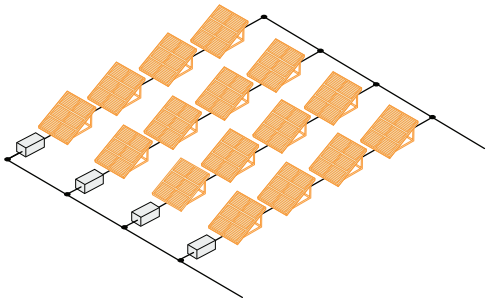
With its small size and competitive cost, this solution does not completely prevent reverse current from circulating in the modules, which must consequently be able to withstand values of at least twice or three times the ISC (such values are normally supported by the majority of the modules available on the market).



Protection for the parallel connection of the strings of photovoltaic modules. Simple parallel.
Advantages: simple to make
Disadvantages: the strings are liable to power reversals; can only be used for a very small number of strings

Miniature circuit-breakers

Use of thermo-magnetic circuit-breakers is a further method for protecting photovoltaic strings. Thus, manufacturers have created specific products comprising technological solutions able to function at high the direct current voltage values that are usual in these applications.
Technically speaking, this is the better solution even though it is not so economical.
In certain cases, it could also be liable to accidentally trip in the presence of transient overvoltage (e.g. of atmospheric origin). However, in such cases they can be reset without having to replace any components.
A further advantage is that the protection and isolating functions can be provided by a single device.



Protection for the parallel connection of the strings of photovoltaic modules. Automatic circuit-breakers.
Advantages: a single device provides both the protection and isolating functions
Disadvantages: More expensive

Isolating devices

A class DC21 switch-disconnector can also be installed in the parallel switchboards to allow the solar energy source to be disconnected if a fault occurs or, more frequently, when servicing is required.
If it is installed in the subsystem's parallel switchboards, lower current values can be used than those that would be obtained with a single isolation on the load side of the inverter, while it also allows the various different strings to be disconnected in a selective way.
To conduct maintenance work and inspections in the utmost safety, it is advisable to install isolating devices on each individual string.

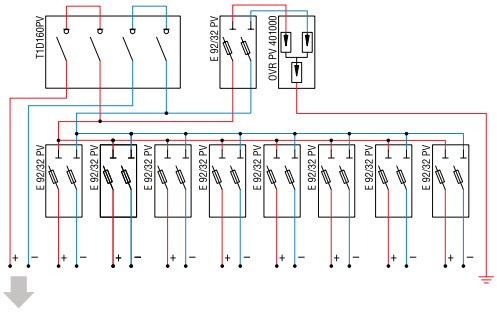


Diagram of a parallel switchboard for 8 strings inclusive of SPD and switch-disconnector

Surge arresters

Solar arrays, which are generally sited in exposed positions and, for the higher power versions, over wide areas, are subject to atmospheric activity and may be damaged by the over voltage generated by lightning.
To avoid problems, it is advisable to install Surge Protective Devices (SPD) on each polarity towards earth in the parallel switchboards once the risks have been correctly assessed in accordance with EN 62305-2 standards.
The impedance of these devices varies, depending on the voltage applied: when on hold, their impedance is extremely high and is reduced in the case of over voltage, by discharging the associated current towards earth.
It is advisable to choose the right sort of SPD with tripping thresholds that suit the operating voltage values of the circuit.
The state of efficiency of the equipment must be constantly displayed locally and in the remote mode if necessary, by use of products equipped with remote signalling contacts.
SPD with varistors or combined SPD should be used in the protection for the direct current side. Inverters generally possess internal protection against over voltage, but the production of energy and negates the need for the intervention of specialized personnel.

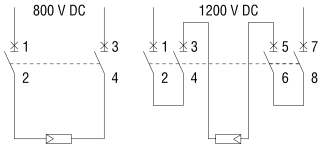
These SPD must therefore possess the following characteristics:
- type 2;
- maximum continuous operating voltage Uc > 1.25 Uoc;
- protection level Up < Uinv, where Uinv is the impulse withstand voltage of the inverter on the d.c. side;
- rated flashover current In > 5 kA;
- thermal protection with short-circuit extinction capacity at life end and coordination with a suitable backup protection.

Since the impulse withstand voltage of the string modules is generally higher than that of the inverter, the SPD installed to protect these generally allow the modules to be protected as well, so long as the distance between the modules and inverter is less than 10 meters. The SPD must be installed on the supply side (direction of the PV generator's energy) of the inverter's isolating device so that it

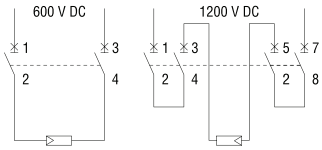
Miniature circuit-breakers
S800 PV-S



≥ 80A



≥ 100, 125A



Connection
Photovoltaic panel network
in earth-insulated systems

S800 PV-S miniature circuit-breakers can be used in networks up to 1200 V d.c. (four-pole version). These products and their vast range of accessories (auxiliary contacts, release coils) can be used to create countless system configurations. The main features of S800 PV-S circuit-breakers are:

- interchangeable terminals
- fault signalling lever in the central position
- contact status displayed for each individual pole
- no restrictions as to polarity or power direction in the wiring
- use of the rotary door operating handle

Main technical specifications		S800 PV-S	
Reference Standards		IEC EN 60947-2	
Rated current In	[A]	10…80	100, 125
Number of poles		2, 4	
Rated voltage Ue			
(d.c.) 2 poles*	[V]	800	1200
(d.c.) 4 poles*	[V]	600	1200
Ultimate rated short-circuit breaking capacity Icu			
(d.c.) 600/800 V (2 poles) *	[kA]	5	5
(d.c.) 1200 V (4 poles) *	[kA]	5	5
Thermomagnetic release characteristic		4 In ≤ Im ≤ 7 In	
Class of use		A	
Operating temperature	[°C]	-25…+60	
Mounting		on EN 60715 channel (35 mm) with a quick coupling device	

Please refer to wiring diagrams*

Poles	Rated current In [A]	Description Type	Order code
2	10	S802PV-S10	2CCP842001R1109
2	13	S802PV-S13	2CCP842001R1139
2	16	S802PV-S16	2CCP842001R1169
2	20	S802PV-S20	2CCP842001R1209
2	25	S802PV-S25	2CCP842001R1259
2	32	S802PV-S32	2CCP842001R1329
2	40	S802PV-S40	2CCP842001R1409
2	50	S802PV-S50	2CCP842001R1509
2	63	S802PV-S63	2CCP842001R1639
2	80	S802PV-S80	2CCP842001R1809
2	100	S802PV-S100	2CCP842001R1829
2	125	S802PV-S125	2CCP842001R1849
4	10	S804PV-S10	2CCP844001R1109
4	13	S804PV-S13	2CCP844001R1139
4	16	S804PV-S16	2CCP844001R1169
4	20	S804PV-S20	2CCP844001R1209
4	25	S804PV-S25	2CCP844001R1259
4	32	S804PV-S32	2CCP844001R1329
4	40	S804PV-S40	2CCP844001R1409
4	50	S804PV-S50	2CCP844001R1509
4	63	S804PV-S63	2CCP844001R1639
4	80	S804PV-S80	2CCP844001R1809

Miniature circuit-breakers
S800 PV-M

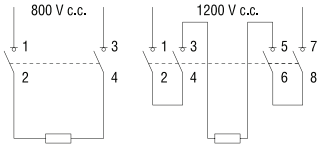


S800 PV-M switch-disconnectors can be used in networks up to 1200 V d.c. (four-pole version). These products and their vast range of accessories (auxiliary contacts, release coils) can be used to create countless system comfigurations. The main features of S800 PV-M switch-disconnectors are:

- interchangeable terminals
- contact status displayed for each individual pole
- no restrictions as to polarity or power direction in the wiring
- use of the rotary door operating handle

Main technical specifications		S800 PV-M
Reference Standards		IEC EN 60947-3
Rated current In	[A]	32, 63, 125
Number of poles		2, 4
Rated voltage Ue (d.c.) 2 poles* (d.c.) 4 poles*	 [V] [V]	 800 1200
Ultimate rated short-circuit breaking capacity Icu (d.c.) 600/800 V (2 poles) * (d.c.) 1200 V (4 poles) *	 [kA] [kA]	 1.5 1.5
Class of use		DC-21A
Operating temperature	[°C]	-25…+60
Mounting		on EN 60715 channel (35 mm) with a quick coupling device

Please refer to wiring diagrams*



Connection
Photovoltaic panel network in earth-insulated systems

Poles	Rated current In [A]	Description Type	Order code
2	32	S802PV-M32	2CCP812001R1329
2	63	S802PV-M63	2CCD842001R1590
2	125	S802PV-M125	2CCP812001R1849
4	32	S804PV-M32	2CCP814001R1329
4	63	S804PV-M63	2CCD844001R1590
4	125	S804PV-M125	2CCP814001R1849

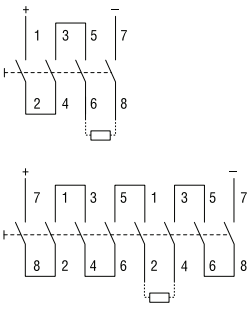
Isolators
OT



OT series disconnectors are available with 16 A to 125 A rated current values in 3, 4, 6 and 8 pole versions, depending on the direct current voltage used.
The main features of OT disconnectors are:
- quick make-break mechanism with independent tripping function (in the OT 45...125 versions).
- accessories that are snap-fitted on the circuit-breakers
- OT 45 ... 125 switch-disconnector mechanism for installation on DIN channel.
- can be locked with a locking adapter

Main technical specifications		OT		
Reference Standards		IEC EN 60947-3		
Rated current In	[A]	16, 25, 32		
Number of poles		4	6	8
Rated voltage Ue				
(d.c.) 4 poles*	[V]	500		
(d.c.) 6 poles*	[V]		550	
(d.c.) 8 poles*	[V]			800
Class of use		DC-21A		
Operating temperature	[°C]	-25…+60		
Mounting		on EN 60715 channel (35 mm) with a quick coupling device		

Please refer to wiring diagrams*



Circuit Diagram

Poles	Rated current In [A]	Rated current/ DC21 [A/V d.c.] voltage	Description Type	Order code
4	16	16/440	OT16F4N2	1SCA104829R1001
6	16	16/550	OT16F6	1SCA104834R1001
6	25	25/550	OT25F6	1SCA104880R1001
6	32	32/550	OT40F6	1SCA104936R1001
8	16	16/800	OT16F8	1SCA104836R1001
8	25	25/800	OT25F8	1SCA104882R1001
8	32	32/800	OT40F8	1SCA104938R1001

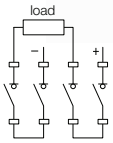
Switch-disconnectors
Tmax PV



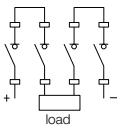
Tmax PV series disconnectors are available with up to 1600 A class DC-22B rated operating current values, for 1100 V d.c. maximum rated operating voltage. The switching devices of the Tmax PV series are the first box disconnectors for direct current high voltage available on the market. They are certainly of interest for use in any type of photovoltaic installation since they are ideal for all disconnecting requirements.
The main features of Tmax PV disconnectors are:

- Comprehensive range. There are 6 different sizes, from the compact T1 (which can be fixed to DIN channel) to T7, available in the two versions with operating lever and motor control
- Excellent performance-dimensions ratio
- Wide choice of accessories to suit every requirement

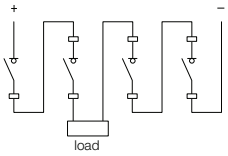
Main technical specifications		Tmax PV
Reference Standards		IEC EN 60947-3
Rated current In	[A]	160 - 1600
Number of poles		4
Rated voltage Ue	[Vd.c.]	1100
Rated insulation voltage Ui	[Vd.c.]	1150
Short time current Icw	[kA]	1.5 - 19.2
Class of use		DC-22B



Circuit Diagram
Valid for T1D PV, T3D PV, T6D PV, T7D PV,



Circuit Diagram
Valid for T4D PV, T5D PV



Circuit Diagram
Valid for all Tmax series

Poles	Ith	Operating current DC 22B [A/V d.c.]	Description Type	Order code
4	160	160/1100	T1D 160 PV	1SDA066881R1
4	250	200/1100	T3D 200 PV	1SDA066882R1
4	250	250/1100	T4D 250 PV	1SDA066883R1
4	630	500/1100	T5D 500 PV	1SDA066884R1
4	800	800/1100	T6D 800 PV	1SDA066885R1
4	1600	1600/1100	T7D 1600 PV	1SDA066886R1
4	1600	1600/1100	T7D 1600 PM	1SDA066887R1

Fuse disconnectors
E 90 PV



The E 90 PV series fuse disconnectors has been designed for up to 1000 V direct current voltage with DC-20B class of use. The E 90 PV series is specifically used for protecting photovoltaic systems against overcurrents and provides a reliable, compact and inexpensive solution since it uses 10.3 x 38 mm cylindrical fuses. The main features of E 90 PV fuse disconnectors are:

- Handle opening through 90° that allows the horizontal fuse to be easily inserted even when wearing gloves or using the thumb
- Only an additional 17 mm larger in the open position than in the closed position
- 25 mm2 terminals with knurled terminal cage to allow the cable to be clamped in a better way
- Fully compatible with electric screwdrivers
- Pozidrive screws for flat-head and cross-point screwdrivers
- Lockable in the open position using the padlocks commonly available on the market, so as to ensure safe maintenance work
- Can be sealed in the closed position to prevent improper use
- Cooling chambers and ventilation slits to facilitate heat dispersion
- Versions with indicator light are available

Main technical specifications		E 90/32 PV
Reference Standards		IEC EN 60947-3
Rated service voltage	[Vd.c.]	1000
Class of use		DC-20B
Fuse	[mm]	10 x 38
Type of current		d.c.
Rated current	[A]	32
IP Rating		IP20
Lockable (when open)		Yes
Sealable (when closed)		Yes

Poles	Rated current In [A]	Modules	Description Type	Order code
1	32	1	E 91/32 PV	2CSM204713R1801
1	32	1	E 91/32 PVs*	2CSM204693R1801
2	32	2	E 92/32 PV	2CSM204703R1801
2	32	2	E 92/32 PVs*	2CSM256913R1801

*s: version with LED for blown fuse indication

Surge arresters for DC
OVR PV



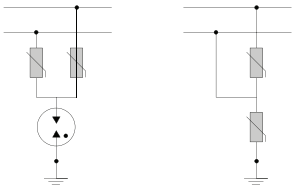


ABB provides a wide range of surge protection devices that have been specifically designed for photovoltaic systems.

The main features of the OVR PV surge arresters are:

- built-in thermal protection with 25 A d.c. breaking capacity*
- removable cartridges for easy maintenance with no need to isolate the line
- remote signalling contact for monitoring the operating status (TS versions)
- no subsequent short-circuit current
- no risk if the polarity is reversed

Main technical specifications		OVR PV
Electrical specifications		
Type of network		photovoltaic systems
Type		2
Response time	[ns]	25
Residual current	[mA]	< 1
Protection class		IP20
Built-in thermal protection		self-protected for up to 100 A d.c. short-circuit current
Back-up protection		
current Icc < 100A		not required
current Icc > 100A		10 A gR fuse
Mechanical specifications		
L/PE terminals		
rigid	[mm2]	2,5…25
flexible	[mm2]	2,5…16
Tightening torque L [	Nm]	2,80
Status indicator		yes
Remote signal contact		
Type		1 NA/NC
Minimum rating		12 V d.c. - 10 mA
Maximum rating		250 V a.c. - 1 A
Cable section	[mm2]	1,5
TS versions		
Operating temperature	[°C]	-40...+80
Storage temperature	[°C]	- 40...+80
Maximum altitude	[m]	2000
Housing material		PC RAL 7035
UL94 fire resistance		V0
Reference standards		IEC 61643-1 / EN 61643-11

I Max	Protection Level (L-L/L-PE) kV	Description Type	Order code
40A	2.8/1.4	OVR PV 40 600 P	2CTB803953R5300
	2.8/1.4	OVR PV 40 600 P TS	2CTB803953R5400
	3.8	OVR PV 40 1000 P	2CTB803953R6400

***Note:**
For surge protection device installed at points of the network where short circuit current exceeds 25A DC suitable protection must be provided

Enclosed switch disconnectors DC
OTP

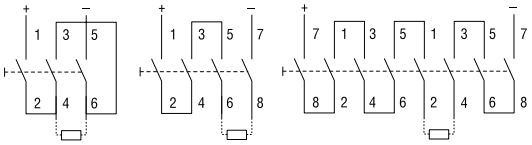




Plastic enclosed switch-disconnectors 3 - 4 - 8 pole IP65

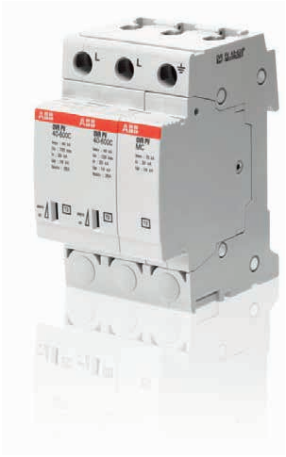
- IP65 rated
- Grey plastic enclosure
- Standard handle - Red/Yellow (padlockable in the off position)
- Cable entries top and bottom

1th [A]	No. Poles	Rated Operated Current/ voltage DC21-A[A]/[VDC]	Cable Outlets Side	Order Code
25	3	16/220	2xM20	OTP16BA3MS
	4	16/500	2xM25+M16	OTP16BA4MS
	8	16/800	2xM25+M16	OTP16BA8MS
32	3	32/220	2xM25+M16	OTP32BA3MS
	8	32/800	2xM25+M16	OTP32BA8MS



Circuit Diagram

Surge Arresters for AC
OVR T2



The OVR T2 protects inverters and installations from over voltages and impulse currents, such as switching and lighting surges. The device ensures the limitation of over voltage to an acceptable level for the equipment to be protected.

The device ha a remote signal control and removable cartridge for easy maintenance without needing to isolate the line.

These devices are available with a remote signal control and removable cartridge (...P TS) for easy maintenance without needing to isolate the line.

Main technical specifications	OVR T2
Rated operating voltage	230V and 400V AC
Poles	1, 2, 3, 4
Maximum discharge current	15, 40, 70kA
Residual current	< 1
Voltage protection level	1.2 .... 3.8kV
Standards	IEC 61643-1 IEC 61643-11

Network TT	I Max	Type	Order code
TT (3 + N)	25	OVR T1 3N 25 255 TS	2CTB815101R0700
TT (1 + N)	40	OVR T2 1N 40 275 SP TS	2CTB803952R0200
TT (3 + N)	70	OVR T2 3N 70 275 SP TS	2CTB803953R0100
TT (1 + N)	15	OVR T2 1N 15 275 P	2CTB803952R1200

Isolators for AC
E 200

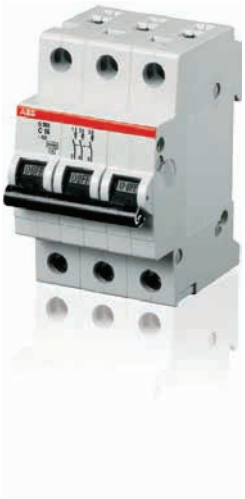


The isolator is used as a master switch on the AC side. It offers reliable and safe switching under load.
Ease of maintenance is guaranteed by the special fastening for easy removal of the device from its present installation. The wide range of accessories facilitates use of all applications.

Main technical specifications	E 200
Reference Standards	IEC 947-3
Rated operating voltage	230V/400V AC
Rated current	16 ... 125A

Poles	Nominal Current	Description Type	Order code
2	100	E202/100R	2CDE282001R0100
3	100	E203/100R	2CDE283001R0100
4	100	E204/100R	2CDE284001R0100

Miniature circuit breaker for AC
S 200M



The S200 M protect installations against overload and short circuit, ensuring reliability and safety for operations. They are selectively switchable, even under load, in the event of a fault or for maintenance purposes. The standstill times are minimised thanks to the devices' reclosing capability. These devices offer users confidence thanks to their 100% factory testing. The devices, with their wide range of accessories, are suitable for international use.

The S200 M are known for their ease of maintenance – thanks to a special type of fastening for easy removal of the device from its present installation. Supply is possible from above or below, also for busbars. Without busbars, two terminal sections can be used. The tripping behaviour caters to customer requirements (B, C, D, K, Z characteristics)

Main technical specifications		S 200M
Reference Standards		IEC 60898, IEC 60947-2 UL 489, UL 1077
Rated operating current	[Vd.c.]	0,5 … 63 A
Ultimate short-circuit breaking capacity		6, 10, 25 kA
Rated operating voltage	1-pole 2-4 pole	12 … 230 VAC 12 … 400 VAC

Rated current In [A]	Rated breaking capacity [kA]	Poles	Description Type	Order code
10	10kA	2	S202MC10	2CDS272001R0104
16			S202MC16	2CDS272001R0164
20			S202MC20	2CDS272001R0204
25			S202MC25	2CDS272001R0254
32			S202MC32	2CDS272001R0324
10		3	S203MC10	2CDS273001R0104
16			S203MC16	2CDS273001R0164
20			S203MC20	2CDS273001R0204
25			S203MC25	2CDS273001R0254
32			S203MC32	2CDS273001R0324
10		4	S204MC10	2CDS274001R0104
16			S204MC16	2CDS274001R0164
20			S204MC20	2CDS274001R0204
25			S204MC25	2CDS274001R0254
32			S204MC32	2CDS274001R0324

RCDs for AC
F200 PV-B



Residual current devices ensure protection of people and installations against fault current to earth and fire risks. An RCD B type is required on the AC side in case of lack of electrical separation between the AC and the DC side.
The devices save money and improve global efficiency by using PV connectors without an internal insulation transformer. The devices, with their wide range of accessories are suitable for international use.
The RCCBs F202 PV B and F204 B are intended for installation of single and three phase PV converters. they protect against fire risks and leakage currents.

Main technical specifications	F202 PV B, F204 B
Rated operating current	25, 40, 63, 125A
Rated sensitivity current	30, 300, 500mA
Rated operating voltage	230 … 400 VAC
Poles	2 ... 4
Type	B, B S (selective version)
Reference Standards	IEC/EN61008 IEC52423

Poles	A / mA	Description Type	Order code
2	40 / 300	F202-A-40/300mA	2CSF202121R3400
2	63 / 300	F202-A-63/300mA	2CSF202121R3630
4	40 / 300	F204-A-40/300mA	2CSF204121R3400
4	63 / 300	F204-A-63/300mA	2CSF204121R3630
4	63 /300	F204-B-63/300mA	2CSF204501R3630

Enclosed switch disconnectors AC
OTP





Plastic enclosed switch-disconnectors 3 - 4 pole IP65

- IP65 rated
- Grey plastic enclosure
- Standard handle - Red/Yellow (padlockable in the off position)
- Cable entries top and bottom

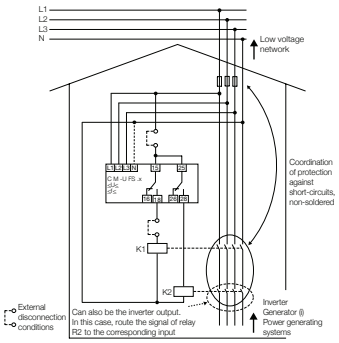
1th [A]	No. Poles	AC22	AC23	kW	Cable Outlets Side	Order Code
25	3	16	16	7.5	2xM20	OTP16BA3M
	4				2xM25+M16	OTP16BA4M
32	3	25	20	9	2xM25+M16	OTP25BA3M
	4				2xM25+M16	OTP25BA4M

Interface relay for connection to the power grid
CM-UFS



Even small distributed generating systems need to be connected to the power grid with guarantees as to completely safe operation, especially when the energy flow towards the network must be shut off for maintenance or if a fault occurs in the network itself. Rapid disconnection is essential if hazardous situations for the people who must work on the lines are to be avoided. This sort of protection can be achieved with an automatic monitoring device able to immediately detect faults in the network. The CM-UFS interface, which conforms to both the Italian ENEL Distribuzione Directive for connections to the electricity main and to German DIN V VDE 0126-1-1, answers to the need for safety for both the installations and the operators in the case of faults and malfunctions in the public power grid during parallel operation.
The main features of the CM-UFS interface relay are:

- Undervoltage protection
- Overvoltage protection
- Minimum frequency protection
- Maximum frequency protection
- Installation on DIN channel, dimension 22 mm
- Configurable connection for the neutral conductor
- 3 LED to indicate the operating status
- Power supply from the circuit under control
- Measurement of the true RMS value
- Can also be used for monitoring single-phase systems
- 2 switch contacts (SPDT)



Main technical specifications		CM-UFS.1
Maximum voltage	[Vn]	> 115 %
Minimum voltage	[Vn]	< 80 %
Maximum frequency	[Hz]	> 50.2
Minimum frequency	[Hz]	< 47.5
Mean value	[Vn]	10 minutes 110 to 115 % adjustable

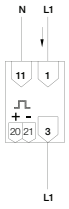
For markets where the German standard VDE is implemented

Main technical specifications		CM-UFS.2
Maximum voltage	[Vn]	> 120 %
Minimum voltage	[Vn]	< 80 %
Maximum frequency	[Hz]	> 50.3 or 51 upon the request of ENEL personnel
Minimum frequency	[Hz]	> 49.5 or 49 upon the request of ENEL personnel

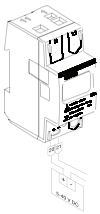
Description Type	Order code
Interface device (VDE Type-approved) CM-UFS.1	1SVR630736R0300
Interface device (ENEL Type-approved) CM-UFS.2	1SVR630736R1300

Modular energy meters
ODINsingle and DELTAplus





Direct connection



Pulse output

Modular energy meters are ideal for metering and monitoring the energy produced by a photovoltaic system. All the meters are tested and comply with the European MID directive, which allows the meters to be used whenever the energy readings must be used for payment quantification purposes. The terminal boards can be sealed so as to prevent the meter's programming functions from being accessed and to safeguard the inputs of the measuring signals.

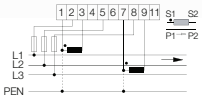
ODINsingle:

- Accuracy class B (1)
- MID certified for sub-billing purposes
- Direct connection in single-phase systems of up to 65 A
- OD1365 with pulse output
- OD1365 with re-setable register
- LCD display, excellent visibility in all lighting conditions
- Front LED for checking load

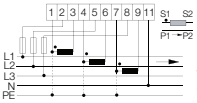


DELTAplus:

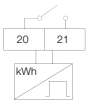
- Accuracy class B (1)
- MID certified for sub-billing purposes
- Connection by current and voltage transformers
- Active energy metering in three phase systems
- With programmable pulse output
- Electric parameters, voltage, current, power and frequency displayed
- Installation assessment: phase presence and sequence
- Front LED for checking load



Threephase system with neutral



Threephase system without neutral



Pulse output of active energy meters

Main technical specifications	ODINsingle	DELTAplus
Reference Standards	IEC EN 50470-1 IEC EN 50470-1	IEC EN 50470-3 IEC EN 50470-3
Voltage	230 V a.c.	3 x 57- 288 V (P+N) 3 x 100 - 500 V (P-P)
Max connection current	65 A	6 A
Start-up current	25 mA	2 mA
Frequency	50-60 Hz ± 5 %	50-60 Hz ± 5 %
Accuracy class	B (Class 1)	B (Class 1)

Poles	Description	Type	Order code
1 + N	65A Direct Class B	OD1065	2CMA131040R1000
1 + N	65A Direct with Reset	OD1365	2CMA131041R1000
3 + N	65A Direct Class A	OD4165	2CMA131024R1000
3 + N	80A Direct Class A	DBB23000	2CMA180800R1000
3 + N	80A Direct Class B	DBB13000	2CMA180801R1000
3 + N	80A Direct Class A	DBB22000	2CMA180802R1000

Enclosures
Europa Series



The Europa series wall-mounted consumer units feature IP65 protection which makes them ideal for installation outdoors. This means that they can be used for making string boxes on the load side of photovoltaic strings.
The main features of the Europa series wall-mounted consumer units:
- class II insulation
- manufactured in self-extinguishing thermoplastic material able to withstand abnormal heat and fire up to 650 °C (glow wire test) in compliance with IEC 60695-2-11 standards
- installation temperature: -25 °C to +60 °C
- rated insulation voltage: 1000 V a.c.; 1500 V d.c.
- shock resistance: 6 joules (IK 08 degrees)
- pull-out DIN channel holder frame for more convenient bench wiring. Can be disassembled (and re-assembled by means of a snap-fit mechanism) to make the individual wires easier to route
- 53, 68 and 75 mm depth switchgear can be installed
- models with 8 or more modules equipped with bi-metal and rigid flanges for easier insertion of pipes and cables
- consumer units in compliance with IEC 23-48, IEC 23-49 and IEC 60670 standards- IMQ Mark



Description	Dimensions	Order code
IP65 consumer unit P/smoke grey 4M	140 x 220 x 140	12744
IP65 consumer unit P/smoke grey 8M	205 x 220 x 140	12748
IP65 consumer unit P/smoke grey 12M	275 x 220 x 140	12752
IP65 consumer unit P/smoke grey 8M 1 row	380 x 220 x 140	12753
IP65 consumer unit P/smoke grey 24M 2 rows	275 x 370 x 140	12754
IP65 consumer unit P/smoke grey 36M 2 rows	380 x 370 x 140	12755

Cable gland		Nut		Dimensions mm		
Description	Order code	Description	Order code	Gauge	Min	Max
M12 cable gland with metric pitch	00 951	Nut for M12 cable gland	00 96	12 x 1.5	3.5	7
M16 cable gland with metric pitch	00 952	Nut for M16 cable gland	00 962	16 x 1.5	5.5	10

Junction boxes



ABB also provides IP65 polycarbonate junction boxes that are perfect for use in outdoor installations.
The main features of the junction boxes are:
- class II insulation
- manufactured in self-extinguishing thermoplastic material able to withstand abnormal heat and fire up to 960 °C (glow wire test) in compliance with IEC 60695-2-11 standards
- installation temperature: -25 °C to +60 °C
- rated insulation voltage: 1000 V a.c.; 1500 V d.c.
- shock resistance: 20 joules (IK 10 degrees)
- junction boxes in compliance with IEC 23-48 and IEC 60670 standards
- IMQ Mark

Description	Dimensions	Order code
Box IP65 PC	140 x 220 x 140	12804
	205 x 220 x 140	12808
	275 x 220 x 140	12812

Modular terminal blocks



ABB produces a complete range of modular terminal blocks, from the conventional screw-clamp and spring-clamp versions to the most technologically advanced self-stripping connection that provides a quick, safe and reliable connection (ADO) by means of a special tool. The screw-clamp or ADO (self-stripping technology) versions are more suitable for photovoltaic applications as they provide a more reliable long term connection.
Innovative and compact, ABB's new SNK series terminal blocks feature a modern design and can be supplied with countless accessories to suit the customers' requirements. They comply with all worldwide standards.

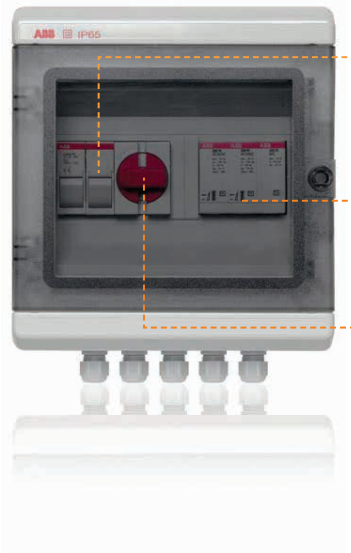
Main technical specifications			
Connection	New SNK series screw type	self-stripping type (ADO System)*	spring type
Voltage max	1000 V max	1000 V max	800 V
Current	max 232 A	max 32 A	max 125 A
Section	max 95 mm²	max 4 mm²	max 35 mm²
Conform to IEC 60947-7-1, IEC 60947-7-2 standards			
Parallel interconnections are available			
V0 self-extinguishing material			

*Also available in the ADO-screw version

Description Type	Application	Section	I [A]	V [V]	Order code
Screw-screw terminal block					
ZS4	F	4 mm²	32	1000	1SNK505010R0000
ZS6	F	6 mm²	41	1000	1SNK506010R0000
ZS10	F	10 mm²	57	1000	1SNK508010R0000
ZS4-BL	N	4 mm²	32	1000	1SNK505020R0000
ZS6-BL	N	6 mm²	41	1000	1SNK506020R0000
ZS10-BL	N	10 mm²	57	1000	1SNK508020R0000
ZS4-PE	PE	4 mm²	480A/1s		1SNK505150R0000
ZS6-PE	PE	6 mm²	720A/1s		1SNK506150R0000
ZS10-PE	PE	10 mm²	1200A/1s		1SNK508150R0000

Accessories	
End section	1SNK505910R0000
End stop	1SNK900001R0000
Circuit separator	1SNK900103R0000
Blank marker	1SNK149999R0000
Protective cover 5mm	1SNK900618R0000
Protective cover 6mm	1SNK900619R0000
Protective cover 8mm	1SNK900620R0000

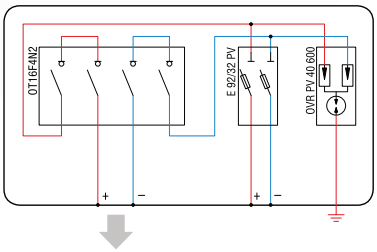
String boxes
1 string 16A 500V



Fuse Disconnectors E90 PV
E90 PV have been designed for up to 1000 V d.c. voltage values (class DC-20B) and are ideally used in photovoltaic systems to isolate the individual strings and protect them against short circuits.
All ABB string boxes are supplied with fuses as part of the standard equipment.

Surge Arresters OVR PV
All ABB string boxes are equipped with OVR PV series surge arresters specifically designed for photovoltaic applications. Only a specifically designed product can ensure that the cartridge functions properly until the end of its useful life, without the risk of short-circuits or dangerous polarity reversals.

Disconnectors OT
High-performance, readily available OT disconnectors stand out for their high voltage values and compliance with the most advanced international standards. They are an excellent choice for small systems both cost-wise and as to performance.



Note:
The following string boxes show options for 1, 2, 3 and 4 string.
Please consult us for other variations.

Direct current string boxes



One string 16 A 500 V

DC string box for string protection and isolation, consisting of:

– Europa series IP 65 wall-mounted 8-module consumer unit.
– disconnector OT 16 F4 N2
– surge arrester OVR PV 40 600 P
– fuse-disconnector E 92/32 PV 10.3 x 38 mm fuses – 1000 V d.c. 10 A
– 2.5 to 10 mm2 screw-clamp terminals (57 A) or above, for voltage up to 1000 V

Description	Dimensions (wxhxd mm)	Order code
DC string box 1str 16 A 500 V sd OT 16 F4 N2	205 x 220 x 140	1TVS151800S1991



One string 10 A 800 V

DC string box for string protection and isolation, consisting of:

– Europa series IP 65 wall-mounted 8-module consumer unit.
– miniature circuit-breaker S802 PV S10
– surge arrester OVR PV 40 1000 P
– 2.5 to 10 mm2 screw-clamp terminals (57 A) or above, for voltage up to 1000 V

Description	Dimensions (wxhxd mm)	Order code
DC string box 1str 10 A 800 V cd S802PV-S10	205 x 220 x 140	1TVS151800S1993

Direct current string boxes



Two strings 16 A 500 V

DC string box for string protection and isolation, consisting of:

– Europa series IP 65 wall-mounted 12-module consumer unit.
– disconnector OT 16 F4 N2
– surge arrester OVR PV 40 600 P
– fuse-disconnector E 92/32 PV 10.3 x 38 mm fuses – 1000 V d.c. 8 A
– 2.5 to 10 mm2 screw-clamp terminals (57 A) or above, for voltage up to 1000 V

Description	Dimensions (wxhxd mm)	Order code
DC string box 2str 16 A 500 V sd OT 16 F4 N2	275 x 220 x 140	1TVS151800S1995



Two strings 16 A 800 V

DC string box for string protection and isolation, consisting of:

– Europa series IP 65 wall-mounted 12-module consumer unit.
– miniature circuit-breaker S802 PV S16
– surge arrester OVR PV 40 1000 P
– 2.5 to 10 mm2 screw-clamp terminals (57 A) or above, for voltage up to 1000 V

Description	Dimensions (wxhxd mm)	Order code
DC string box 2str 16 A 800 V cb S802PV-S16	275 x 220 x 140	1TVS151800S1997

Direct current string boxes



Three strings 25 A 750 V

DC string box for string protection and isolation, consisting of:

– Europa series IP 65 wall-mounted 18-module consumer unit.
– disconnector OT 25 F8
– surge arrester OVR PV 40 1000 P
– fuse-disconnector E 92/32 PV 10.3 x 38 mm fuses – 1000 V d.c. 8 A
– 2.5 to 10 mm2 screw-clamp terminals (57 A) or above, for voltage up to 1000 V

Description	Dimensions (wxhxd mm)	Order code
DC string box 3str 25 A 750 V sd OT 25 F8	380 x 220 x 140	1TVS151800S1999



Three strings 32 A 800 V

DC string box for string protection and isolation, consisting of:

– Europa series IP 65 wall-mounted 18-module consumer unit.
– miniature circuit-breaker S802 PV-S32
– surge arrester OVR PV 40 1000 P
– fuse-disconnector E 92/32 PV 10.3 x 38 mm fuses – 1000 V d.c. 10 A
  4A gR fuses for protecting OVR surge arrester
– 2.5 to 10 mm2 screw-clamp terminals (57 A) or above, for voltage up to 1000 V

Description	Dimensions (wxhxd mm)	Order code
DC string box 3str 32 A 800 V cb S802PV-S32	380 x 220 x 140	1TVS151800S2001



Four strings 32 A 750 V

DC string box for string protection and isolation, consisting of:

– Europa series IP 65 wall-mounted 36-module consumer unit.
– disconnector OT 40 F8
– surge arrester OVR PV 40 1000 P
– fuse-disconnector E 92/32 PV 10.3 x 38 mm fuses – 1000 V d.c. 10 A
  4A gR fuses for protecting OVR surge arrester
– 2.5 to 10 mm2 screw-clamp terminals (57 A) or above, for voltage up to 1000 V

Description	Dimensions (wxhxd mm)	Order code
DC string box 4str 32 A 750 V sd OT 40 F8	380 x 370 x 140	1TVS151800S2003

Technical literature

Installation Equipment



2CSC400002D0208

MCCBs



1SDC210015D0204

Switch Disconnectors



1SCC301001C0201

SNK Series



1SNK161001C0201

5000 Series



1SNC160001C0207

Interface CM-UFS



1SDC112001L0901

Gemini Series



1SLC805001D0906

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AQUAFIX MILIEU®
WWW.AQUAFIX.NL
AQUAFIX MILIEU B.V.
Genieweg 20, 3641 RH Mijdrecht
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info@aquafix.nl
Rabobank nr. 35.18.50.600
IBAN: NL 42RABO0351850600
BIC: RABONL2U
KvK Utrecht nr. 301.40753
BTW nr. NL.80.629.0213.B01
DÉ FABRIKANT VAN HET KRONINGSDEKSEL

OFFERTE	
Project	Prêt-à-Loger
Ons kenmerk	NVo102214
Rayon	2/ZH
Relatienummer	
Offerte datum	4 april 2014

Solar Decathlon Team TU Delft
T.a.v. heer T. Jonathan
Stevinweg 1
NL-2628 CN DELFT

Tel. 06-19193421
Email partners@pretaloger.nl

Geachte heer Jonathan,

Hierbij hebben wij het genoegen u geheel vrijblijvend, **op uw aangeven,** het volgende aan te bieden:

1 st. OPSLAGTANK, materiaal PE.

Artikelnummer:	718.0450.0208
Type:	**Hori** model C
Inhoud:	750 liter.
Materiaal:	Hoogwaardig polyethyleen.
Afdekking:	Voorzien van een kunststof schroefdeksel met opening Ø 300 mm.
Aansluiting:	Onder aansluiting 1 x 1 ½" + 1 x 1"
L x B x H (uitwendig):	1580 x 750 x 840 mm.
Geschikt voor:	Bovengrondse opstelling
Prijs	**per stuk € 399,00**

1 st. REGENWATER OPSLAGTANK, materiaal HDPE.

Materiaal:	Hoogwaardig HDPE
Afdekking	Voorzien van een kunststof schroefdeksel met opening Ø 300 mm.
Aansluitingen in / uit:	Ø 50 mm.
L x B x H (uitwendig):	2500 x 2000 x 400 mm.
Geschikt voor:	Bovengrondse opstelling
Prijs	**per stuk € 2.699,00**

1 st. ZELFAANZUIGENDE POMP, materiaal RVS.

Artikelnummer:	740.108.60
Type:	ASPRI 15-3 + KIT02
Omschrijving:	Zelfaanzuigende, onderhoudsvrije, meertraps, horizontale centrifugaalpomp speciaal voor regenwatergebruik ontwikkeld. Zuigzijde 1/Perszijde 1
Materiaal:	Pomphuis RVS Aisi 304, Waaier RVS Aisi-420, Zuig en pershuis van Messing.
Technische gegevens pomp:	Motor: 0,6 kW (P1) - 50 Hz - 230V - Toerental 2900 T/m.
Capaciteit pomp:	Capaciteit maximaal: 3,5 m3/h Opvoerhoogte 33 m.w.k. Maximale hoogte 15 m.w.k.(max. druk 10 bar)
Drukbesturing:	Drukbesturing KIT-02, een speciaal voor regenwatergebruik ontwikkelde pompbesturing. Met geïntegreerde waterslagdemper, drukbesturing, manometer en droogloopbeveiliging.
Prijs	**per stuk € 799,00**

AQUAFIX MILIEU B.V.
Genieweg 20, 3641 RH Mijdrecht
Postbus 288, 3640 AG Mijdrecht
Tel. 0297 26 29 29 Fax 0297 26 12 72
info@aquafix.nl
Rabobank nr. 35.18.50.600
IBAN: NL 42RABO0351850600
BIC: RABONL2U
KvK Utrecht nr. 301.40753
BTW nr. NL.80.629.0213.B01

Vervolg offerte NVo102214 AQUAFIX MILIEU:

1 st. **BETONNEN PUTRAND MET GIETIJZEREN <u>KRONINGSDEKSEL.</u>**

Type	-	525.7400.170 / 240
Materiaal putrand	-	Gewapend beton B45 en inlegrand van gietijzer.
Deksels	-	**Gietijzer kroningsdeksel <u>met goudkleurig kroontje</u>** verkeersklasse D. 400 kN.
Onderhoudsschacht	-	1 stuks.
Hoogte	-	170 / 240 mm.
Diameter mangat	-	520 mm.
L x B (uitwendig)	-	740 x 740 mm.
Gewicht	-	Totaal ca. 182 Kg.

Prijs putrand. | Prijs per stuk €uro 179,90

<u>Optioneel</u>: fundatieplaat 900 x 900 x 200 mm. | Prijs per stuk €uro 79,95

Levertijd:	In overleg. Normaal ca. 5 tot 8 werkdagen na opdracht.
Levering:	● Franco Nederland, behalve de Waddeneilanden ● Gelost naast de wagen, gelost tot 5.000 kg. ● Levering per gecombineerd transport. ● Bij orders onder een netto orderbedrag van EUR 750,- berekenen wij vrachttoeslag
Prijzen:	Netto in euro's, exclusief 21% BTW.
Betaling:	In overleg.
Prijzen geldig tot:	Één maand na offertedatum.

Op al onze offertes en leveringen zijn onze algemene levering- en betalingsvoorwaarden van toepassing. Deze kunt u gratis bij ons opvragen. Op uw verzoek kunnen wij voor onze afscheiders ook capaciteitsberekeningen maken volgens de euronorm. Offerte: exclusief teken- en berekenwerk en de eventueel hieruit voortvloeiende constructiewijzigingen. Eventuele hijsvoorzieningen worden onder statiegeld meegeleverd. Al onze producten dienen conform onze inbouwvoorschriften te worden ingebouwd en verwerkt.

Heeft u na het lezen van deze offerte toch nog vragen? Dan kunt u te allen tijde contact met ons opnemen, wij zijn gaarne bereid uw vragen te beantwoorden.

Hopende u hiermee voldoende te hebben geïnformeerd,

Met vriendelijke groeten,

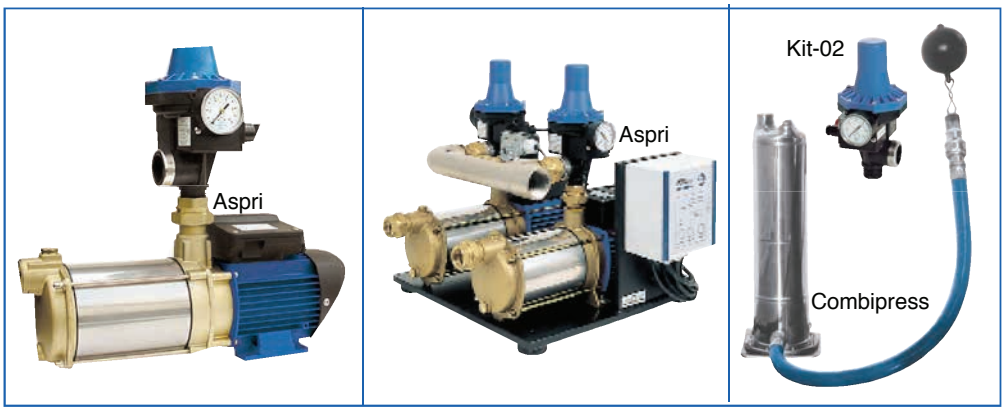
AQUAFIX MILIEU BV
Nathalie Vos

De AQUAFIX vertegenwoordiger in uw regio:
Hans Stam
Tel.: 06-20614995

AQUAFIX MILIEU®

AQUAFIX MILIEU B.V. Postbus 288 3640 AG MIJDRECHT Tel.: 0297-262929 Fax: 0297-261272

ASPRI/COMBIPRESS POMPEN



AQUAFIX ASPRI 15-3/15-4 & 25-3/25-4 inclusief Kit-02:
Zelfaanzuigende, onderhoudsvrije, meertraps. horizontale centrifugaalpomp. Speciaal voor regenwaterhergebruik ontwikkeld.
De voordelen van de ASPRI pomp:

- Zeer stille werking en zelfaanzuigend tot 8 meter.
- Hoge bedrijfszekerheid.
- Volledig corrosiebestendig.
- Zelfaanzuigend.
- Levering inclusief: manometer, droogloopbeveiliging & besturingskit.

Materiaal:
Pomphuis van RVS Aisi304, waaiers van RVS Aisi420, zuig- en pershuis van messing, asafdichting van keramiek, leiwiel van noryl, motorhuis van lichtmetaal L-2521, besturingshuis van polypropyleen (PP).

Motor:
Electrische kortsluitankermotor 230V/50Hz, beschermings klasse IP55, isolatieklasse F, voor continue bedrijf, eenfase met geïntegreerde thermische beveiliging.

Pomptype	15-3	15-4	25-3	25-4	20-5
M³/h	3,5	3,5	6,5	7,0	4,5
opvoer mwk	33	44	35	45	68
Druk pd	tot 10 bar				
Max hoogte	15	20	15	20	20
kW (P1)	0,6	0,8	1,2	1,4	1,4
Amperage	2,7	3,5	5,5	6,8	6,7
Gewicht (kg)	10,5	11,3	13,6	14,7	17,5

AQUAFIX Combipress 5-40 & 5-60 inclusief Kit-02:
Compleet drukdompelpompsysteem t.b.v. onderwateropstel ling. Speciaal voor regenwaterhergebruik ontwikkeld.
De voordelen van de Combipress pomp:

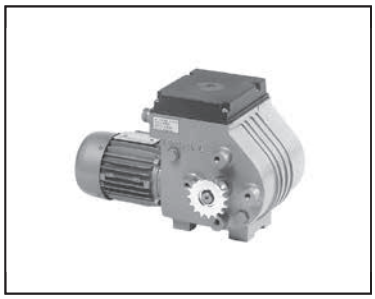
- Speciaal geschikt voor de TEA/TEO systeembesturing.
- Extra brede voet voor horizontale plaatsing.
- Dompelpomp voorzien van 15 meter kabel.
- Opstelling in de bufferput i.p.v. binnenshuis.
- Leve ring inclusief: drukbesturing Kit-02, wandhouder t.b.v. Kit-02, drijvende aanzuigleiding Twist met 1 m slang.

Materiaal:
Pomphuis van RVS Aisi304, waaiers van RVS Aisi304, dub bele asafdichting van silicum-karbonaat en aluminium oxide/keramiek in oliegevulde kamer, leiwiel van noryl, besturingshuis van polypropyleen (PP), slang van bacterie remmend thermoplast, zuigkorf en slangklemmen van RVS.

Motor:
Mantelgekoelde kortsluitankermotor 230V/50Hz, bescher- mingsklasse IP68, isolatieklasse F, voor continue bedrijf, eenfase met geïntegreerde thermische beveiliging.

Pomptype	5-40	5-60
M³/h	4,8	4,8
opvoer mwk	42	58
Druk pd	tot 10 bar	
Max hoogte	15	20
kW (P1)	0,94	1,12
Amperage	4,4	5,2
Gewicht (kg)	16,7	17,0

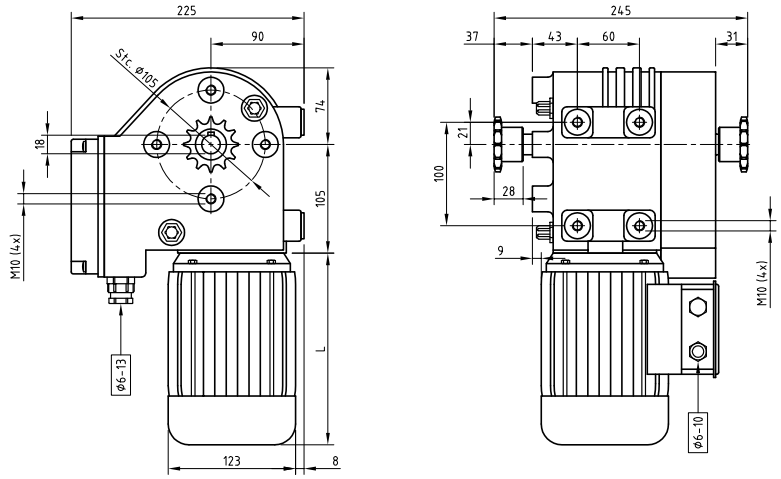
Maten in millimeters, gewichten in Kilogrammen, wijzigingen in afbeeldingen, maatvoeringen en omschrijving voorbehouden. Plaatsing, installatie en gebruik conform onze voorschriften.



De GW10, met kettingkoppelingen op de uitgaande as, wordt onder andere toegepast als aandrijving van luchtings- of schermingssystemen.

Standaard is de GW10 voorzien van een kettingkoppelingset met een duplex ketting volgens DIN kettingnummer 08B-2 of 10B-2. Het laskettingwiel is leverbaar voor aandrijfbuis 1" (08B-2), 5/4" of 2" (beide 10B-2). Voor de bevestiging van de motorreductor kan uit de zij- of voetmontage worden gekozen. De beschermingsklasse, volgens de norm EN60529, van de elektromotor is IP55.

Als optie kan de GW10 worden uitgerust met een buis-boutkettingkoppelingset voor aandrijfbuizen 1" of 5/4".
Elektromotoren met afwijkende spanningen en/of frequenties of een hogere beschermingsklasse, bijvoorbeeld tropenwikkeling, kunnen op aanvraag worden geleverd.

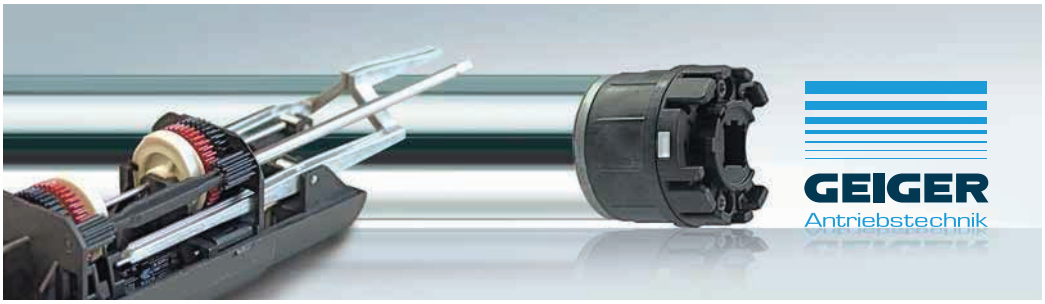


Omschrijving	T [Nm]	50Hz P [kW]	U [V]	I [A]	n [tpm]	60Hz P [kW]	U [V]	I [A]	n [tpm]	L [mm]	m [kg]
GW10-1.3, 400V, 3~	100	0,09	230/400	0,9/0,5	1,3	0,09	255/440	0,9/0,5	1,6	185	20
GW10-2.6, 400V, 3~	100	0,09	230/400	0,7/0,4	2,6	0,10	255/440	0,7/0,4	3,1	168	20
GW10-5.2, 400V, 3~	100	0,18	230/400	1,0/0,6	5,2	0,21	255/440	1,0/0,6	6,3	185	23
GW10-1.3, 230V, 1~	100	0,09	230	1,2	1,3	-	-	-	-	185	20
GW10-2.6, 230V, 1~	100	0,18	230	1,6	2,6	-	-	-	-	185	23
GW10-5.2, 230V, 1~	100	0,18	230	1,5	5,2	-	-	-	-	185	23

De Gier B.V., Westlandseweg 9, 2291 PG WATERINGEN, THE NETHERLANDS, Tel. +31 (0)174 292089, Fax +31 (0)174 295644, E-mail: sales@degier.nl
www.degier.eu
Versie 1 maart 2012

In onderstaande tabel staan de artikelnummers van de GW10-motorreductoren, afhankelijk van de aandrijfbuis en de standaard meegeleverde kettingkoppelingset, inclusief ketting en laskettingwiel.

Omschrijving	DIN kettingnummer	Aantal tanden kettingwiel	Aandrijfbuis	Artikelnummer
GW10-1.3, 400V, 3~	08B-2	12	1”	P.GW10.400.13.K100
GW10-1.3, 400V, 3~	10B-2	16	5/4”	P.GW10.400.13.K125
GW10-1.3, 400V, 3~	10B-2	16	2”	P.GW10.400.13.K200
GW10-2.6, 400V, 3~	08B-2	12	1”	P.GW10.400.26.K100
GW10-2.6, 400V, 3~	10B-2	16	5/4”	P.GW10.400.26.K125
GW10-2.6, 400V, 3~	10B-2	16	2”	P.GW10.400.26.K200
GW10-5.2, 400V, 3~	08B-2	12	1”	P.GW10.400.52.K100
GW10-5.2, 400V, 3~	10B-2	16	5/4”	P.GW10.400.52.K125
GW10-5.2, 400V, 3~	10B-2	16	2”	P.GW10.400.52.K200
GW10-1.3, 230V, 1~	08B-2	12	1”	P.GW10.230.13.K100
GW10-1.3, 230V, 1~	10B-2	16	5/4”	P.GW10.230.13.K125
GW10-1.3, 230V, 1~	10B-2	16	2”	P.GW10.230.13.K200
GW10-2.6, 230V, 1~	08B-2	12	1”	P.GW10.230.26.K100
GW10-2.6, 230V, 1~	10B-2	16	5/4”	P.GW10.230.26.K125
GW10-2.6, 230V, 1~	10B-2	16	2”	P.GW10.230.26.K200
GW10-5.2, 230V, 1~	08B-2	12	1”	P.GW10.230.52.K100
GW10-5.2, 230V, 1~	10B-2	16	5/4”	P.GW10.230.52.K125
GW10-5.2, 230V, 1~	10B-2	16	2”	P.GW10.230.52.K200



Product Data Sheet

GEIGER-SOLIDline Touch –

A new dimension in the mechanical end stop

Introduction

The mechanical end stop Touch opens up new dimensions with regard to the commissioning of sun protection systems. The well-known and proven GEIGER two-button technology has been further simplified. Only one button to complete the adjustment:

THE GEIGER 1- BUTTON TECHNOLOGY

Problem and Solution

Assembly Efficiency

PROBLEM:	SOLUTION:
The adjustment of the mechanical end stops just takes too long and is not accurate enough. Again and again the final positions have to be adjusted until the fit is perfect. Frequent testing of the final positions can lead to overheating of the motor.	The **GEIGER SOLIDline Touch** ensures an extremely fast and accurate programming without special tools or setting cable: this saves assembly time and money.

Easy adjustment even in hard-to-reach areas

PROBLEM:	SOLUTION:
The adjustment of a front-mounted shutter in the upper levels is quite a dangerous undertaking without scaffolding. The setting of the lower end position is almost impossible.	The **GEIGER SOLIDline Touch** minimizes the risk considerably. Indeed, it is very easy to actuate the setting button from the inside of the building – when the hanging is extended .

Protection of the sun protection system

PROBLEM:	SOLUTION:
Inaccurate shutdowns set the hanging under permanent tensile stress. The initial end position accuracy can no longer be guaranteed which means that the end positions have to be readjusted and that is as complex as the start-up.	The **GEIGER SOLIDline Touch** has an extremely high positioning accuracy thus avoiding unnecessary strain on the hanging.

Contents

Introduction 1
Problem and Solution 1
The mechanical end stop Touch 2
Motor series SOLIDline 3
Technical Data 4

GEIGER
Antriebstechnik

Made by GEIGER

GEIGER relies on Germany as production location: the **GEIGER-SOLIDline**, like all GEIGER motors, are developed and produced in Germany. This situation allows an optimal combination of R & D, manufacturing processes and quality management.

Our clients benefit from

- low noise motors
- low energy consumption, a big plus factor today
- low heating of the engine which means a longer period of time for adjustment purposes
- high quality radio system

100 % MADE BY GEIGER MADE IN GERMANY

All from one source

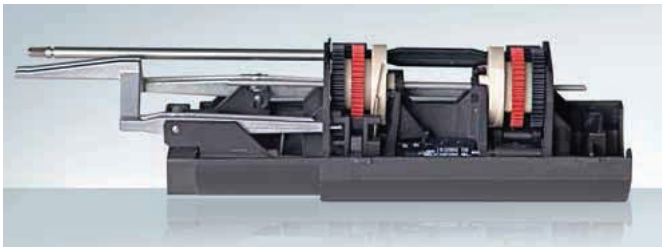
PROBLEM:	SOLUTION:
When motors and accessories come from different manufacturers, assembly problems, operational malfunction or even damage might be resulting in individual cases.	We will provide you on request with the GEIGER anti-lift device and the different controls especially adapted to the **GEIGER SOLIDline Touch**.

The mechanical end stop Touch

Development objective

Our goal was clearly defined: the mechanical end stop Touch should combine all the advantages of our **Venetian blind motor GJ56..** and our **motor for rolling shutters MODULARline** and make it even better!

The goal was achieved with the SOLIDline Touch.



Mechanical end stop

The **SOLIDline Touch** end stop consists of a counter with adjustable end positions. The adjustment range between the upper and the lower end position consists of 38 rotations and is thus suitable for big-size curtains.

Drive and shutdown are not mechanically connected. Thus no load from the drive is transmitted to the end stop. The setting of both end positions is achieved with only one button on the motor head.

Application range

The **SOLIDline Touch** is operational in all classical sun protection areas.

Best suited applications:

- **Rolling shutters either built-in, front-mounted or top mounted**
- **Facade awnings, vertical awnings and window awnings**
- **Open style folding arm awnings and semi cassette awnings**

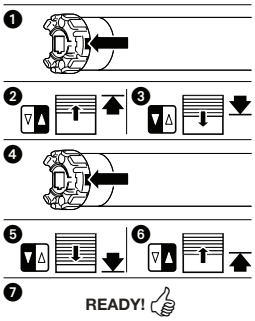
Burglar resistant

The **SOLIDline Touch** provides a high degree of safety in connection with the GEIGER anti-lift devices. It is very easy to adjust the end stops together with the anti-lift device (please note: there is no automatic torque shutdown).

Learning the end positions

The learning is quite simple and can begin either with the upper or lower end position:

1. Move the hanging in a middle position. Push deeply the setting button on the motor head.
2. Move up the hanging to the upper end position.
3. Return to a middle position (at least one rotation or 5 seconds away from the 1st final position.
4. Press again the setting button.
5. Move down the hanging to the lower end position.
6. Go back to a middle position.
7. Ready!



The **SOLIDline Touch** installation requires no special tools or setting cable. A screwdriver or a ball point pen will do.

For a cost-effective production of sun protection systems, the preadjustment of the upper end position can be made in your factory. The setting/changing of just one end position is possible at any time.


Adjustment without special tools


SOLIDline-KS


SOLIDline-COM


SOLIDline-SIC


SOLIDline-SOC

Motor series SOLIDline

The **GEIGER SOLIDline** motors have been developed for the specific needs of the sun protection industry and the craft trade. The motor is characterized by:

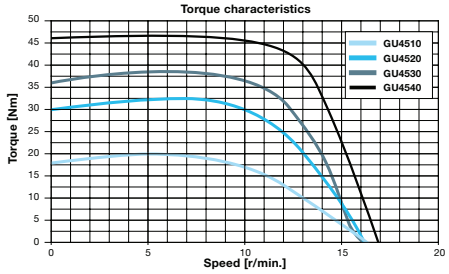
- **Low noise emissions and extremely smooth operation**
- **Low power consumption and reduced operating costs**
- **Long service life and high reliability**

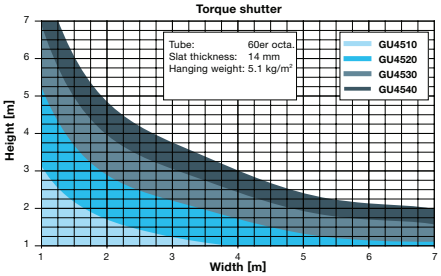
SOLIDline Motor Heads

All **SOLIDline Touch** motors are available with four different motor heads:

- The extremely narrow **KS-motor head** made of plastic is best suited for all GEIGER fixing systems in order to provide quick and easy assembly/disassembly with low space requirement.
- The extremely thin **COM-motor head** offers the possibility to optimize the fabric width for screens and facade awnings. The sun protection system can be designed independently from the selected drive. Light slots should be minimized or avoided altogether – as in ZIP screens.
- Both motor heads **SIC** and **SOC** are optimally designed for installation with fixation systems with stay bolts (**SIC**) or star shaped (**SOC**). The motor heads are universally applicable in the rolling shutter area also together with traditional fastening systems.

Technical Data





Specifications series GEIGER SOLIDline (GU45..)	GU4510	GU4520	GU4530	GU4540
Voltage	230 V~/50 Hz	230 V~/50 Hz	230 V~/50 Hz	230 V~/50 Hz
Current	0,47 A	0,63 A	0,8 A	1,0 A
Cos Phi (cosφ)	>0,95	>0,95	>0,95	>0,95
Inrush current (factor)	x 1,2	x 1,2	x 1,2	x 1,2
Power	105 W	140 W	180 W	220 W
Torque	10 Nm	20 Nm	30 Nm	40 Nm
Speed of rotation	16 1/min	16 1/min	16 1/min	16 1/min
Protection type	IP 44	IP 44	IP 44	IP 44
Total length [1]	515,5 mm	545,5 mm	565,5 mm	585,5 mm
Operating type	S2 4 min	S2 5 min	S2 4 min	S2 4 min
Diameter	45 mm	45 mm	45 mm	45 mm
Weight	approx. 1,9 kg	approx. 2,2 kg	approx. 2,4 kg	approx. 2,7 kg

[1] **SOLIDline-ZN** / **SOLIDline-KS**: +1 mm / **SOLIDline-COM** and **-SIC**: + 4,5 mm / **SOLIDline-SOC**: + 4 mm

Subject to technical modifications





The name GEIGER Antriebstechnik is synonymous worldwide for drive solutions in the sun protection area.

Today we are with more than 300 employees one of the leading manufacturers of mechanical and electrical drives for Venetian blinds, awnings and rolling shutters.

GEIGER is a well-known, mid-sized company which offers worldwide drive components for the sun protection systems.

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Fax +49 (0) 71 42 / 938-230
www.geiger-antriebstechnik.de
info@geiger-antriebstechnik.de

100W0571 en 0811

Van Dorp Energie
De heer P. van Dorp
Koraalrood 161
2718 SB Zoetermeer

Onze referentie	122752a
Behandeld door	Walter van Kampen
Algemeen	0548 – 374 374
E-mail	wvankampen@ocg.eu
Verkoper	van Kampen, Walter
Mob. Verkoper	+31 6 43 87 41 09
Datum	18 februari 2014

Betreft: Offerte DCC-90 woonhuisverkoeler voor Solar Decathlon Europe

Geachte heer van Dorp,

U ontvangt hierbij onze offerte voor de levering van onderstaande producten en diensten ten behoeve van uw project Solar Decathlon Europe. Een en ander per e-mail besproken met de heer Hardik Joshi

1 Stuks DCC-90 woningverkoeler met 90 stuks PCM 198 mm panelen afgevuld met PCM 23.

Deze DCC-90 is geschikt voor montage in een de luchttoevoer van een kanalensysteem in combinatie met een 350 m3/h HR-WTW unit een en ander conform bijlage.

Tabel 1: DCC-woningverkoeler		
Ventilatiedebiet	m^3/h	350
Ontwerptemperatuur	Celsius	28
Voelbare koelcapaciteit	Wh	5530
Berekend debiet per paneel	m3/h.per paneel	4,0
Toegepast PCM	Soort	PCM 23
Aantal PCM 198 mm panelen	Stuks	90
COP	-	
Gewicht	Kg	Ca. 175
Afmetingen (lxbxh)	mm	tekening
Luchtzijdige aansluiting	mm	tekening
Opstelling	-	Grond op fundatie
Isolatie	Soort	PU 6 mm
Luchtzijdige weerstand	Pa	30

Wij vertrouwen erop u hiermede een passend voorstel hebben toen toekomen en wij vernemen graag uw reactie op ons voorstel.

Met vriendelijke groeten,
Orange Climate Group Autarkis

M. van Kempen
Directeur OCG Autarkis

Bijlagen : Tekening DCC-90, principe werking DCC

1 Leveringsomvang

Hierbij onze opgave voor de levering van de volgende compomenten:

Een woonhuisverkoeler type DCC 90, conform omschreven specificaties
uit tabel 1.

De totaal prijs hiervoor bedraagt per stuk Euro 2.600,00

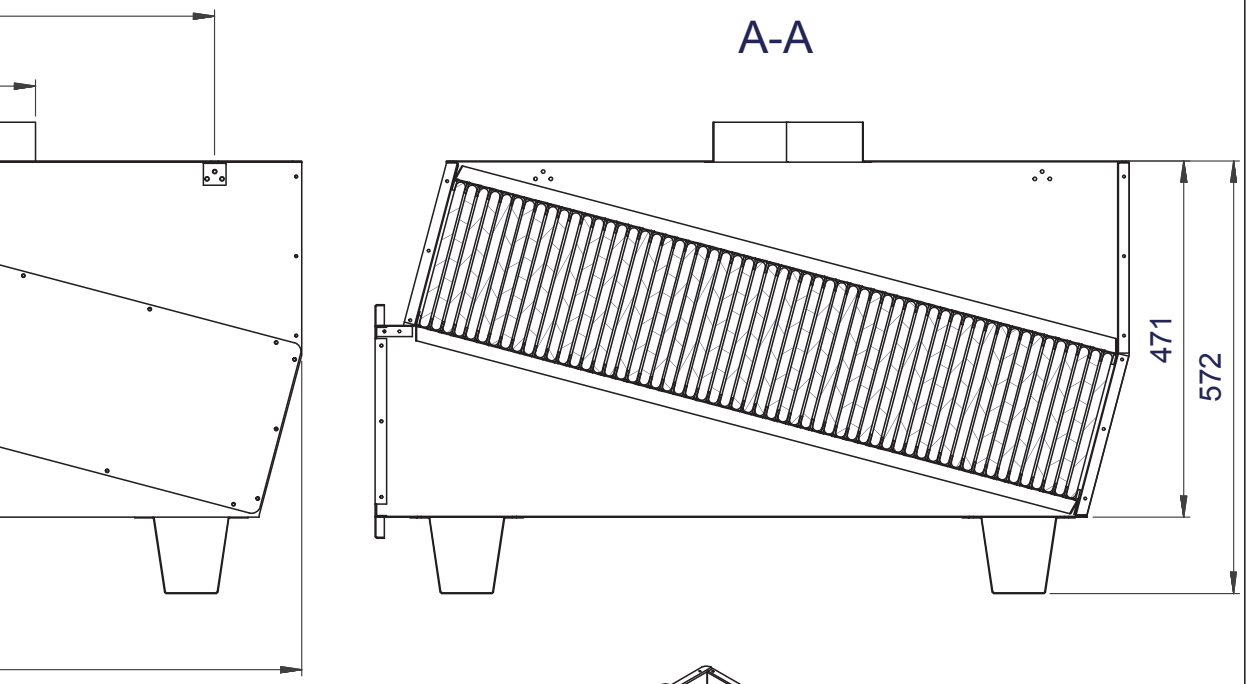
Let op : naar aanleiding van een gesprek met Dirk Jan Peters is de regeltechniek niet meer in de unit opgenomen. Het plaatsen van voelers kan door VDE / VDI zelf gebeuren vanuit de centrale woningregeling. Dit bespaart kosten en onnodige veldapparatuur,

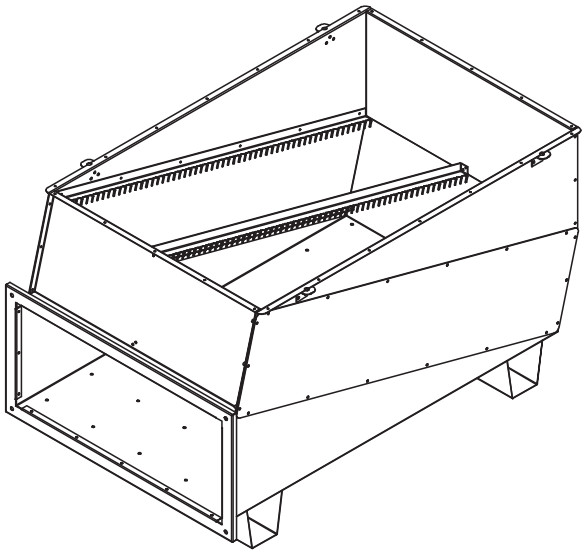
2. Algemene condities

Prijsstelling	Alle in deze offerte genoemde bedragen zijn exclusief BTW. en excl. Verwijderingsbijdrage (van toepassing vanaf 1 september 2005) Uitgangspunt bij de voor het gehele project, zoals dit in deze aanbieding tot uitdrukking is gebracht. In geval deelopdrachten worden verstrekt, of de uitvoering van het project wordt uitgesteld of in gedeelten plaatsvind herziening van prijzen plaatsvinden.
Levering	DDP, conform INCOTERMS 2000 (Franco, niet afgeladen op een door u aan te geven adres in Nederland, uitgezonderd de Waddeneilanden)
Levertijd	In overleg.
Geldigheidsduur offerte	3 maanden na datum dagtekening
Garantiecondities	Op de door OCG geleverde producten geldt een garantietermijn van 12 maanden na levering.
Betalingsschema	Voor dit project stellen wij het volgende betalingsschema voor: ▪ 50% bij opdracht, per ommegaande ▪ 40% voor levering op rekening ▪ 10% na levering, binnen 30 dagen
Opslagkosten	Indien, op uw verzoek, goederen in opslag dienen te worden genomen zullen de kosten aan u worden doorberekend
Betalingstermijn	De factuur dient binnen 30 dagen betaald te zijn (tenzij anders overeengekomen)
Algemene Leveringsvoorwaarden	Op deze offerte zijn de Metaalunie leveringsvoorwaarden van kracht. Deze voorwaarden kunt u downloaden van onze website. Levering op rekening is onder voorwaarde van goedkeuring door onze afdeling debiteurenmanagement. Indien op uw verzoek de aflevering binnen 3 weken voor de overeengekomen leverdatum wordt uitgesteld behouden wij ons het recht voor om op deze datum toch te factureren.



A-A





Benaming

PCM verkoeler voor woonhuizen

Klant	Eenheid (mm)
Materiaal	Getekend
ORANGE CLIMATE GROUP AUTARKIS	Datum
Projectie	Gewijzigd
	Gewijzigd
	Gewijzigd
Deze tekening is eigendom van Waterloo B.V. ©	Gewijzigd

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7451 PK Holten
TEL: +31 (0)548 374374
FAX: +31 (0)548 364165
www.waterloo.nl

Maattolerantie: NEN-ISO-2768-MK

Formaat	Tekeningnummer
A3	**50073-44**

ORANGE CLIMATE GROUP
AUTARKIS

DOMESTIC CRYSTAL COOLER (DCC): EEN PCM VERKOELER VOOR WOONHUIZEN

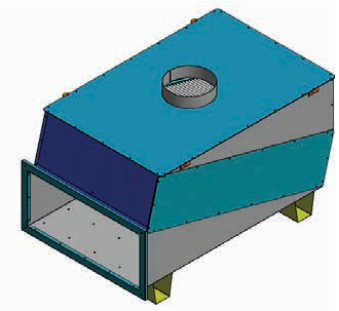
De Domestic Crystal Cooler is een PCM oplossing speciaal ontworpen voor het energiezuinig verkoelen en op temperatuur houden van (goed geïsoleerde) woonhuizen, zowel nieuwbouw als renovatie. De DCC is een ventilatiebox welke is voorzien van een samengestelde gepatenteerde warmtewisselaar opgebouwd uit onze Crystal Storage Panels en stevig sendzimir verzinkt plaat materiaal, geïsoleerd met PU schuim. Door de DCC te integreren in een (bestaande) ventilatie installatie in combinatie met een ventilatie unit voorzien van hoog rendement warmteterugwinning en een bypass, worden woningen in alle seizoenen van een constantere en aangenamere temperatuur voorzien. Hierdoor wordt automatisch bespaart op de energiekosten voor het verwarmen van de woning en wordt de woning "gratis" gekoeld. De DCC kan op de grond worden opgesteld, maar ook worden opgehangen.

Enkele kenmerken van de DCC:

- Speciaal voor het verkoelen van een woning.
- PCM warmtewisselaar voor binnen opstelling.
- Diverse soorten PCM's zijn toepasbaar in onze panelen.
- Dient te worden geïntegreerd in een ventilatie installatie.
- Geen draaiende of slijtende onderdelen.
- Verbruikt geen elektrische energie; COP=100.
- Het standaard toegepaste fase-overgangsmateriaal is niet toxisch en niet brandbaar.
- Fase-overgangsmaterialen vallen onder de subsidieregeling EIA nummer 210405.

DCC		
Ventilatiedebiet	m^3/h	300
Ontwerptemperatuur	Celcius	28
Voelbare koelcapaciteit	Wh	3120
Gemiddeld Voelbaar koelvermogen	W	260
Maximaal voelbaar koelvermogen	W	500
COP	-	100
Gewicht	Kg	90
Elektrische aansluiting*)	V/ph/Hz	230/1/50
Afmetingen (lxbxh)	mm	997x637x572
Luchtzijdige aansluiting	mm	249x276 en rond 200
Ophanging		4xM8
Isolatie	Soort	PU 6 mm

*) Alleen voor de aansturing van temperatuurvoelers van de meet en regeltechniek



Phase Change Material

Phase change materials, ook wel fase-overgangsmaterialen genoemd, zijn materialen waarvan de faseverandering van vast naar vloeibaar en andersom wordt gebruikt om warmte/koude op te slaan en af te staan. Autarkis kiest voor het toepassen van macro verkapselde anorganische zouten, dit zijn niet brandbare zouten. In PCM's wordt energie opgeslagen voor gebruik op een later moment.

PCM's gedragen zich als thermische accu's en zijn zodoende zeer geschikt om als warmte/koude buffer te fungeren. Een correct toegepast PCM heeft door zijn functie als thermische accu bij een dagelijks variërende buitentemperatuur, zonnestraling en een wisselende binnenbelasting een dempende werking op de binnentemperatuur. Het principe van fase-overgangsmaterialen als warmte

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AUTARKIS



accumulerende materialen is als volgt: Door warmteopname uit de omgeving smelt het materiaal; de omgeving wordt gekoeld. Wanneer de temperatuur zakt stolt het materiaal weer door warmteafgifte aan de omgeving; de omgeving wordt verwarmd. Het resultaat is een gelijkmatiger temperatuur in het gebouw zodat het te installeren additionele koel- en verwarmingsvermogen sterk wordt gereduceerd en in een aantal gevallen zelfs niet meer noodzakelijk is. Dit resulteert direct in reductie en het gebruik van o.a. koelmachines en CV ketels wat zorg draagt voor een forse energiebesparing en waardoor de CO2 uitstoot beperkt blijf.

Eén uniek PCM paneel als basis

Het door Autarkis gepatenteerde kunststof (HDPE) gevulde PCM paneel wordt als basis toegepast in al onze PCM oplossingen. Voor een uiteindelijke toepassing moeten deze panelen worden samengesteld tot een PCM warmtewisselaar. Van een samengestelde PCM warmtewisselaar kunnen wij onder elke omstandigheid exact bepalen wat de opslagcapaciteit en het koel- en verwarmingsvermogen bedraagt. Omdat de mogelijkheden zeer divers zijn hebben wij een reeks standaard producten ontworpen zoals de Crystal Beam Module (CBM), Domestic Crystal Cooler (DCC), Crystal Wall (CWL), Crystal Climate Ceiling (CCC) en de Crystal Thermal Battery (CTB).

De Orange Climate Group

De Orange Climate Group ontwikkelt, produceert en levert innovatieve en duurzame concepten op gebied van gezondheid, thermisch comfort en energiemanagement. Industriële bedrijven, zorg- en onderwijsinstellingen, overheidsgebouwen, zakelijke dienstverlening, horeca en recreatie vormen het speelveld voor de realisatie van toonaangevende projecten. Zorg voor mens, omgeving en milieu staan hierbij altijd centraal. De OCG biedt u integrale oplossingen bestaande uit zeer betrouwbare en degelijke componenten van Hollands fabricaat die naadloos op elkaar aansluiten en die u de laagste investeringen, onderhouds- en energiekosten garanderen. U bent verzekerd van een innovatieve state-of-the-art-oplossing met gegarandeerde prestaties. Niet alleen bij oplevering, maar gedurende de gehele levenscyclus.

OCG Autarkis

OCG Autarkis richt zich op het ontwikkelen, produceren en leveren van innovatieve en energiebesparende oplossingen voor klimaatbeheersing door de toepassing van PCM materialen. Een van de kerncompetities van Autarkis is het bieden van maatwerkoplossingen welke volledig worden afgestemd op uw specifieke eisen. Autarkis beschikt over een eigen Research and Development afdeling, meetkamer en verschillende productielocaties in Nederland waardoor Autarkis haar oplossingen/producten kan ontwerpen, 3D visualiseren, meten en valideren. In samenwerking met OCG Waterloo produceert Autarkis PCM vloer-, wand- en plafondinductie units van hoge kwaliteit, toepasbaar voor een duurzame koeling en verwarming van leefzones. Aan de hand van een definitief ontwerp zijn onze fabrieken in Holten en Drunen in staat om elk uniek eindproduct te kunnen produceren.

Versie 11/2013







Meer informatie

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Bezoekadres kantoor en fabriek:
Ondernemersweg 2
7451 PK Holten

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THERMODYNAMIC EQUIPMENT THERMBOIL

THERMBOIL E SERIES

Thermodynamic solar equipment for domestic hot water


FRONTAL

The serial THERMBOIL E is an innovative water heater, based on the system of heat pump which uses a solar panel as system of evaporation. Furthermore, the system is capable of absorbing the solar and ambient energy all year long, even during the cold period.
The got energy is passed on in the water via a condenser surrounding the outside of the tank.

- Water heater for heat pump with thermodynamic panels integrated into the equipment.
- Stainless steel tank
- Compact unit, steel carcass lacquered.
- High-efficiency compressor
- Ecological cooling liquid R134 in.
- Stainless steel condenser.
- Isolating injected polyurethane 40 kg / cm.
- System of protection against high pressures and temperatures of functioning.
- Thermostatic expansion valve.
- Auxiliary electric system.
- All the equipments are tested in factory before sending.

Technical specifications

TECHNICAL CHARACTERISTICS Thermboil E							
Model	TB100E	TB200E	TB300E	ACS temperature range with thermodynamics (ºC)	55 ºC		
Mean thermal capacity (only thermodynamic) (W)	2000 W			Maximum working pressure (bar)	6 bar		
Mean power consumed (thermodynamic) (W)	500 W			Refrigerant fluid	R134a		
Maximum power consumed (thermodynamic + resistance)	2500 W			Cold/hot water input/output connections (")	3/4"		
Voltage / frequency	230 V / I ph / 50 Hz			Insulation type (kg/m3)	PUR 40kg/m^3		
Atmospheric temperature range (ºC)	5ºC-45ºC			Thermodynamic panel weight (kg)	7.6 kg		
COP range	3-7			Packaging dimensions (height x width x depth)	910 x 650 x 680	1360 x 650 x 680	1930 x 650 x 680
Accumulator volume (L)	100	200	300	Thermodynamic panel connections (")	3/8"		
Approx. weight of equipment when empty (kg)	75	90	125	Dimensions of the thermodynamic panel	1960 x 920 x 20		
Dimensions (depth x width x height) (AxBxC)(mm)	900 x 600 x 590	1350 x 575 x 590	1920 x 575 x 590	Protection class	IP 20		

At room temperature = 24ºC; entrance water temperature = 10ºC

THERMBOIL E+I SERIES

The serial THERMBOIL E+I is an innovative water heater, based on the system of heat pump which uses a solar panel as system of evaporation. Furthermore, the system is capable of absorbing the solar and ambient energy all year long, even during the cold period.
The got energy is passed on in the water via a condenser surrounding the outside of the tank.
When the exterior conditions are very critical (very low temperatures), a forced evaporator comes into operation which is included with the equipment. In this way, if the evaporation in the panel has not been sufficient, the forced evaporator comes into motion, only bin said more critical conditions.

- Water heater for heat pump with thermodynamic panels integrated into the equipment.
- Stainless steel tank
- Compact unit, steel carcass lacquered.
- High-efficiency compressor
- Ecological cooling liquid R134a.
- Stainless steel condenser.
- Isolating injected polyurethane 40 kg / cm.
- System of protection against high pressures and temperatures of functioning.
- Thermostatic expansion valve.
- Auxiliary electric system.
- All the equipments are tested in factory before sending.



FRONTAL

TECHNICAL CHARACTERISTICS Thermboil E+I							
Model	TB100E+I	TB200E+I	TB300E+I	ACS temperature range with thermodynamics (ºC)	55 ºC		
Mean thermal capacity (only thermodynamic) (W)	2000 W			Maximum working pressure (bar)	6 bar		
Mean power consumed (thermodynamic) (W)	500 W			Refrigerant fluid	R134a		
Maximum power consumed (thermodynamic + resistance)	2000 W			Cold/hot water input/output connections (")	3/4"		
Voltage / frequency	230 V / I ph / 50 Hz			Insulation type (kg/m3)	PUR 40kg/m^3		
Atmospheric temperature range (ºC)	5ºC-45ºC			Thermodynamic panel weight (kg)	7.6 kg		
COP range	3-7			Packaging dimensions (height x width x depth)	910 x 650 x 680	1360 x 650 x 680	1930 x 650 x 680
Accumulator volume (L)	100	200	300	Thermodynamic panel connections (")	3/8"		
Approx. weight of equipment when empty (kg)	75	90	125	Dimensions of the thermodynamic panel	1960 x 920 x 20		
Dimensions (height x width x depth) (mm) (AxBxC)	900 x 600 x 590	1350 x 575 x 590	1920 x 575 x 590	Protection class	IP 20		
				Power of the double ventilator	45W		

At room temperature = 24ºC; entrance water temperature = 10ºC

THERMBOIL I SERIES



Thermodynamic compact solar equipments with use of the ambient energy, conceived to produce some hot water.

Innovative water heater, based on the system of the heat pump capable of getting the ambient energy to warm the water in a effective way, with a consumption reduced with regard to the traditional systems. The obtained return is until 20 % upper to the thermal solar systems of the market.

- Stainless steel tank
- Compact unit, steel carcass lacquered.
- High-efficiency compressor
- Ecological cooling liquid R134 a.
- Stainless steel condenser.
- Isolating injected polyurethane 40 kg / cm.
- System of protection against high pressures and temperatures of functioning.
- Thermostatic expansion valve.
- Auxiliary electric system.
- Optional system of heat recovering for premises with strong thermal values.
- All the equipments are tested in factory before sending.

Technical specifications

TECHNICAL CHARACTERISTICS Thermboil I							
Model	TB100 I	TB200 I	TB300 I	ACS temperature range with thermodynamics (ºC)	55 ºC		
Mean thermal capacity (only thermodynamic) (W)	2000 W			Maximum working pressure (bar)	6 bar		
Mean power consumed (thermodynamic) (W)	500 W			Refrigerant fluid	R134a		
Maximum power consumed (thermodynamic + resistance)	2500 W			Cold/hot water input/output connections (")	3/4"		
Voltage / frequency	230 V / I ph / 50 Hz			Insulation type (kg/m3)	PUR 40kg/m^3		
Atmospheric temperature range (ºC)	5ºC-45ºC			Packaging dimensions (height x width x depth)	910 x 650 x 680	1360 x 650 x 680	1930 x 650 x 680
COP range	3-5						
Accumulator volume (L)	100	200	300	Protection class	IP 20		
Approx. weight of equipment when empty (kg)	75	90	125				
Dimensions (height x width x depth) (mm) (AxBxC)	900 x 600 x 590	1350 x 575 x 590	1920 x 575 x 590	Power of the double ventilator	45W		

At room temperature = 24ºC; entrance water temperature = 10ºC

WORKING CONDITIONS	
Outside Temperature	5 ºC
Inside Temperature	21 ºC
Inlet water temperature	7 ºC
Outlet water temperature	50 ºC

Comparation Thermoil E/ E+I/ I series with an electric boiler and gasoil boiler.

Taking into account the working conditions, **the COP of the Thermboil equiptments** is calculated and shown in the following table:

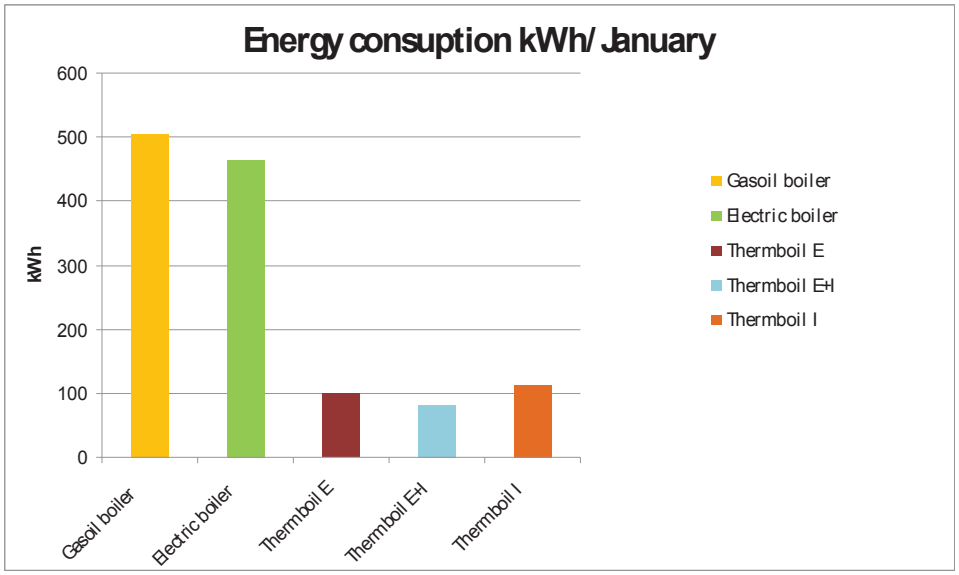
RESULTS FROM THE WORKING CONDITIONS	
COP Thermboil E	4.52
COP Thermboil E+I	5.64
COP Thermboil I	4.02
Average efficiency gasoil boiler	0.9
Average efficiency electric boiler	0.98

Supposing a **demand of 300 L of sanitary hot water per day,** the energy consumption which should be covered per month, is:

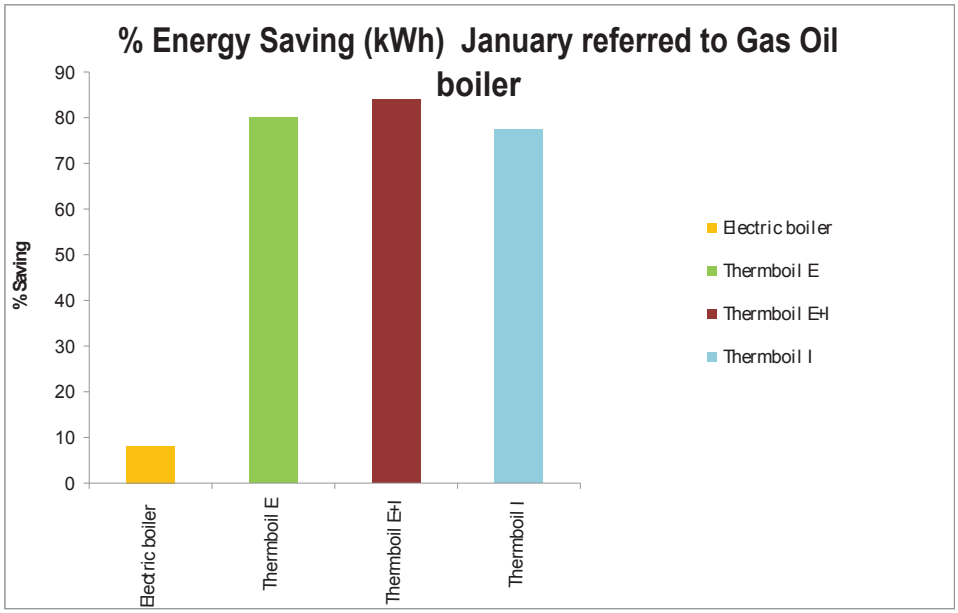
ENERGY CONSUPTION PER MONTH
455 kWh/month

The working conditions are referred to cold month like **January.** In this month the energy consumption for each equipment is:

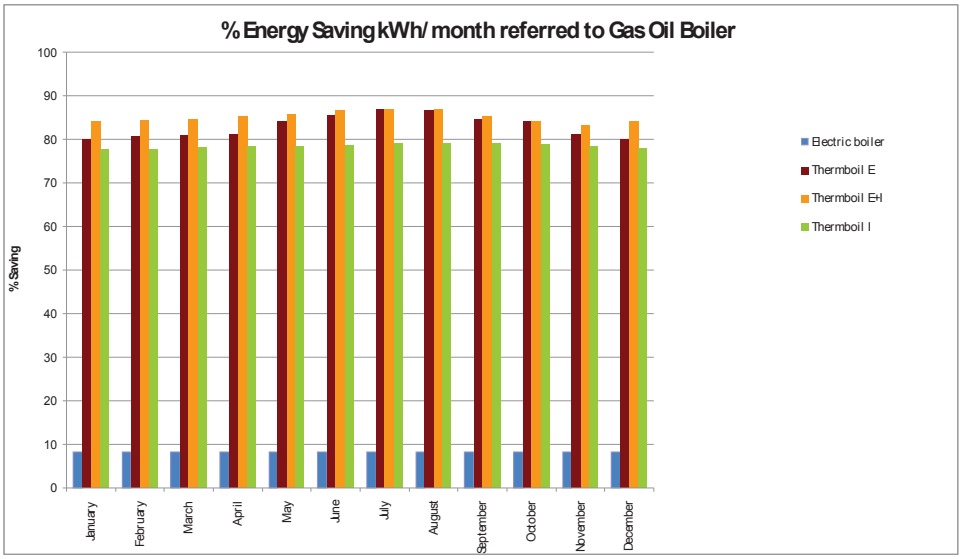
ENERGY CONSUPTION (kWh January)	
Gasoil boiler	504,66
Electric boiler	463,46
Thermboil E	100,48
Thermboil E+I	80,49
Thermboil I	112,82



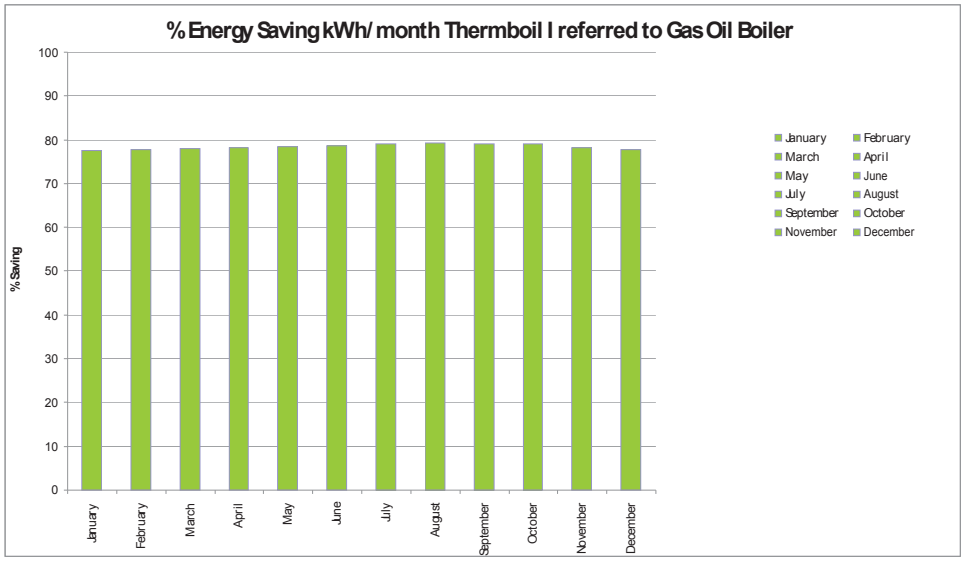
Also, it is calculated the **energy saving percentage** of each system as the ratio between the energy consumption of each system and the energy consumption of the gas oil boiler. It is shown in the following table:

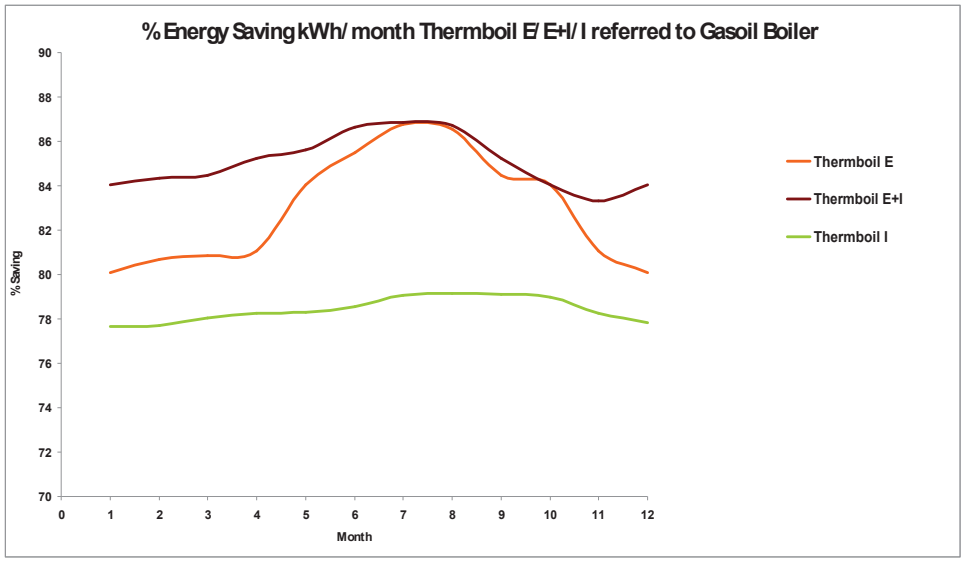


Since the Thermodinamic solar systems (Thermboil E/ E+I), **capture the ambient energy besides the solar radiation**, when the weather conditions are better, the equipments are more efficient. You can see the improvement of the system performance in a whole year:

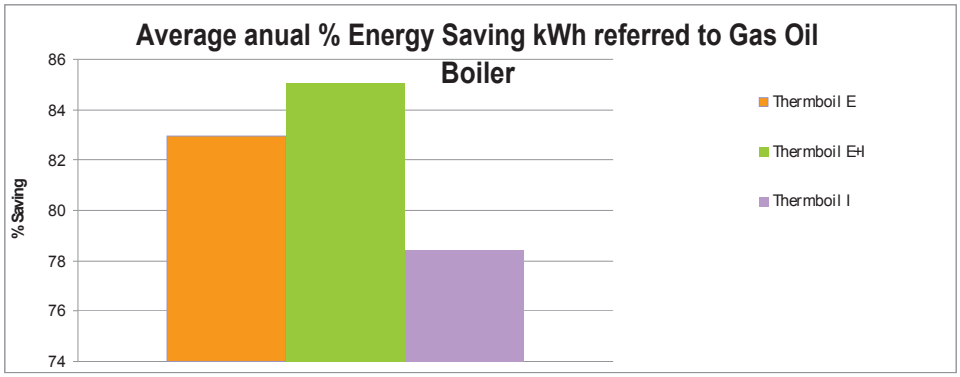








The **average annual** percentage of energy saving is as follow:


Average anual % Energy Saving kWh referred to Gas Oil Boiler
% Saving
86
84
82
80
78
76
74
Thermboil E
Thermboil EH
Thermboil I

soLaR COMPLEET

De Solar Thermo warmtepompboiler werkt onder alle weersomstandigheden



De unieke eigenschappen van het revolutionaire Thermodynamisch warmwater opwekkingssysteem

Een zeer hoog rendement, het hele jaar door (COP = 2,5 tot 7)

- Recentste generatie zonne-energie
- Erkend en gecertificeerd
- Energieopname aan 2 kanten van het paneel
- Energiebesparing tot 90%!
- Werkt tot bij -15 °C

De thermo warmtepompboiler werkt 24u/24u het hele jaar door, zelfs zonder zon, bij sneeuw en 's nachts.

- Dekt 100% van uw warmtapwaterbehoeften
- Verwarmt standaard tot 55 °C
- Werkt zelfs in de winter
- Optioneel met elektrische /CV-water naverwarming
- Mogelijkheid om de panelen buiten of binnen te plaatsen (garage...)

Een milieuvriendelijke benadering

- Gebruik van hernieuwbare energie die geen CO_2 uitstoot
- Niet-giftig koelmiddel

Comfort en rust

- Uitrusting van hoogwaardige kwaliteit
- Geluidloos systeem
- Mooi design
- Lichte, stevige en gemakkelijk te plaatsen panelen
- Geen onderhoud, reinigt zichzelf





Technische eigenschappen systeem

- Niet-giftig koelmiddel, zonder chloor (R134a).
- Warmtepomp en toebehoren: A-label compressor, elektronische temp.regeling, rvs-warmtewisselaar, elektronisch expansieventiel, rvs-buffervat.
- Paneel in geanodiseerd aluminium.
- Afmetingen per stuk: ~~1,96~~ 1,70 x 80 m x 92 cm.
- Gewicht per stuk: 7,6 kg.
- Thermisch oppervlak paneel (aan beide kanten): 3,60 m².

Technische eigenschappen

série E+I		
Thermal power	[W]	2000 (100/200/300) 4000 (500)
Absorbed power	[W]	500 (100/200/300) 1000 (500) *
Maximun absorbed power	[W]	2500 (100/200/300) 3000 (500)
Tension/Frequency	[A]/[Hz]	230/50
Ambient temperature scale	[°C]	-5 a 45
Minimum and maximum COP		2,5 a 7
Cooling fluid		R134a Charge: 1,2 kg
Tank volume	[L]	100/200/300/500 (solo E y E+I)
Sanitary hot water temperature	[°C]	50 à 55
Dimensions	[mm] HxLxP	100L : 900x600x590 200L : 1350x600x590 300L : 1915x600x590 500L : 2000x710x590 ← zelfde lager
Ø Hydraulic connections dimensions	[p]	Inlet 3/4" male Outlet 3/4" female
Isolation		PUR 40kg/m3
Thermodynamic panel connections	[p]	1/4" inlet 3/8" outlet
Protection Category		IP 20
Weight	[kg]	100L : 70kg 200L : 90kg 300L : 120kg 500L : 180kg

Prestaties complete systeem

Minimum en maximum COP
Van 2,5 tot 7

Onze oplossingen:

DRIE SOORTEN SYSTEMEN:

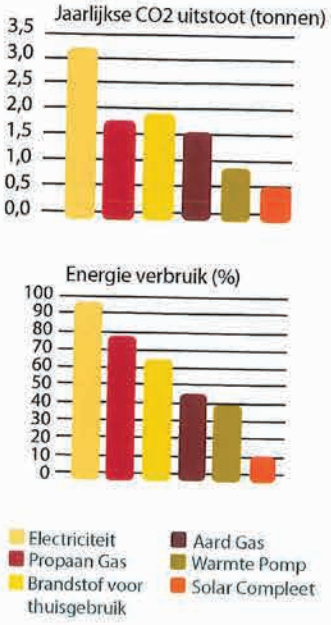
- Type: E (buiten) extern paneel
- Type: E + I (buiten + binnen)extern paneel - recirculatie MV
- Type: I (binnen) recirculatie MV

Warmtapwater:
Systeem dat zowel geschikt is voor privégebruik, als voor grote ruimtes (woongebouwen, kantoorgebouwen, sportaccommodaties, campings...).

Europese certificering: EN255-3:1997

Garanties: 5 jaar op het paneel en 2 jaar op de warmtepomp met buffervat

De goedkoopste energie met de laagste CO_2-uitstoot



Uw installateur

SOLAR COMPLEET

Keyserswey 52
2201 CX Noordwijk
Postbus 148
2200 AC Noordwijk
Tel. +31(0)71 - 364 10 40
Fax. +31(0)71 - 361 03 16
info@solarcompleet.nl
www.solarcompleet.nl

EnergyPanel® Eficiencia alternativa

Thermodynamic solar equipment

THERMBOIL E SERIES

Thermodynamic solar equipment for domestic hot water

The **THERMBOIL E** is an innovative water heater, based on the system of heat pump which uses a solar panel as system of evaporation. Furthermore, the system is capable of absorbing the solar and ambient energy all year long, even during the cold period. The got energy is passed on in the water via a condenser surrounding the outside of the tank.

SANITARY HOT WATER AT 55ºC



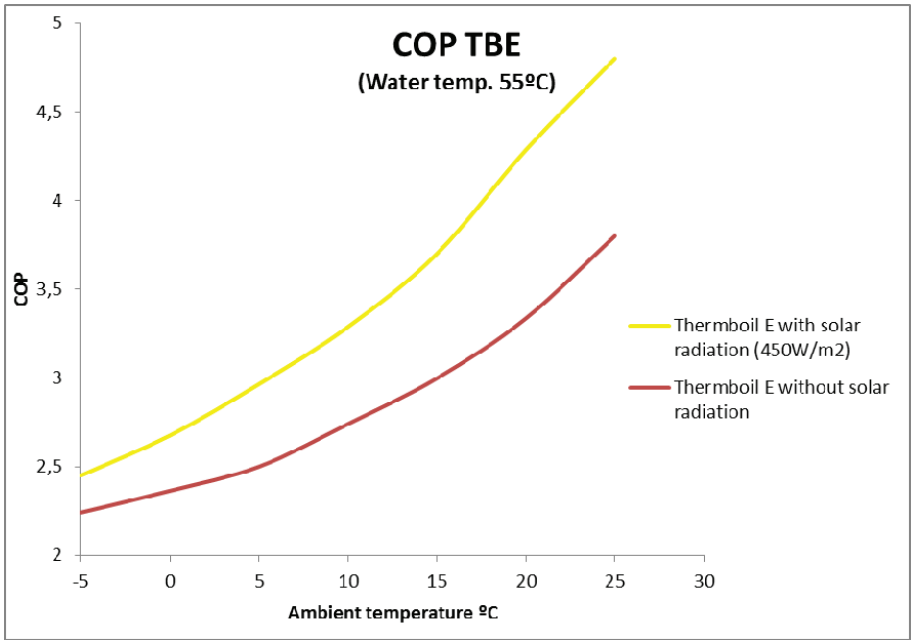
TECHNICAL CHARACTERISTICS THERMBOIL TB E

Model	TB100E	TB200E	TB250E	TB300E
Mean thermal capacity (only thermodynamic) (W)	2000 W			
Power consumed range (thermodynamic) (W)	300-500 W			
Maximum power consumed (W)	2000 W			
Voltage / frequency	230 V / I ph / 50 Hz			
Atmospheric temperature range (ºC)	-5ºC-45ºC			
COP range	3-7			
Accumulator volume (L)	100	200	250	300
Approx. weight of equipment when empty (kg)	70	85	105	120
ACS temperature range with thermodynamics (ºC)	45-55ºC			
Maximum working pressure (bar)	6 bar			
Refrigerant fluid	R134a			
Cold/hot water input/output connections (")	3/4			
Thermodynamic panel connections (")	1/4-3/8			

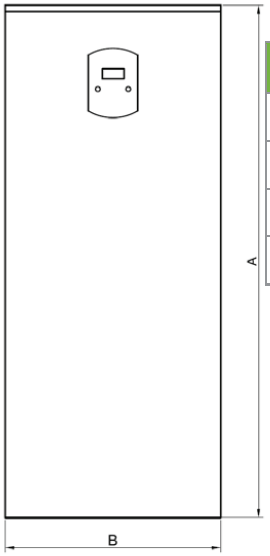
THECNICAL SPECIFICATIONS

- Water heater for heat pump with thermodynamic panels integrated into the equipment.
- Stainless steel tank
- Compact unit, steel carcass lacquered.
- High-efficiency compressor
- Ecological cooling liquid R134 a.
- Aluminum condenser.
- Isolating injected polyurethane 40 kg /m^3.
- System of protection against high pressures and temperatures of functioning.
- Thermostatic expansion valve.
- Auxiliary electric system.
- All the equipments are tested in factory before sending.

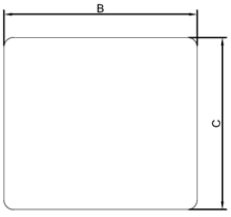
PERFORMANCE DATA



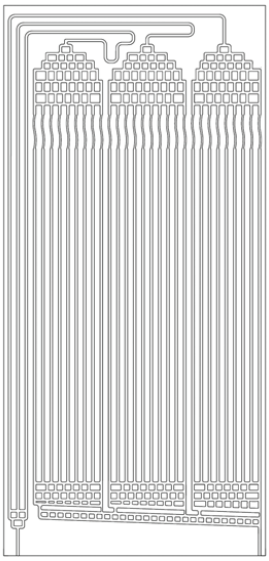
SYSTEM DIMENSIONS



Modelo	A(mm)	B(mm)	C(mm)
TB100	985	590	575
TB200	1435	590	575
TB250	1753	590	545
TB300	2000	590	575



THERMODINAMIC PANEL DIMENSIONS



1700 x 800x 25 mm

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5 USAGE RULES ..... **Fout! Bladwijzer niet gedefinieerd.**

5.1 TEMPERATURE ADJUSTMENT ..... **Fout! Bladwijzer niet gedefinieerd.**
5.2 ELECTRICAL RESISTANCE ..... **Fout! Bladwijzer niet gedefinieerd.**

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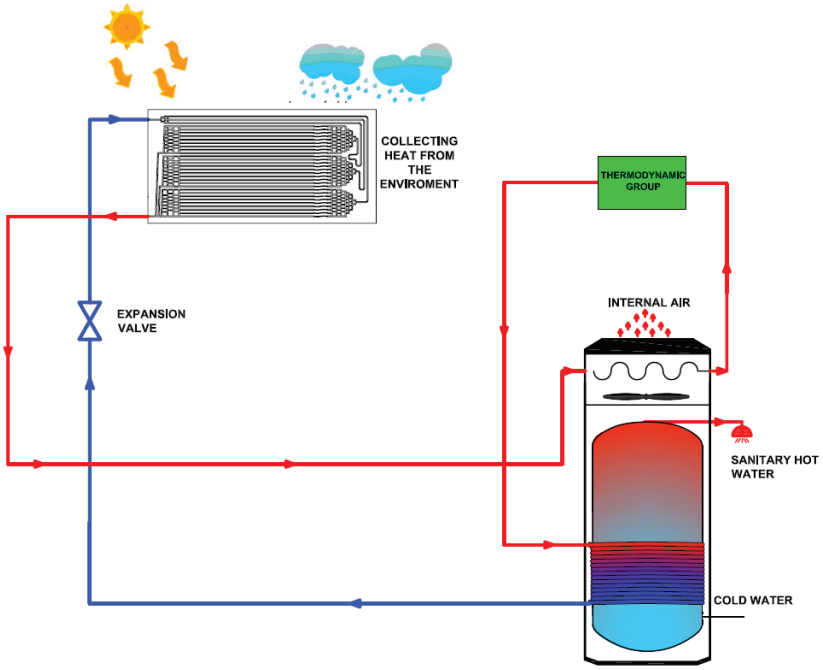
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1 GENERAL SAFETY WARNINGS

- To avoid any injury to the user as well as material damages, the following instructions shall be followed. Incorrect operation due to ignoring these instructions may cause damages.
- The installation is the responsibility of the purchaser. Read the information supplied with the equipment carefully before installing and using it. The manufacturer declines any responsibility as regards damages deriving from an incorrect installation and a failure to follow the instructions detailed here.
- Ask a professional installer to install this equipment as incorrect installation may cause gas and water leaks, electrical discharges etc.
- Install the equipment in the following places which may bring about the malfunctioning thereof (even if it is unavoidable, consult the supplier): areas with corrosive gases, factories where the electrical voltage tries out strong fluctuations, places with strong electromagnetic waves, places with inflammable materials or gases, other special environments.
- The electrical connection has to be carried out in accordance with that specified in the respective point.
- It is vital to install in appropriate fashion the safety valve which is supplied with the equipment and check that it is working properly.
- In the event that the system pressure exceeds the pressure of 4 bar, a pressure reducing valve must be used.
- Sufficient space shall be set aside for installation and maintenance.
- The equipment shall always remain in a vertical position during transport, transfer and installation.
- The support surface shall be flat, bear the weight of the unit and be ready for the installation of the unit without increasing the noise or the vibrations.
- The installation site shall allow the connections of pipes and wiring.
- Maintenance repairs and tasks shall be carried out by a professional technical service. An incorrect maintenance task or repair may bring about gas and water leaks, electrical discharges etc.

2 OPERATIONG PRINCIPLE

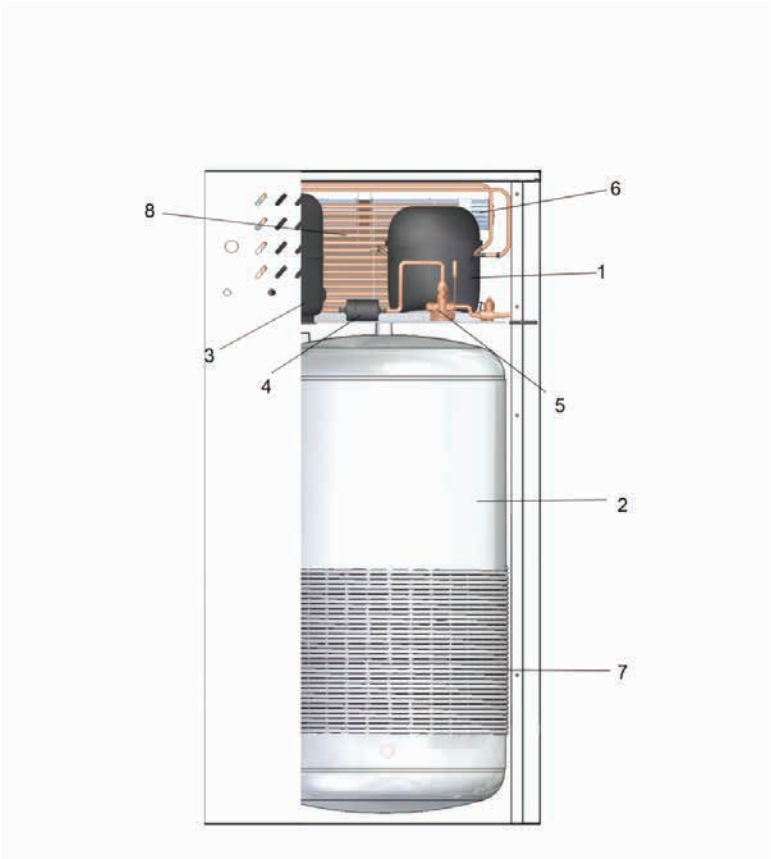
Thermboil is a thermodynamic solar system. Thermodynamic solar system is the name given to the combination of heat pump technologies with the solar thermal energy technologies. It consists of solar collectors called thermodynamic panels, formed by a metallic panel which are directly exposed to the sun and which act as a heat pump circuit evaporator, collecting heat from the Sun and the environment. In the illustration, the simplified scheme for the thermodynamic systems can be observed for obtaining sanitary hot water.



3 TECHNICAL FEATURES

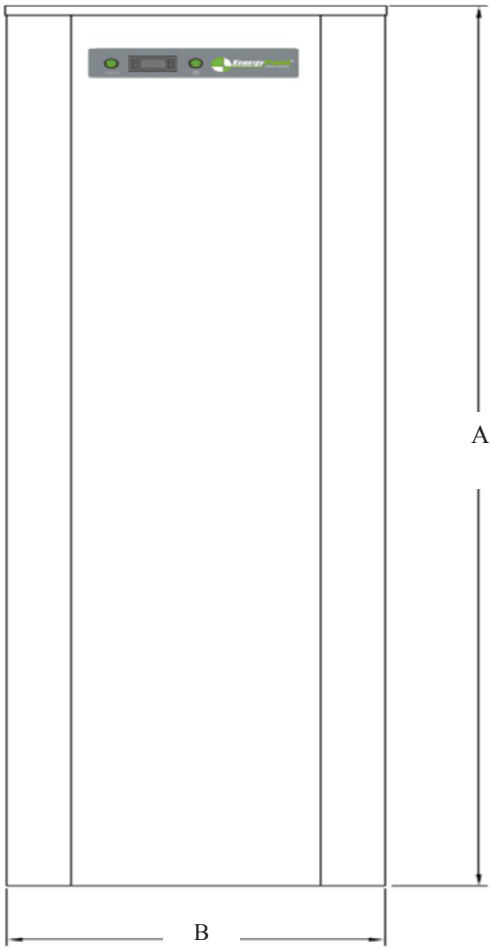
TECHNICAL FEATURES- THERMBOI SERIES E+I				
Model	**TB100E+I**	**TB200E+I**	**TB250E+I**	**TB300E+I**
Mean thermal capacity (only thermodynamic) (W)	2000			
Mean power consumed (thermodynamic) (W)	500			
Maximum power consumed (thermodynamic + resistance)	2500			
Voltage / frequency	230 V / I ph / 50 Hz			
Atmospheric temperature range (ºC)	5-45			
COP range	3-5			
Refrigerant fluid	R134a			
Accumulator volume (L)	100	200	250	300
ACS temperature range with thermodynamics (ºC)	45-50			
Dimensions (height x width x depth) (mm)	910 x 590 x 575	1360x 590 x 575	1678 x 590 x 575	1925 x 590 x 575
Maximum working pressure (bar)	6			
Cold water input connections (") /Hot water output connections (")	3/4 - 3/4			
Insulation type (kg/m3)	PUR 40			
Thermodynamic panel weight (kg)	7,6			
Packaging dimensions (height x width x depth)	1960 x 920 x 20 mm			
Packaging dimensions (height x width x depth)	910 x 650 x 680	1360 x 650 x 680	1750 x 650 x 680	1920 x 650 x 680
Protection class	IP 20			
Approx. weight of equipment when empty (kg)	70	90	105	120
Dimensions of the thermodynamic panel	1960 x 920 x 20 mm			
Thermodynamic panel input/ output connections (thread) SAE(")	1/4 - 3/8			
Thermboil input/ output connections (thread) SAE(")	3/8 – 1/4			

Fig. 1 DESCRIPTION SCHEMATIC THERMBOIL TBE+I
(transversal section)



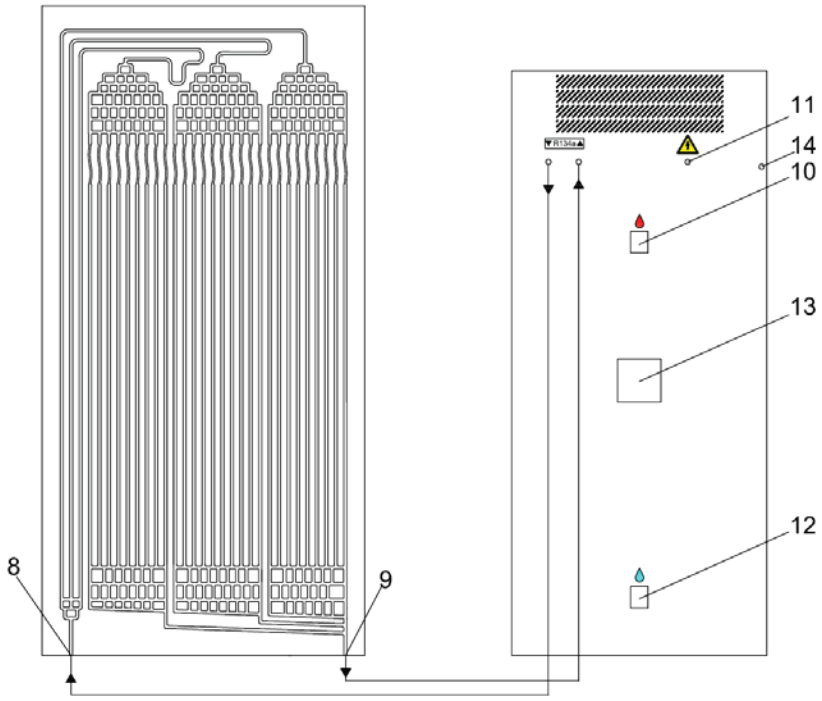
1. Compressor
2. Condenser
3. Drum
4. Dehydrator
5. Expansion valve
6. Ventilator
7. Tank
8. Evaporator

Fig. 2 DIMENSIONAL SCHEME
(Front part)



Models/Dimensions	TB100E+I	TB200E+I	TB250E+I	TB300E+I
A (fig. 2) (cm)	90	135	167,8	191,5
B (fig. 2) (cm)	59	59	59	59

Fig. 3 DIMENSIONAL CONNECTIONS SCHEME
(rear part)



8. Liquid inlet (impulsion)
9. Gas outlet (aspiration)
10. Hot water outlet
11. Electrical connection
12. System water inlet
13. Resistance
14. Wastepipe



- Between the thermodynamic unit and the panels there should not be a distance of over 8 m and it is recommended that there should be the least possible distance between the thermodynamic block and the panels with a view to improving system performance. For better distance, see with Energy Panel

- For the anchorage of the panels 6 L supports measuring 105x55x5 mm are supplied which have two M8 holes (8 mm in diameter).

- The evaporator panels shall be preferably oriented to the SOUTH, SOUTHWEST or SOUTHEAST as other orientations slightly reduce their performance. The ideal inclination horizontally is more or less equal to the latitude of the place, so that they collect the greatest solar radiation; however, they may be positioned at a wide range of angles which stretch from 10 to 90.

- For greater yield, the panels must be in contact with the wind to favour heat exchange between the coolant and the atmosphere. For this reason, it is recommended that as far as possible the panels should be situated in a direction parallel to the prevailing wind in the area, allowing the air to pass freely between them.

- Connection of the panel: Gas outlet (aspiration) (fig. 3, 9) is connected to the gas inlet of the system and liquid inlet (impulsion) (fig. 3,8) is connected to the liquid inlet of the system.

Fig. 5 Thermodynamic panel

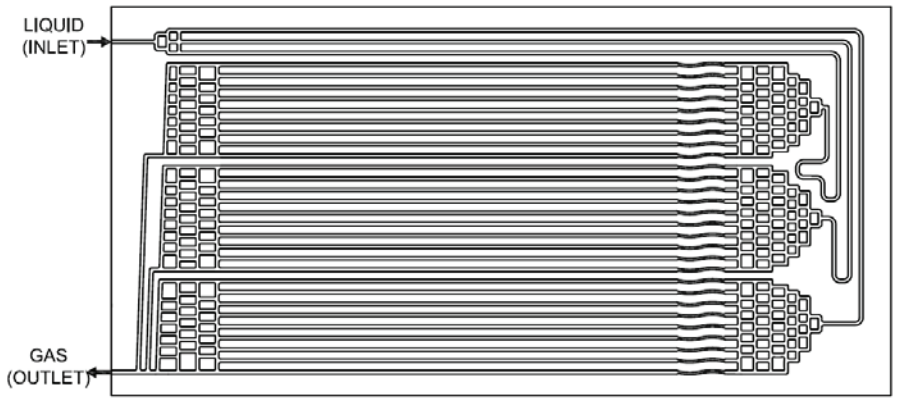
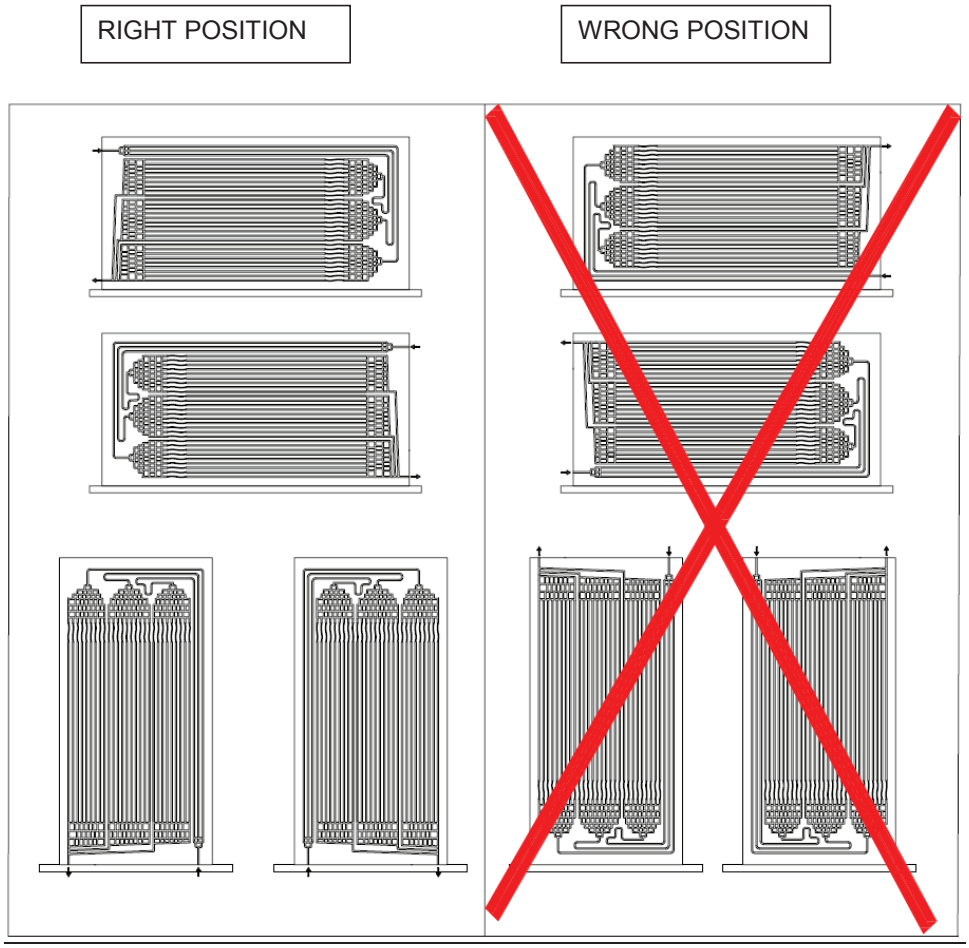


Fig. 6 Correct and incorrect placing of the panel



4.2 REFRIGERANT CONNECTIONS

The piping which has to be used to join the thermodynamic panel to the Thermboil equipment shall be made of refrigeration quality copper (dehydrated copper pipe).

In interior spaces, this piping must be properly insulated with flexible anti-condensation insulation. In the event that the water condensations do not entail any problem, this piping will not need to be insulated.

Contact between the liquid and aspiration line shall be avoided to prevent energy losses in the system.

Before welding the piping, it shall be checked that the system is free of humidity and particles.

The gas piping shall be designed with as few bends as possible to minimize the load loss and it shall be supported properly with a view not to transmit stresses or vibrations.

Before insulating the piping and loading the installation, carry out a preliminary control to ensure that there are no leaks in the installation.

4.3 HYDRAULIC CONNECTIONS

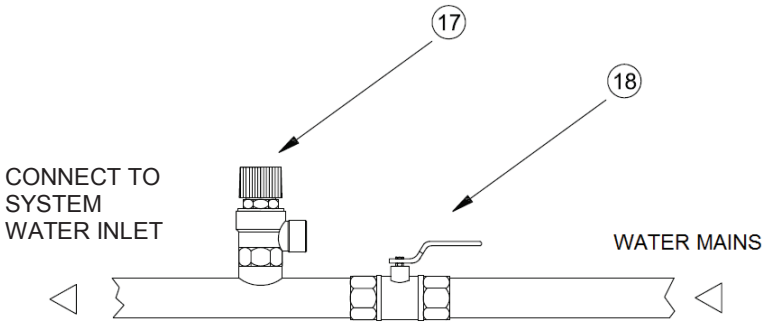
The Thermboil equipment is endowed with mains water inlet situated on the rear lower part. The hot water outlet is located on the rear upper part. This shall be connected to the hot water piping of the house. Anti-electrolysis sleeves must be worn to avoid contact between the equipment water outlet and inlet intakes of the equipment and the piping of the home in the event that they are metallic.

Mains water shall enter in accordance with figure 7. The safety valve supplied with the equipment must be installed, checking that it works properly.
.

This equipment is not prepared to bear over 0.6 MPa (6 bar) of regulatory pressure. A safety valve rated at 6 bars is supplied with this equipment for the safety thereof and its placement is vitally important. It is recommended to incorporate in the installation an expansion vessel for sanitary hot water.

Should the pressure of the house water exceed 4 bars, a pressure reducing valve shall be installed before the safety valve.

Fig. 7 SCHEMA NETWORK CONNECTION



17. Safety valve
18. Cutoff valve

4.4 ELECTRICAL CONNECTIONS

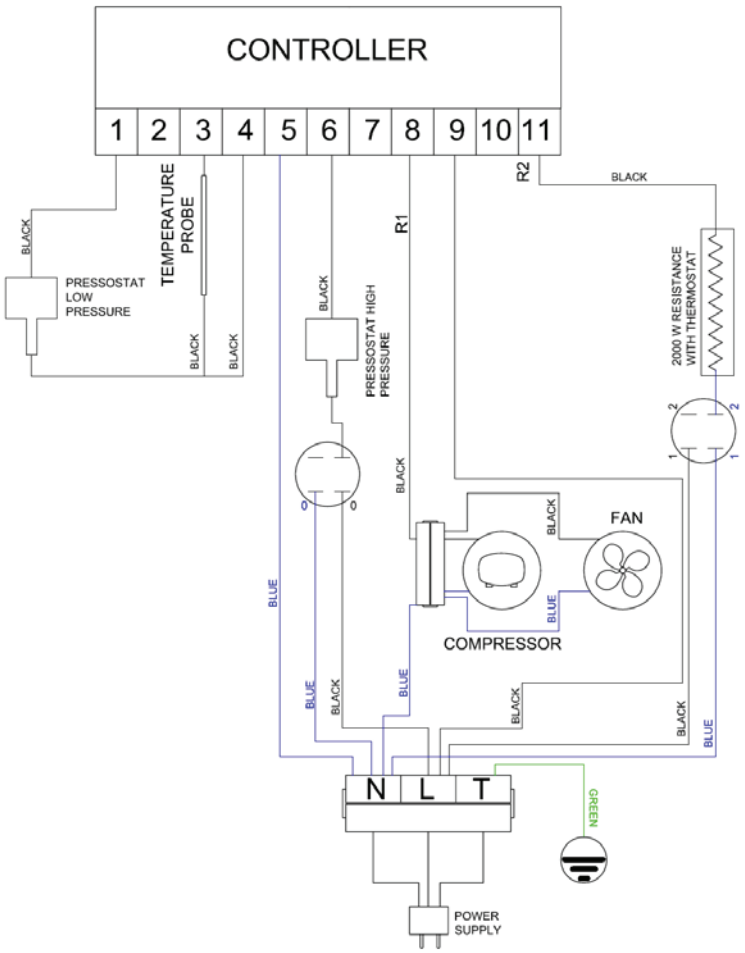
The equipment shall be connected to the electrical system when all the refrigerant connections have been made and the accumulator is full of water.

The power supply is monophase: 230V / 50Hz and earthing connection.

The power supply line must be protected by a 16A magnetic-thermal device.

The electrical scheme of the equipment has been shown in the following figure:

Fig. 8 WIRING DIAGRAM



Check the water tightness of the circuit at the welds, for example using soapy water.

Should there be any leaks in the installation, contact the technical service as an intervention by qualified staff will be necessary.

4.7 FILLING THE ACCUMULATOR

To fill the accumulator, the cold water power key of the equipment shall be opened.

Once open, a hot water tap of the installation shall be opened, thereby allowing the emptying of all the air contained in the tank.
Once full, turn off the tap.

Check for any possible water leaks in the installation.

4.8 TURNING THE SYSTEM ON

Thermboil may be set in motion once the steps described previously have been set in motion. The equipment shall attain the anticipated temperature (55ºC) in a variable time period (2-10 hours) which shall depend on the environmental and mains water inlet temperature conditions.

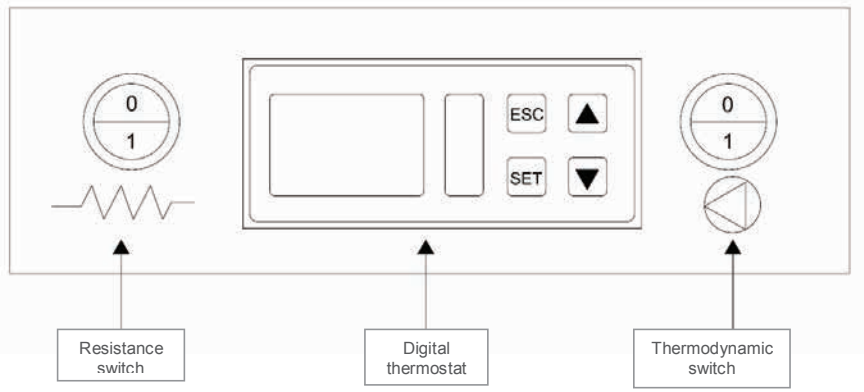
Once the installation has been completed, it shall be checked that the accumulator is full of water and the installation free of air.

To turn the Thermboil on, the latter shall be connected to the electrical system

WARNING: In order to avoid damages to the electrical resistance, it shall be checked that the tank is full of water before turning on the apparatus.

Once said indications have been checked, connect the thermodynamic equipment (right switch) which shall remain on.
The electrical resistance switch (left) shall remain off.
The thermodynamic equipment, once connected, shall operate automatically thanks to the digital controller which shall start up when the temperature falls below the prefixed value.

Fig. 10 Control panel scheme



5 USAGE RULES

5.1 TEMPERATURE ADJUSTMENT

The digital thermostat of the equipment marks the temperature of the water at any time.
This thermostat is preset at 55ºC for the compressor, and 70ºC for the resistance.

Compressor

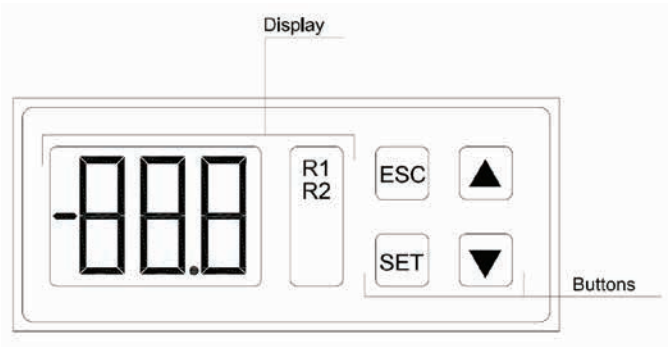
- To view the set point temperature of the compressor, press the SET button. To modify the adjustment temperature leave the SET button pressed for 7 seconds, SP be displayed. Using the buttons with the arrow pointing upwards / downwards we can increase / reduce the set point temperature. Once set, press the "set" button again. Press ESC to cancel.

Resistance

- To view the set point temperature of the resistance, press the UP button. To modify the adjustment temperature leave the UP button pressed for 7 seconds, SP2 be displayed. Using the buttons with the arrow pointing upwards / downwards we can increase / reduce the set point temperature. Once set, press the "set" button again. Press ESC to cancel.

WARNING: The programmed temperature for the compressor should never exceed 55ºC

Fig.11 Digital thermostat scheme



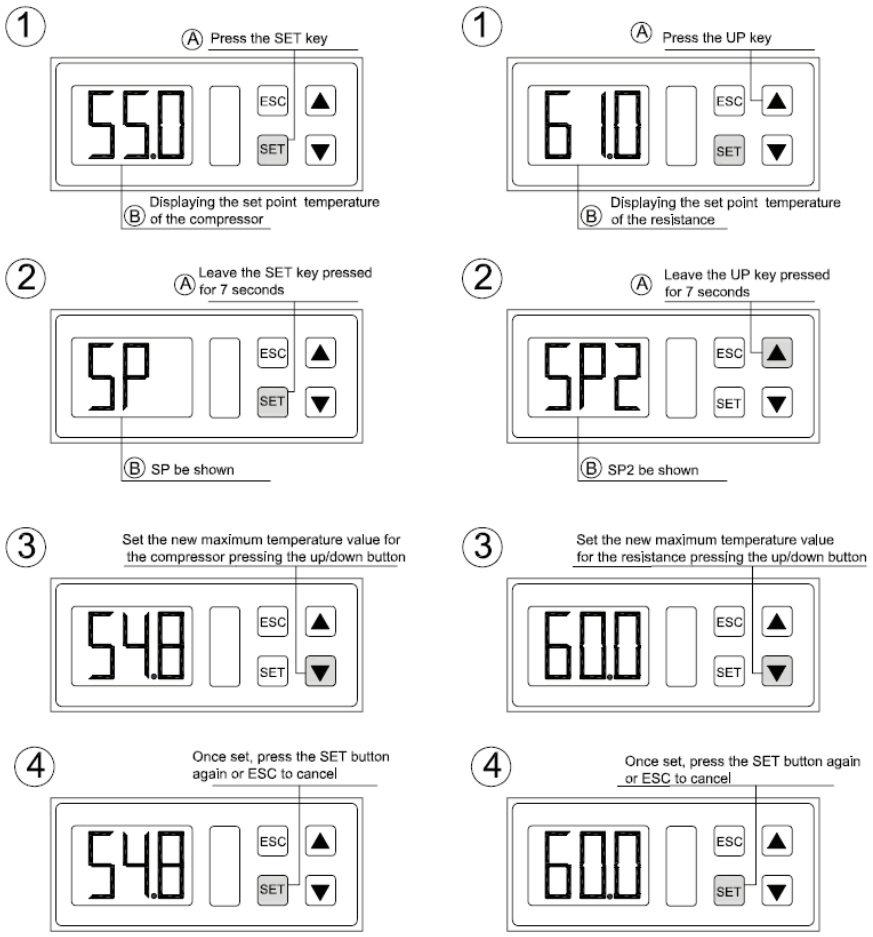
.

OPERATING:

DESCRIPTION	ACTION	COMMENTS
SET BUTTON	Keep pressed down for 7 seconds to change the operating temperature of the compressor	The temperature of the compressor is pre-set at 55 ° C ***Never exceed 55°C.***
UP BUTTON ▲	Keep pressed down for 7 seconds to change the operating temperature of the resistance	The temperature of the resistance is pre-set at 70 ° C
UP BUTTON ▲	Increases the temperature	
DOWN BUTTON ▼	Decreases the temperature	

To modify the temperature follow the instructions in diagram 12.

Fig. 12. Operating the digital thermostat



5.2 ELECTRICAL RESISTANCE

The equipment has electrical resistance of 2000 W which is connected manually (by way of the left switch) when greater power to heat up the water is foreseen (demand for hot water greater than that foreseen, extremely low external temperatures, legionellosis prevention). The resistance has its own thermostat preset at 70ºC.
The use of the resistance shall be exceptional and exclusive to those cases mentioned above and the unit shall be disconnected and returned to its normal operation when the anomaly has been resolved.

To connect the resistance, both the thermodynamic switch and the resistance switch, must be in position 1 (see fig. 10).

6 MAINTENANCE, REPAIR AND CLEANING

WARNING. Follow the general warnings and safety rules listed at the start of the text carefully, paying due attention to everything which is indicated.
All maintenance operations and interventions shall be carried out by specialized staffs (who have the requirements requested by the prevailing standards in this regard).

Before requesting the intervention of the Technical Service owing to a possible malfunction, check that the operating failure does not depend on other causes such as, for example, a temporary lack of water or electrical energy.

- The sitting of the unit shall be dry, clean and well-ventilated.
- It is usually not necessary to clean the solar thermodynamic panels in view of their self-cleaning power when it rains. When they are very dirty (dust, leaves or bird excrements), it can be cleaned with water and non-abrasive detergent. This operation should not be carried out when sunlight is strong.
- A mandatory annual revision must be carried out by authorized installers checking:
  - The proper operation of the installation, the regulator and the safety devices.
  - The state of the installation components exposed to the inclement weather (affixations, panel…).
  - The state of the electrical resistance, changing this where applicable.
- In addition to the mandatory annual revision, a visual inspection of the installation is recommended every 6 months and in any case whenever any anomaly occurs in installation operation.
- It is vital to empty the apparatus if it has to remain out-of-use for a prolonged time period. Where necessary, empty the apparatus as indicated below:
  - disconnect the apparatus from the electrical system;
  - turn off the central tap of the domestic installation;
  - turn on the hot water tap (sink or bath);

Periodic maintenance

To obtain the optimum performance of the apparatus, it is recommended to replace the resistance every two years.

Overpressure device

- Avoid placing below the thermo accumulator any object and/or apparatus which may be damaged by a possible water loss.
- In the event of a prolonged period of inactivity of the apparatus it is necessary to:
  - disconnect the apparatus from the electrical power supply.
  - turn off the hydraulic circuit taps.
- If the hot water coming out of the taps is at a temperature of over 50°C, this may cause serious burns immediately. Children, the handicapped and the elderly are more easily exposed to the risk of burns.

The user is forbidden from carrying out the ordinary and extraordinary maintenance of the apparatus.
If the electrical power cable is replaced, call specialized staff.

The overpressure device shall be put into operation on a regular basis to check it is not blocked and eliminate any lime scale.

7 TROUBLESHOOTING

Problems	*Causes*	*Solutions*
The screen doesn't show any information	Lack of power	Check the power supply
		Check that the power switch is on
	Pressure switch is on	Check the R134a load
		Check that the pressure switches function properly
	Screen error	Check that the screen functions properly
The system starts and stops, the screen switches off	Refrigeration circuit leak	Check the water tightness of the connections
	Incorrect gas load	Check the R134a load
	Very low water temperature	Connect the resistance until the system activates
	Obstruction in the filter drier	Replace the filter drier and clean the thermodynamic panel's circuit(Models E/E+I/ E+I HT)
	Pressure switch is on	Check that the pressure switches function properly
	Non condensable gases in the refrigeration circuit	Empty the refrigeration circuit
E1 error appears on screen	Temperature probe	Check the temperature probe connection
		Check the continuity of the probe using a multimeter
The water is cold and the compressor is working	Water leak	Check the water tightness of the hydraulic circuit
	Incorrect gas load	Check the R134a load
	Adjustment of the water temperature	Check the temperature adjustment on screen
The compressor is working short cycles	Gas leak	Check for leaks in the refrigerating circuit
	Non condensable gases in the refrigerating circuit	Empty the refrigerating circuit

Problems	*Causes*	*Solutions*
The compressor is working short cycles	Power supply tension	Check the power supply tension
	Water leak	Check the water tightness of the hydraulic circuit joints
Water escaping from the tank	The stainless steel pipe is not tightened	Check the stainless steel pipe is properly connection to the system
	Condensates	Check the proper evacuation of the water through the condensate pipe. (Models I/E+I/FX/E+I HT) or check the condensate pan

8 PREVENTION OF ISSUES

Cause of the issue	Consequences
Forgetting to install the security valve	Pierced accumulator and leaks in the hydraulic connections
Opening the valve allowing gas to circulate without having checked the water tightness	The system will stop working alter a couple of hours
Starting the machine without having filled with water	Risk of deteriorating the refrigeration circuit
Excessive tube distance between the thermodynamic unit and the panels	Overheating of the compressor decreasing its lifespan
Upside-down positioning of the panel	The system will have constant low pressure and the compressor will lose oil
Installing the system on a wall without the right support	The system risks falling and damages
Bad fixation of the panels on the roof	Risk of the panels breaking or falling from the roof, especially during strong winds
Absence of dielectric junction	Risk of corrosion in the hot and cold water connections as well as damaging the accumulator
Not holding the hot water pipe during connection causing twisting of the pipe	Partial or total obstruction of the hot water exit from the system
Anchoring of the outlet connections and absence of anti-vibratory muffs	Gradual loss of refrigerant fluid, malfunctioning followed by shutting down of the system

De vorstklep kan zonder gereedschap en zonder verdere actie uit de bovenzijde van de HRU ECO BAL worden weggenomen.
Duw met vier vingers naast elkaar (de nagelzijde) de vorstklep open (de unit in). Zorg dat uw duim buiten de unit op het zwarte schuim drukt (tussen de klepbehuizing en de naastliggende tuit). Trek nu de behuizing van de klep voorzichtig omhoog en schuif het geheel tegelijk in horizontale richting van de tuit. De motor en de overige onderdelen van bypass zijn nu bereikbaar voor inspectie. Indien nodig is de servomotor nu eenvoudig te vervangen door het loskoppelen van de connector en het losdraaien van de twee kruiskopschroeven.

Let op!
Zorg dat er nooit iets boven op de vorstklep wordt neergelegd, dit zou een goede werking van de vorstbeveiliging belemmeren.

2.5 Specificaties

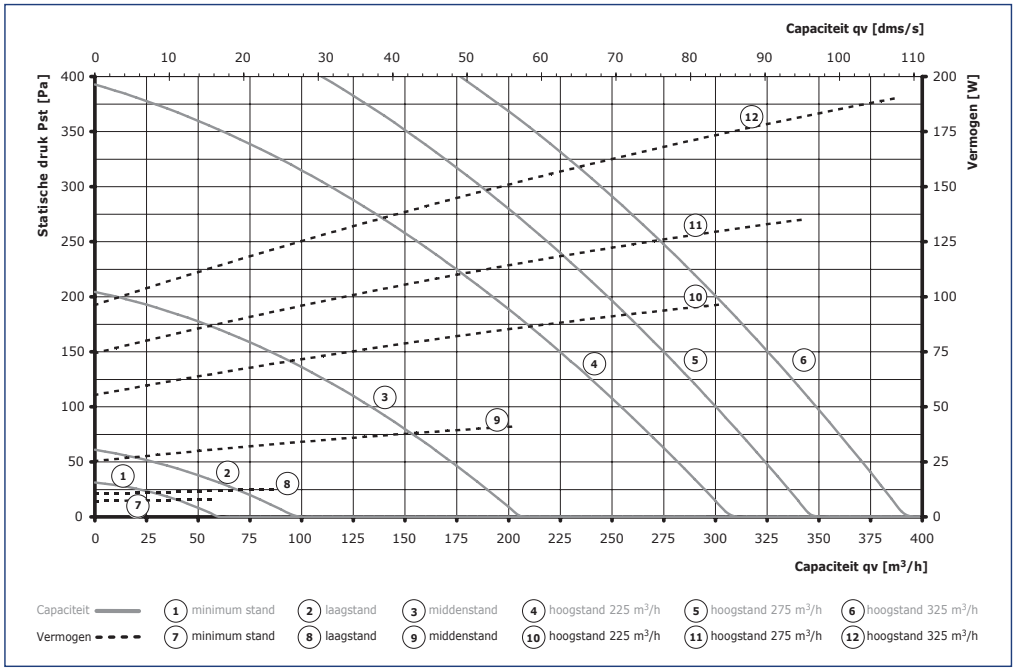
	Capaciteit [m³/h]	Druk [Pa]	Vermogen [W]	Stroom [A]*	Spanning [V]*	Cos phi *	Thermisch rendement [%]
Stand 1 Minimum stand	50	10	8	0,05	230	0,07	98
Stand 1 Laagstand	**75**	**20**	**12**	**0,1**	**230**	**0,55**	**98**
Stand 2 Middenstand	150	40	29	0,24	230	0,53	96,2
Stand 2 Middenstand	**150**	**80**	**38**	**0,31**	**230**	**0,53**	**96,2**
Stand 3 Hoogstand	225	100	74	0,59	230	0,59	94
Stand 3 Hoogstand	**225**	**150**	**88**	**0,69**	**230**	**0,56**	**94**
Stand 3 Hoogstand	275	100	106	0,83	230	0,56	93
Stand 3 Hoogstand	275	150	126	0,99	230	0,56	93
Stand 3 Maximum stand	325	100	156	1,22	230	0,56	92
Stand 3 Maximum stand	325	150	176	1,36	230	0,56	92
* Waarden in te vullen in de EPC berekening volgens NEN5128.							

Het thermisch rendement van de HRU ECO BAL is door TNO vastgesteld op 96,2%, onder referentienummer TNO-MEP 2002KTW/534.

Overige technische gegevens

Temperatuur rendement bij gelijke massastromen:	96,2% (gemeten conform NEN 5138)
Voedingsspanning:	230 V ± 5%
Frequentie:	50 Hz
Gewicht:	24 kg + 1 kg
Afmetingen:	hoogte 848 mm breedte 730 mm diepte 479 mm
Diameter kanalen:	150 mm inwendig en 180 mm uitwendig
Diameter condensafvoer:	40 mm uitwendig
Beschermingsgraad:	IP 31
Filterklasse:	G3

2.6 Capaciteitsgrafiek





3.4 Appliances Specifications and User Manuals

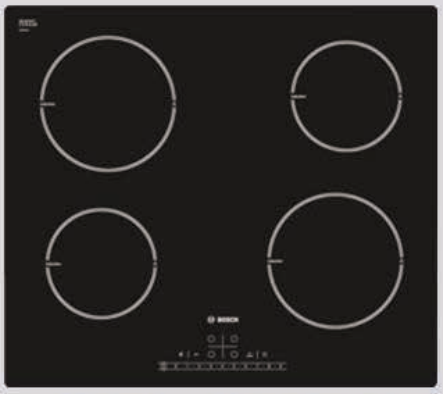
In this part of the project manual, the appliances that are included in the Pret-a-Loger pavilion are going to be presented. The criteria behind the choice of those appliances is the energy efficiency which contribute greatly in the sustainability of the whole project. The appliances chosen are among the most energy efficient currently available. First, a table with all the appliances is going to be presented. After this table, the instruction manual of each appliance is included as well. It should be noted here that no DVD-Player is included since the video function is integrated onto the chosen TV. Also all the appliances chosen are in accordance to the restrictions of the competition in RULE 20 CONTEST 6.
Remark 1: The Fridge and the Refrigerator are included in the same appliance.
Remark 2: No DVD player is included since the TV has an integrated video playback feature via USB. This is acceptable according to what is already mentioned in the WAT forum.
Remark 3: The dryer is used in the drying procedure during the competition days.

Appliance	Brand	Model	Additional Information
Fridge	Bosch	KIS86AD40	Refrigerator volume: 188lt, freezer volume: 74lt
Washing Machine	Bosch	WAY28770NL	Subcontest 6.3: kreukherstellend 40o or 50o
Dryer	Bosch	WTY88782NL	---
Dishwasher	Bosch	SBV99T10NL	Capacity: 13 place settings Subcontest 6.5: Auto 45o-65o
Hot plates	Bosch	PIA611F18E	---
Kitchen Hood	Bosch	DWB097A51 & DSZ6240	---
Oven	Bosch	HBG36B650	Volume: 67lt
TV	Samsung	UE28H4000	Diagonal length: 28''
Laptop	Apple	Macbook Pro	Diagonal length: 17''

Prêt-à-Loger



Smart-inductie (PIA611F18E)



Algemeen:
- 4 Elektronisch geregelde inductiekookzones met panwaarneming
- - Linksvoor: Ø 145 mm / 1.4 kW (met powerBoost 1.8 kW)
- - Linksachter: Ø 180 mm / 1.8 kW (met powerBoost 2.5 kW)
- - Rechtsvoor: Ø 180 mm / 1.8 kW (met powerBoost 2.5 kW)
- - Rechtsachter: Ø 145 mm / 1.4 kW (met powerBoost 1.8 kW)
- PowerBoost-functie voor alle kookzones
- Elektronische besturing met 17 standen

Design:
- HighSpeed keramisch glas
- Zonder rand

Technische specificaties:
- Inbouwmaten (bxdxh): 560 x 490 x 51 mm
- Minimale werkbladdikte: 20 mm
- Aansluitwaarde: **3,68** kW
- Aansluitsnoer: 1,1 m

Bediening:
- DirectSelect
- Timer met uitschakelfunctie voor elke kookzone
- Kookwekker
- ReStart functie
- QuickStart functie
- Weergave energieverbruik
- 2-traps restwarmte-indicatie voor elke kookzone
- Schoonmaakvergrendeling
- PowerManagement functie
- Hoofdschakelaar
- Kinderbeveiliging
- Veiligheidsuitschakeling

RVS Bakoven (HBG36B650)

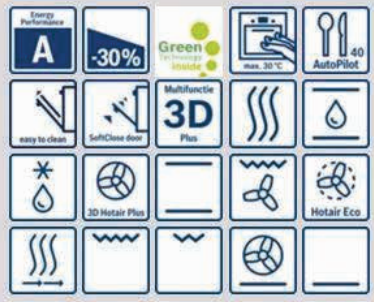


Algemeen:
- Energieklasse A
- Energieverbruik A-30%: 30% (0.64 kWh) dan de grenswaarde van energieklasse A
- Oven: Multifunctie 3D Plus (11 verwarmingssystemen: boven- en onderwarmte, onderwarmte, hydrobakken, Hetelucht eco, 3D hetelucht Plus, infra-circulatiegrill, variabele grootvlakgrill, variabele kleinvlakgrill, ontdooien, pizzastand en warmhouden)
- AutoPilot met 40 programma's
- Automatisch snel voorverwarmen

Bediening:
- Extra grote ovenruimte: 67 liter
- Ovenruimte met GranietEmail
- EcoClean: zelfreinigende katalytische achterwand (boven- en zijwanden als optionele accessoire te bestellen)
- Elektronische klok
- Dialoog-elektronica met symboolindicatie
- Nauwkeurige temperatuurregeling van 30-300°C
- Neerklapbare grill
- Te verzinken draaiknoppen, met lichtring
- Klapdeur met SoftClose
- Volledig glazen binnendeur
- Kijkvenster met comfort-warmtebescherming max. 30°C
- Comfort-binnenverlichting, uitschakelbaar
- Kinderbeveiliging
- Automatische veiligheidsuitschakeling

Uittreksysteem:
- Telescopisch uittreksysteem, tegen meerprijs leverbaar
- Vet- en geurkatalysator tegen meerprijs leverbaar

Technische specificaties:
- Inbouwmaten (hxbxd): 575 x 560 x 550 mm
- Geforceerde koeling met naventilatie
- Aansluitwaarde: 3.65 kW
- Aansluitsnoer met stekker (1,20 m)



Blokschouw en rvs module (DWB097A51 & DSZ6240)



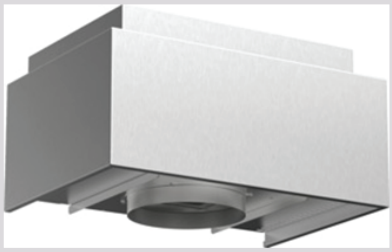
Algemeen:
- Voor wandmontage
- Geschikt voor luchtafvoer- of circulatiewerking
- Efficiënte koolborstelloze EcoSilence Drive technologie
- Afzuigcapaciteit volgens DIN/EN 61591: normaalstand 460 m³/u; intensiefstand 730 m³/u
- Dubbelzijdig zuigende ventilator
- Geluidsdruk/-niveau volgens EN 60704-3 en EN 60704-2-13 bij luchtafvoer: Max. normaalstand: 40 dB(A) / 54 dB (re 1 pW) Intensiefstand: 50 dB(A) / 64 dB (re 1 pW)
- Extreem stille werking



Design:
- Blok design

Bediening:
- Elektronische bediening via Tiptoetsen met verlicht
- 3 standen + intensiefstand
- Intensiefstand met automatische terugschakeling
- 3 x 3 W LED verlichting
- Metalen vetfilter(s), uitwasbaar
- Binnenframe

Technische specificaties:
- Afmetingen luchtafvoer (hxbxd): 642-954 x 900 x 500 mm
- Afmetingen recirculatie (hxbxd): 642-1064 x 900 x 500 mm
- Afmetingen recirculatie met CleanAir recirculatie-unit (hxbxd): 689 x 900 x 500 mm - montage op buitenschacht; 809-1139 x 900 x 500 mm - montage op binnenschacht
- Snelmontage systeem
- Diameter luchtafvoeraansluiting Ø 150 mm, 120 mm
- Aansluitwaarde: 139 W
- Voor circulatiewerking is een recirculatieset of een CleanAir recirculatie-unit (optioneel toebehoor) nodig
- Speciale schachtverlengingen mogelijk (optioneel toebehoor)



Los verkrijgbare accessoire
- Voor recirculatie
- Verbeterde afname van geuren in vergelijking tot standaard systemen met recirculatie
- Geluidsreducering
- Verlenging van vervangingsperiode koolstoffilter
- Voor montage op de buitenschacht of binnenschacht
- Bestaat uit: wandbevestiging, actief koolstoffilter, flexibele buis en 2 klemmen

Koel-diepvriescombinatie (KIS86AD40)



Algemeen
- Energieklasse: A+++; Energieverbruik: 152 kWh/jaar
- Totale netto inhoud: 262 liter
- touchControl: Elektronisch tot op de graad nauwkeurige temperatuurregeling
- Gescheiden temperatuurregeling
- Superkoelen met autom. terugschakeling
- Super-vriessysteem met invriesautomaat
- Vakantieschakeling
- Optisch en akoestisch alarmsysteem, met memory-functie

Koelruimte:
- Netto inhoud koelruimte: 188 liter
- 5 veiligheidsglas plateaus (4 in hoogte verstelbaar), waarvan 1 VarioShelf: variabel legplateau uit veiligheidsglas, 1 uitschuifbaar legplateau uit veiligheidsglas
- PowerVentilation met luchtfilter
- LED verlichting in koelgedeelte
- HydrofreshBox met luchtvochtigheidsregeling houdt groente en fruit tot 2x langer vers
- 5 deurvakken

4-Sterren diepvriesruimte:
- Netto inhoud diepvriesruimte: 74 liter
- 3 Diepvriesladen, waarvan 1 BigBox
- LowFrost: minder en sneller ontdooien
- VarioFreezing: makkelijk uitneembare glasplateus voor nog meer ruimte
- Invriescapaciteit: 10 kg per 24 uur
- Bewaartijd bij storing: 33 uur

Technische data:
- Inbouwmaten (hxbxd): 177.5 x 56 x 55 cm.
- Klimaatklasse: SN-T
- Geluidsniveau: 38 dB(A) re 1 pW
- Aansluitwaarde: 120 W

Prestatie en verbruik
- Resultaat op basis van een standaard 24 uur's test, het daadwerkelijke verbruik van het apparaat is afhankelijk van de locatie en de wijze van gebruik
- SmartCool
- Easy Installation



Gerüche

Falls Sie unangenehme Gerüche feststellen:

1. Gerät mit Ein/Aus-Taste ausschalten. Bild 2/1
2. Alle Lebensmittel aus dem Gerät herausnehmen.
3. Innenraum reinigen (siehe Kapitel Gerät reinigen).
4. Alle Verpackungen reinigen.
5. Stark riechende Lebensmittel luftdicht verpacken, um Geruchsbildung zu verhindern.
6. Gerät wieder einschalten.
7. Lebensmittel einordnen.
8. Nach 24 Stunden prüfen, ob es erneut zu Geruchsbildung gekommen ist.

Beleuchtung (LED)

Ihr Gerät ist mit einer wartungsfreien LED-Beleuchtung ausgestattet.

Reparaturen an dieser Beleuchtung dürfen nur vom Kundendienst oder autorisierten Fachkräften ausgeführt werden.

Energie sparen

- Gerät in einem trockenen, belüftbaren Raum aufstellen. Das Gerät soll nicht direkt in der Sonne oder in der Nähe einer Wärmequelle stehen (z. B. Heizkörper, Herd).

  Verwenden Sie ggf. eine Isolierplatte.
- Nischentiefe 560 mm wählen.

  Eine kleinere Nischentiefe führt zu höherer Energieaufnahme.
- Warme Lebensmittel und Getränke erst abkühlen lassen, dann ins Gerät stellen.
- Gefriergut zum Auftauen in den Kühlraum legen und die Kälte des Gefriergutes zur Kühlung von Lebensmitteln nutzen.
- Gerät so kurz wie möglich öffnen.
- Reifschicht im Gefrierraum regelmäßig abtauen.

  Die Reifschicht verschlechtert die Kälteabgabe an das Gefriergut und erhöht den Stromverbrauch.
- Darauf achten, dass die Gefrierraum-Tür immer geschlossen ist.
- Um einen erhöhten Stromverbrauch zu vermeiden, sollte die Geräterückseite gelegentlich gereinigt werden.
- Die Anordnung der Ausstattungsteile hat keinen Einfluss auf die Energieaufnahme des Gerätes.

Betriebsgeräusche

Ganz normale Geräusche

Brummen

Motoren laufen (z. B. Kälteaggregate, Ventilator).

Blubbernde, surrende oder gurgelnde Geräusche

Kältemittel fließt durch die Rohre.

Klicken

Motor, Schalter oder Magnetventile schalten ein/aus.

Geräusche vermeiden

Das Gerät steht uneben

Richten Sie das Gerät mit Hilfe einer Wasserwaage aus. Legen Sie, falls notwendig, etwas unter.

Behälter oder Abstellflächen wackeln oder klemmen

Prüfen Sie die herausnehmbaren Teile und setzen Sie sie eventuell neu ein.

Flaschen oder Gefäße berühren sich

Rücken Sie die Flaschen oder Gefäße leicht auseinander.

Kleine Störungen selbst beheben

Bevor Sie den Kundendienst rufen:

Überprüfen Sie, ob Sie die Störung aufgrund der folgenden Hinweise selbst beheben können.

Sie müssen die Kosten für Beratung durch den Kundendienst selbst übernehmen – auch während der Garantiezeit!

Störung	Mögliche Ursache	Abhilfe
Temperatur weicht stark von der Einstellung ab.		In einigen Fällen reicht es, wenn Sie das Gerät für 5 Minuten ausschalten. Ist die Temperatur zu warm, prüfen Sie nach wenigen Stunden, ob eine Temperaturannäherung erfolgt ist. Ist die Temperatur zu kalt, prüfen Sie am nächsten Tag die Temperatur nochmal.
Keine Anzeige leuchtet.	Stromausfall; die Sicherung hat ausgelöst; der Netzstecker sitzt nicht fest.	Netzstecker anschließen. Prüfen, ob Strom vorhanden ist, Sicherungen überprüfen.
Temperaturanzeige zeigt „E..“ an.	Elektronik hat einen Fehler erkannt.	Kundendienst rufen.

Störung	Mögliche Ursache	Abhilfe
Warnton ertönt, Alarm-Taste leuchtet. Bild 2/5 Im Gefrierraum ist es zu warm! Gefahr für das Gefriergut!		Zum Abschalten des Warntones Alarm-Taste 5 drücken.
	Gerät ist geöffnet.	Gerät schließen.
	Be- und Entlüftungsöffnungen sind verdeckt.	Be- und Entlüftung sicherstellen.
	Es wurden zu viele Lebensmittel auf einmal zum Gefrieren eingelegt.	Max. Gefriervermögen nicht überschreiten.
		Nach Beheben der Störung hört die Alarm-Taste 5 nach einiger Zeit auf zu leuchten.
Temperaturanzeige Gefrierraum blinkt, Bild 2/4 Warnton ertönt Taste Alarm leuchtet. Bild 2/5 Im Gefrierraum ist es zu warm! Gefahr für das Gefriergut!		Zum Abschalten des Warntones Alarm-Taste Bild 2/5 drücken.
	Gerät ist geöffnet.	Gerät schließen.
	Be- und Entlüftungsöffnungen sind verdeckt.	Be- und Entlüftung sicherstellen.
	Es wurden zu viele Lebensmittel auf einmal zum Gefrieren eingelegt.	Max. Gefriervermögen nicht überschreiten.
		Nach Beheben der Störung erlischt die Anzeige Alarm nach einiger Zeit.
Temperaturanzeige Gefrierraum blinkt, Bild 2/4	Durch eine Störung war es in der Vergangenheit im Gefrierraum zu warm.	Nach Drücken der Alarm-Taste 5 wird das Blinken der Temperaturanzeige abgeschaltet. Bild 2/4 Temperaturanzeige zeigt fünf Sekunden lang die wärmste Temperatur an, die im Gefrierraum geherrscht hat.
Gerät kühlt nicht, Temperaturanzeige und Beleuchtung leuchten.	Ausstellungsmodus ist eingeschaltet.	Alarm-Taste Bild 2/5 für 10 Sekunden gedrückt halten, bis ein Bestätigungston ertönt. Überprüfen Sie nach einiger Zeit, ob Ihr Gerät kühlt.

Geräte-Selbsttest

Ihr Gerät verfügt über ein automatisches Selbsttestprogramm, das Ihnen Fehlerquellen anzeigt, die nur von Ihrem Kundendienst behoben werden können.

Geräte-Selbsttest starten

1. Gerät ausschalten und 5 Minuten warten.
2. Gerät einschalten.
3. Alarm-Taste Bild 2/5 drücken, um den Alarm abzuschalten.

   Wenn kein Warnton ertönt entfällt dieser Schritt.
4. Innerhalb der ersten 10 Sekunden nach dem Einschalten des Geräts für 3 bis 5 Sekunden die Super-Taste Bild 2/2 gedrückt halten, bis ein akustisches Signal ertönt.

   Das Selbsttestprogramm startet. Während der Selbsttest läuft, ertönt ein langes akustisches Signal.

Wenn der Selbsttest beendet ist und zweimal ein akustisches Signal ertönt, ist Ihr Gerät in Ordnung.

Blinkt die Super-Taste 10 Sekunden und ertönen 5 akustische Signale, handelt es sich um einen Fehler. Benachrichtigen Sie den Kundendienst.

Geräte-Selbsttest beenden

Nach Ablauf des Programmes geht das Gerät in den Regelbetrieb über.

Kundendienst

Einen Kundendienst in Ihrer Nähe finden Sie im Telefonbuch oder im Kundendienst-Verzeichnis. Geben Sie bitte dem Kundendienst die Erzeugnisnummer (E-Nr.) und die Fertigungsnummer (FD-Nr.) des Gerätes an.

Sie finden diese Angaben auf dem Typenschild. Bild 14

Bitte helfen Sie durch Nennung der Erzeugnis- und Fertigungsnummer mit, unnötige Anfahrten zu vermeiden. Sie sparen die damit verbundenen Mehrkosten.

Reparaturauftrag und Beratung bei Störungen

Die Kontaktdaten aller Länder finden Sie im beiliegenden Kundendienst-Verzeichnis.

D	01801 22 33 55	0,039 €/Min. aus dem Festnetz, Mobilfunk max. 0,42 €/Min.
A	0810 550 511	
CH	0848 840 040	

Safety and warning information

Before you switch ON the appliance

Please read the operating and installation instructions carefully! They contain important information on how to install, use and maintain the appliance.

The manufacturer is not liable if you fail to comply with the instructions and warnings. Retain all documents for subsequent use or for the next owner.

Technical safety

This appliance contains a small quantity of environmentally-friendly but flammable R600a refrigerant. Ensure that the tubing of the refrigerant circuit is not damaged during transportation and installation. Leaking refrigerant may cause eye injuries or ignite.

If damage has occurred

- Keep naked flames and/or ignition sources away from the appliance,
- thoroughly ventilate the room for several minutes,
- switch off the appliance and pull out the mains plug,
- inform customer service.

The more refrigerant an appliance contains, the larger the room must be in which the appliance is situated. Leaking refrigerant can form a flammable gas-air mixture in rooms which are too small.
The room must be at least 1 m^3 per 8 g of refrigerant. The amount of refrigerant in your appliance is indicated on the rating plate inside the appliance.

If the power cord of this appliance is damaged, it must be replaced by the manufacturer, customer service or a similarly qualified person. Improper installations and repairs may put the user at considerable risk.

Repairs may be performed by the manufacturer, customer service or a similarly qualified person only.

Only original parts supplied by the manufacturer may be used. The manufacturer guarantees that only these parts satisfy the safety requirements.

A extension cable may be purchased from customer service only.

Important information when using the appliance

- Never use electrical appliances inside the appliance (e.g. heater, electric ice maker, etc.). Risk of explosion!
- Never use a steam cleaner to defrost or clean the appliance! The steam may penetrate electrical parts and cause a short-circuit. Risk of electric shock!
- Do not use pointed or sharp-edged implements to remove frost or layers of ice. You could damage the refrigerant tubing.
  Leaking refrigerant may ignite or cause eye injuries.
- Do not store products which contain flammable propellants (e.g. spray cans) or explosive substances in the appliance. Risk of explosion!
- Do not stand or support yourself on the base, drawers or doors, etc.
- Before defrosting and cleaning the appliance, pull out the mains plug or switch off the fuse.
  Do not pull out the mains plug by tugging the cable.
- Bottles which contain a high percentage of alcohol must be sealed and stored in an upright position.
- Keep plastic parts and the door seal free of oil and grease.
  Otherwise, parts and door seal will become porous.
- Never cover or block the ventilation openings for the appliance.
- People (childern incl.) who have limited physical, sensory or mental abilities or inadequate knowledge must not use this appliance unless they are supervised or given meticulous instructions.
- Do not store bottled or canned drinks (especially carbonated drinks) in the freezer compartment. Bottles and cans may explode!
- Never put frozen food straight from the freezer compartment into your mouth.
  Risk of low-temperature burns!
- Avoid prolonged touching of frozen food, ice or the evaporator pipes, etc. Risk of low-temperature burns!

Children in the household

- Keep children away from packaging and its parts.
  Danger of suffocation from folding cartons and plastic film!
- Do not allow children to play with the appliance!
- If the appliance features a lock: keep the key out of the reach of children!

General regulations

The appliance is suitable

- for refrigerating and freezing food,
- for making ice.

This appliance is intended for use in the home and the home environment.

The appliance is suppressed according to EU Directive 2004/108/EC.

The refrigeration circuit has been checked for leaks.

This product complies with the relevant safety regulations for electrical appliances (EN 60335-2-24).



Information concerning disposal

♻ Disposal of packaging

The packaging protects your appliance from damage during transit. All utilised materials are environmentally safe and recyclable. Please help us by disposing of the packaging in an environmentally friendly manner.

Please ask your dealer or inquire at your local authority about current means of disposal.

♻ Disposal of your old appliance

Old appliances are not worthless rubbish! Valuable raw materials can be reclaimed by recycling old appliances.



This appliance is identified according to the European guideline 2002/96/EC on waste electrical and electronic equipment – WEEE. The directive specifies the framework for an EU-wide valid return and re-use of old appliances.

⚠ Warning

Redundant appliances

1. Pull out the mains plug.
2. Cut off the power cord and discard with the mains plug.
3. Do not take out the trays and receptacles: children are therefore prevented from climbing in!
4. Do not allow children to play with the appliance once it has spent its useful life. Danger of suffocation!

Refrigerators contain refrigerant and gases in the insulation.
Refrigerant and gases must be disposed of professionally. Ensure that tubing of the refrigerant circuit is not damaged prior to proper disposal.

Scope of delivery

After unpacking all parts, check for any damage in transit.

If you have any complaints, please contact the dealer from whom you purchased the appliance or our customer service.

The delivery consists of the following parts:

- Built-in appliance
- Interior fittings (depending on model)
- Bag containing installation materials
- Operating instructions
- Installation manual
- Customer service booklet
- Warranty enclosure
- Information on the energy consumption and noises

Room temperature, ventilation and cavity depth

Ambient temperature

The appliance is designed for a specific climate class. Depending on the climate class, the appliance can be operated at the following temperatures.

The climate class can be found on the rating plate. Fig. 14

Climate class	Permitted ambient temperature
SN	+10 °C to 32 °C
N	+16 °C to 32 °C
ST	+16 °C to 38 °C
T	+16 °C to 43 °C

Note

The appliance is fully functional within the room temperature limits of the indicated climatic class. If an appliance of climatic class SN is operated at colder room temperatures, the appliance will not be damaged up to a temperature of +5 °C.

Ventilation

The air on the rear panel of the appliance heats up. Conduction of the heated air must not be obstructed.
Otherwise, the refrigeration unit must work harder. This increases power consumption. Therefore: Never cover or block the ventilation openings!

Cavity depth

A cavity depth of 560 mm is recommended for the appliance.
If the cavity depth is smaller – at least 550 mm – the energy consumption increases slightly.

Installation location

Install the appliance in a dry, well ventilated room. The installation location should neither be exposed to direct sunlight nor near a heat source, e. g. a cooker, radiator, etc. If installation next to a heat source is unavoidable, use a suitable insulating plate or observe the following minimum distances to a heat source:

- 3 cm to electric or gas cookers.
- 30 cm to an oil or coal-fired cooker.

Connecting the appliance

After installing the appliance, wait at least 1 hour until the appliance is switched on. During transportation the oil in the compressor may have flowed into the refrigeration system.

Before switching on the appliance for the first time, clean the interior of the appliance (see chapter “Cleaning the appliance”).

Electrical connection

The socket must be near the appliance and also freely accessible following installation of the appliance.

The appliance complies with the protection class I. Connect the appliance to 220–240 V/50 Hz alternating current via a correctly installed socket with protective conductor. The socket must be fused with a 10 to 16 A fuse.

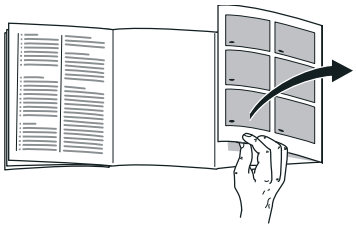
For appliances operated in non-European countries, check whether the stated voltage and current type match the values of your mains supply.
This information can be found on the rating plate. Fig. 14

⚠ Warning

Never connect the appliance to electronic energy saver plugs.

Our appliances can be used with mains and sine-controlled inverters.
Mains-controlled inverters are used for photovoltaic systems which are connected directly to the national grid.
Sine-controlled inverters must be used for isolated applications (e.g. on ships or in mountain lodges) which are not connected directly to the national grid.

Getting to know your appliance



Please fold out the illustrated last page.
These operating instructions refer to several models.

The features of the models may vary.

The diagrams may differ.

Fig. 1

* Not all models.

1-9	Controls
10 *	Fan
11	Light
12	Glass shelf in the refrigerator compartment
13	Extendable glass shelf
14	Vegetable container
15 *	Berry tray
16	Freezer calendar
17	Frozen food container
18	Butter and cheese compartment
19	Door shelf
20 *	Vario door shelf
21	Shelf for large bottles

A	Refrigerator compartment
B	Freezer compartment

Controls

Fig. 2

1 **On/Off button**
Serves to switch the whole appliance on and off.

2 **“Super” button (freezer compartment)**
Switches super freezing on and off.

3 **Temperature selection buttons freezer compartment**
These buttons set the temperature in the freezer compartment.

4 **Temperature display freezer compartment**
The numbers correspond to the set freezer compartment temperatures in °C.

5 **Alarm button**
Used to switch off the warning signal, see chapter “Alarm function”.

6 **Holiday button**
Is used to switch vacation mode on and off (see chapter entitled Vacation mode).

7 **Temperature selection buttons refrigerator compartment**
These buttons set the temperature in the refrigerator compartment.

8 **Temperature display refrigerator compartment**
The numbers correspond to the set refrigerator compartment temperatures in °C.

9 **“Super” button refrigerator compartment**
Switches super cooling on and off.

Switching the appliance on

Fig. 2

1. Switch on the appliance with the On/Off button 1.
   A warning signal sounds, the temperature display 4 flashes and the alarm button 5 is lit.
2. The warning signal is switched off by pressing the alarm button 5.
   The appliance begins to cool. Light is switched on when the door is open.

The factory has recommended the following temperatures:

- Refrigerator compartment: +4 °C
- Freezer compartment: -18 °C

Operating tips

- When the appliance has been switched on, it may take several hours until the set temperatures have been reached.
  Do not put any food in the appliance beforehand.
- The sides of the housing are sometimes heated slightly. This prevents condensation in the area of the door seal.
- If the freezer compartment door cannot be immediately re-opened after it has been closed, wait until the resulting low pressure has equalised.

Setting the temperature

Fig. 2

Refrigerator compartment

The temperature can be set from +2 °C to +8 °C.

Keep pressing temperature setting button 7 until the required refrigerator compartment temperature is set.

The value last selected is saved. The set temperature is indicated on temperature display 8.

Freezer compartment

The temperature can be set from -16 °C to -24 °C.

Keep pressing temperature setting button 3 until the required freezer compartment temperature is set.

The value last selected is saved. The set temperature is indicated on display 4.

Holiday mode

If leaving the appliance for a long period of time, you can switch the appliance over to the energy-saving holiday mode.

The temperature of the refrigerator compartment is automatically switched to +14 °C.

Do not store any food in the refrigerator compartment during this time.

Switching on and off

Fig. 2

Press the holiday button 6.

If vacation mode is switched on, the button is lit and the refrigerator compartment temperature 8, no longer indicates a temperature.

Alarm functions

Door alarm

The door alarm (continuous sound) switches on if the appliance door is open for longer than one minute.
Close the door to switch off the warning signal.

Temperature alarm

The temperature alarm switches on if the freezer compartment is too warm and the frozen food is at risk of thawing.

When the alarm button 5 is pressed, the freezer compartment temperature display 4 indicates for five seconds the warmest temperature reached in the freezer compartment.

Then this value is deleted.
The temperature display for the freezer compartment 4 indicates the set freezer compartment temperature without flashing.

Henceforth the “warmest temperature” will be redefined and saved.

The alarm may switch on without any risk to the frozen food:

- when the appliance is switched on,
- when large quantities of fresh food are placed in the appliance,
- if the freezer compartment door is open too long.

Note

Do not refreeze thawing or thawed food. Only ready meals (boiled or fried) may be refrozen.

No longer store the frozen produce for the max. storage period.

Switching off the alarm

Fig. 2
Press the alarm button 5 to switch off the warning signal.

Usable capacity

Information on the usable capacity can be found inside your appliance on the rating plate. Fig. 14

Fully utilising the freezer volume

The maximum amount of food can be placed in the freezer by removing all fittings. The food can be stacked directly on the shelves and in the bottom of the freezer compartment.

Removing the fittings

Pull out the frozen food container all the way, lift at the front and remove. Fig. 3

Refrigerator compartment

The refrigerator compartment is the ideal storage location for meat, sausage, fish, dairy products, eggs, ready meals and pastries.

Storing food

- Store fresh, undamaged food. The quality and freshness will then be retained for longer.
- In the case of ready-made products and bottled goods, observe the best-before date or use-by date specified by the manufacturer.
- To retain aroma, colour and freshness, pack or cover food well before placing in the appliance. This will prevent the transfer of flavours and the discolouration of plastic parts in the refrigerator compartment.
- Allow warm food and drinks to cool down before placing in the appliance.

Note

Avoid contact between food and rear panel. Otherwise the air circulation will be impaired.

Food or packaging could freeze to the rear panel.

Note the chill zones in the refrigerator compartment

The air circulation in the refrigerator compartment creates different chill zones:

- Coldest zone is between the arrow stamped on the side and the glass shelf situated below. Fig. 5

  Note

  Store perishable food (e.g. fish, sausage, meat) in the coldest zone.

- Warmest zone is at the very top of the door.

  Note

  Store e.g. hard cheese and butter in the warmest zone. Cheese can then continue to release its flavour and the butter will still be easy to spread.

Vegetable container with humidity controller

Fig. 4

The vegetable container is the optimum storage location for fresh fruit and vegetables. A humidity controller and a special seal can be used to adjust the air humidity in the vegetable container. This allows fresh fruit and vegetables to be stored twice as long as with conventional storage.

The air humidity in the vegetable container can be set according to the type and amount of products to be stored:

- Mainly fruit as well as for a large load – lower air humidity
- Mainly vegetables as well as for a mixed load or small load – higher air humidity

Notes

- Fruit sensitive to cold (e.g. pineapple, banana, papaya and citrus fruit) and vegetables sensitive to cold (e.g. aubergines, cucumbers, zucchini, peppers, tomatoes and potatoes) should be stored outside the refrigerator at temperatures of approx. +8 °C to +12 °C for optimum preservation of quality and flavour.
- Condensation may form in the vegetable container depending on the type and quantity of products stored. Remove condensation with a dry cloth and adjust air humidity in the vegetable container with the humidity controller.

Super cooling

Super cooling sets the refrigerator temperature to the coldest temperature setting for approx. 15 hours. Then the appliance automatically switches to the temperature set prior to super cooling mode.

Switch on super cooling mode, e.g.

- before placing large quantities of food in the refrigerator compartment.
- for the fast cooling of drinks.

Note

When super cooling is switched on, increased operating noises may occur.

Switching on and off

Fig. 2

Press super button 9 refrigerator compartment.

The button is lit when super cooling is switched on.

Freezer compartment

Use the freezer compartment

- To store deep-frozen food.
- To make ice cubes.
- To freeze food.

Note

Ensure that the freezer compartment door has been closed properly. If the door is open, the frozen food will thaw. The freezer compartment will become covered in thick ice. Also: waste of energy due to high power consumption!

Max. freezing capacity

Information about the max. freezing capacity within 24 hours can be found on the rating plate. Fig. 14

Prerequisites for max. freezing capacity

- Switch on super freezing before placing fresh products in the compartment (see chapter entitled “Super freezing”).
- Remove the fittings. The food can be stacked directly on the shelves and in the bottom of the freezer compartment.
- Large quantities of food are frozen most quickly in the top compartment. If the top compartment is not adequate for the freezing capacity indicated on the rating plate, you can place the remaining quantity in the compartment underneath starting at the front right side.
- Freeze fresh food as close as possible to the side panels.

Freezing and storing food

Purchasing frozen food

- Packaging must not be damaged.
- Use by the “use by” date.
- Temperature in the supermarket freezer must be -18 °C or lower.
- If possible, transport deep-frozen food in an insulated bag and place quickly in the freezer compartment.

Note when loading products

- Freeze large quantities of food preferably in the very top compartment where food freezes particularly quickly and therefore also gently.
- Place the food over the whole area of the compartments or the frozen food containers.

  Note

  Food which is already frozen must not come into contact with the food which is to be frozen. If required, move the frozen food to the frozen food containers.

Storing frozen food

Insert frozen food container all the way to ensure unrestricted air circulation.

Freezing fresh food

Freeze fresh and undamaged food only.

To retain the best possible nutritional value, flavour and colour, vegetables should be blanched before freezing. Aubergines, peppers, zucchini and asparagus do not require blanching.

Literature on freezing and blanching can be found in bookshops.

Note

Keep food which is to be frozen away from food which is already frozen.

- The following foods are suitable for freezing:
  Cakes and pastries, fish and seafood, meat, game, poultry, vegetables, fruit, herbs, eggs without shells, dairy products such as cheese, butter and quark, ready meals and leftovers such as soups, stews, cooked meat and fish, potato dishes, soufflés and desserts.
- The following foods are not suitable for freezing:
  Types of vegetables, which are usually consumed raw, such as lettuce or radishes, eggs in shells, grapes, whole apples, pears and peaches, hard-boiled eggs, yoghurt, soured milk, sour cream, crème fraîche and mayonnaise.

Packing frozen food

To prevent food from losing its flavour or drying out, place in airtight containers.

1. Place food in packaging.
2. Remove air.
3. Seal the wrapping.
4. Label packaging with contents and date of freezing.

Suitable packaging:

Plastic film, tubular film made of polyethylene, aluminium foil, freezer containers.
These products are available from specialist outlets.

Unsuitable packaging:

Wrapping paper, greaseproof paper, cellophane, bin liners and used shopping bags.

Items suitable for sealing packaged food:

Rubber bands, plastic clips, string, cold-resistant adhesive tape, etc.

Bags and tubular film made of polyethylene can be sealed with a film heat sealer.

Shelf life of frozen food

Storage duration depends on the type of food.

At a temperature of -18 °C:

- Fish, sausage, ready meals and cakes and pastries:
  up to 6 months
- Cheese, poultry and meat:
  up to 8 months
- Vegetables and fruit:
  up to 12 months

Super freezing

Food should be frozen solid as quickly as possible in order to retain vitamins, nutritional value, appearance and flavour.

Several hours before placing fresh food in the freezer compartment, switch on super freezing to prevent an unwanted temperature rise.

As a rule, 4-6 hours is adequate.

This appliance runs constantly and the freezer compartment drops to a very low temperature.

If the max. freezing capacity is to be used, super freezing must be switched on for 24 hours before the fresh produce is placed in the freezer compartment.

You can place smaller quantities of food (up to 2 kg) in the top compartment without super freezing.

Note

When super freezing is switched on, increased operating noises may occur.

Switching on and off

Fig. **2**

Press “super” button 2.

If the super freezing has been switched on the button is lit.

Super freezing automatically switches off after approx. 2½ days.

Thawing frozen food

Depending on the type and application, select one of the following options:

- at room temperature
- in the refrigerator
- in an electric oven, with/without fan assisted hot-air
- in the microwave

⚠ Caution

Do not refreeze thawing or thawed food. Only ready meals (boiled or fried) may be refrozen.

No longer store the frozen produce for the max. storage period.

Interior fittings

(not all models)

Glass shelves

Fig. **6**

If required, you can vary the shelves inside the appliance: To do this, pull out shelf, lift at the front and take out.

Extendable glass shelf

Fig. **7**

The extendable glass shelf can be pulled out for a better overview of the food.

Vario shelf

Fig. **8**

To facilitate the storage of tall items (e.g. cans or bottles), the front part of the Vario shelf can be taken out and pushed under the rear part.

Vario door shelf

Fig. 9
The position of the Vario door shelf can be moved to the side so that tall bottles can be stored on the lower shelf.

Bottle holder

Fig. 10
The bottle holder prevents bottles from falling over when the door is opened and closed.

Freezer calendar

Fig. 1/16

To prevent the quality of the frozen food from deteriorating, do not exceed the storage duration. The storage period depends on the type of produce.
The figures next to the symbols indicate the permitted storage period of the produce in months. In the case of commercially available frozen food observe the date of manufacture or use-by date.

Ice cube tray

Fill the ice cube tray ¾ full of drinking water and place in the freezer compartment.

If the ice tray is stuck to the freezer compartment, loosen with a blunt implement only (spoon-handle).

To loosen the ice cubes, twist the ice tray slightly or hold briefly under flowing water.

Ice pack

(if enclosed, quantity varies)

If a power failure or malfunction occurs, the ice packs can be used to slow down the thawing process. The longest storage time is obtained by placing the ice pack on the food in the top compartment.

The ice packs can also be used to cool food temporarily, e.g. in a cold bag.

Sticker “OK”

(not all models)

The “OK” temperature monitor can be used to determine temperatures below +4 °C. Gradually reduce the temperature if the sticker does not indicate “OK”.

Note

When the appliance is switched on, it may take 12 hours until the temperature is reached.



Correct setting

Switching off and disconnecting the appliance

Switching off the appliance

Fig. 2

Press the On/Off button 1.
Temperature display goes out, refrigerating unit switches off.

Disconnecting the appliance

If you do not use the appliance for a prolonged period:

1. Switch off the appliance.
2. Pull out mains plug or switch off fuse.
3. Clean the appliance.
4. Leave the appliance door open.

Defrosting

Refrigerator compartment defrosts fully automatically

While the refrigerating unit is running, beads of condensation or hoarfrost form at the back of the refrigerator compartment. This is quite normal. It is not necessary to wipe off the condensation or frost. The rear panel defrosts automatically. The condensation runs into the condensation channel, Fig. 11. and is conveyed to the refrigerating unit where it evaporates.

Note

Keep the condensation channel and drainage hole clean, so that the condensation can run out.

Defrosting the freezer compartment

The freezer compartment does not defrost automatically, otherwise the frozen food would start thawing. A layer of frost in the freezer compartment impairs refrigeration of the frozen food and increases power consumption. Remove the layer of hoarfrost regularly.

⚠ Caution

Do not scrape off hoarfrost or ice with a knife or pointed object. You could damage the refrigerant tubes.
Leaking refrigerant may ignite or cause eye injuries.

Proceed as follows:

Note

Approx. 4 hours before defrosting the appliance, switch on super freezing so that the food drops to a very low temperature and can therefore be stored at room temperature for a longer period.

1. Remove the frozen food and place temporarily in a cool location.
2. Switch the appliance off.
3. Pull out the mains plug or remove the fuse.
4. To accelerate the defrosting process, place a pan of hot water on a trivet in the freezer compartment. Fig. 12
5. Wipe up condensation with a cloth or sponge.
6. Wipe dry the freezer compartment.
7. Switch the appliance on again.
8. Put the frozen food back in the freezer compartment.

Cleaning the appliance

⚠ Caution

- Do not use abrasive, chloride or acidic cleaning agents or solvents.
- Do not use scouring or abrasive sponges. The metallic surfaces could corrode.
- Never clean the shelves or containers in the dishwasher. The parts may become deformed!

Proceed as follows:

1. Before cleaning: Switch off the appliance.
2. Pull out the mains plug or switch off the fuse!
3. Take out the food and store in a cool location. Place ice pack (if available) on the food.
4. Wait until the layer of frost has thawed.
5. Clean the appliance with a soft cloth, lukewarm water and a little pH neutral washing-up liquid. The rinsing water must not run into the light or through the drainage hole into the evaporation area.
6. Wipe the door seal with clear water only and then wipe dry thoroughly.
7. After cleaning reconnect and switch the appliance back on.
8. Put the food back into the appliance.

Interior fittings

All variable parts of the appliance can be taken out for cleaning.

Take out glass shelves

Fig. 6

To do this, pull out shelf, lift at the front and take out.

Taking out extendable glass shelf

Fig. 7

Press levers on the underside on both sides, pull forwards glass shelf, lower and swivel out to the side.

Condensation channel

Fig. 11

Regularly clean the condensation channel and drainage hole with a cotton bud or similar implement to ensure that the condensation can drain.

Take out shelves in the door

Fig. 13

Lift shelves upwards and take out.

Taking out glass shelf above vegetable container

Fig. 15

The glass shelf can be taken out and disassembled for cleaning.

Note

Before taking out the glass shelf, pull out vegetable container.

Removing the container

Fig. 3

Pull out the container all the way, lift at the front and remove.

Odours

If you experience unpleasant odours:

1. Switch off the appliance with the On/Off button. Fig. 2/1
2. Take all food out of the appliance.
3. Clean interior (see chapter “Cleaning the appliance”).
4. Clean all packages.
5. Seal strong smelling food in order to avoid odours from forming.
6. Switch the appliance on again.
7. Store food in the appliance.
8. Check whether the formation of odours is still occuring after 24 hours.

Light (LED)

Your appliance features a maintenance-free LED light.

These lights may be repaired by customer service or authorised technicians only.

Tips for saving energy

- Install the appliance in a dry, well ventilated room! The appliance should not be installed in direct sunlight or near a heat source (e.g. radiator, cooker).

  If required, use an insulating plate.
- Select 560 mm cavity depth.

  A smaller cavity depth will result in a higher energy consumption.
- Allow warm food and drinks to cool down before placing in the appliance.
- Thaw frozen food in the refrigerator compartment and use the low temperature of the frozen food to cool refrigerated food.
- Open the appliance as briefly as possible.
- Regularly defrost the freezer compartment to remove the layer of frost.

  A layer of hoarfrost will impair refrigeration of the frozen food and increase power consumption.
- Ensure that the freezer compartment door is always closed properly.
- Occasionally clean the rear of the appliance to prevent an increased power consumption.
- The arrangement of the fittings does not affect the energy rating of the appliance.

Operating noises

Quite normal noises

Droning

Motors are running (e.g. refrigerating units, fan).

Bubbling, humming or gurgling noises

Refrigerant is flowing through the tubing.

Clicking

Motor, switches or solenoid valves are switching on/off.

Preventing noises

The appliance is not level

Please align the appliance with a spirit level. If required, place something underneath.

Containers or storage areas wobble or stick

Please check the removable parts and re-insert them correctly if required.

Bottles or receptacles are touching each other

Move the bottles or receptacles slightly away from each other.

Eliminating minor faults yourself

Before you call customer service:

Please check whether you can eliminate the fault yourself based on the following information.

Customer service will charge you for advice – even if the appliance is still under guarantee!

Fault	Possible cause	Remedial action
Temperature differs greatly from the set value.		In some cases it is adequate to switch off the appliance for 5 minutes. If the temperature is too high wait a few hours and check whether the temperature has approached the set value. If the temperature is too low check the temperature again the next day.
Displays do not illuminate.	Power failure; the fuse has been switched off; the mains plug has not been inserted properly.	Connect mains plug. Check whether the power is on, check the fuses.
Temperature display indicates “E..”.	Electronics have detected a fault.	Call customer service.

Fault	Possible cause	Remedial action
Warning signal sounds, “alarm” button lights up. Fig. 2/5 The freezer compartment is too warm! Frozen food is at risk!		To switch off the warning signal, press the “alarm” button 5.
	Appliance is open.	Close the appliance.
	Ventilation openings have been covered.	Ensure that there is adequate ventilation.
	Too much food was placed in the freezer compartment at once.	Do not exceed max. freezing capacity.
		When the fault has been eliminated, the “alarm” button 5 goes out shortly afterwards.
Freezer compartment temperature display flashes. Fig. 2/4 Warning signal sounds. The alarm button is lit. Fig. 2/5 The freezer compartment is too warm! Frozen food is at risk!		To switch off the warning signal, press the “alarm” button, Fig. 2/5.
	Appliance is open.	Close the appliance.
	Ventilation openings have been covered.	Ensure that there is adequate ventilation.
	Too much food was placed in the freezer compartment at once.	Do not exceed max. freezing capacity.
		When the fault has been eliminated, the alarm display goes out shortly afterwards.
Freezer compartment temperature display flashes. Fig. 2/4	A fault caused the freezer compartment to become too warm in the past.	When the alarm button 5 is pressed, the temperature display stops flashing. Fig. 2/4 The temperature display indicates for 5 seconds the warmest temperature which was reached in the freezer compartment.
Appliance is not cooling, temperature display and light are lit.	Showroom mode is switched on.	Hold down alarm button, Fig 2/5, for 10 seconds until an acknowledgement signal sounds. After a short time check whether your appliance is cooling.

Appliance self-test

Your appliance features an automatic self-test program which shows you sources of faults which may be repaired by customer service only.

Starting the appliance self-test

1. Switch off the appliance and wait 5 minutes.
2. Switch the appliance on.
3. Press alarm button, Fig. 2/5, to switch off the warning signal.

   If there is no warning signal, this step is not applicable.
4. Within the first 10 seconds after switching on the appliance, hold down the super button, Fig. 2/2, for 3 to 5 seconds until an acoustic signal sounds.

   The self-test programme starts. While the self-test is running, a long acoustic signal sounds.

When the self-test ends and an acoustic signal sounds twice, your appliance is in working order.

If the super button flashes for 10 seconds and 5 acoustic signals sound, there is a fault. Inform customer service.

Ending the appliance self-test

When the programme has ended, the appliance switches over to normal operation.

Customer service

Your local customer service can be found in the telephone directory or in the customer-service index.
Please provide customer service with the appliance product number (E-Nr.) and production number (FD).

These specifications can be found on the rating plate. Fig. 14

To prevent unnecessary call-outs, please assist customer service by quoting the product and production numbers. This will save you additional costs.

Repair order and advice on faults

Contact information for all countries can be found on the enclosed customer service list.

GB	0844 892 8979	Calls from a BT landline will be charged at up to 3 pence per minute. A call set-up fee of up to 6 pence may apply.
IE	01450 2655	
US	800 944 2904	toll-free

BOSCH







Bosch
WAY28770NL
Wasmachine

Voorganger:

Opvolger:

EAN-code:
4242002743516

Verkoopprogramma:

WAY28770NL
HomeProfessional
Wasmachine

Algemeen:
- Vulgewicht: 1 - 8 kg
- Energieklasse A+++-40%
- Max. centrifugesnelheid: 1400 rpm
- Centrifuge droogklasse: B
- 10 jaar garantie op de koolborstelloze motor

Comfort / Zekerheid:
- AquaStop waterbeveiliging met levenslange garantie
- AntiVibration Design: stabiliteit en stilte
- activeWater: zuinig en nauwkeurig watermanagement
- EcoSilence Drive: meest energiezuinige en stille motortechnologie
- varioPerfect: tijd- of energiebesparing bij maximaal wasresultaat
- VarioSoft trommel: uiterst voorzichtig of uiterst intensief wassen
- Beladingssensor en doseeradvies
- Speciale programma's: Kreukherstellend, Dons, Overhemden, Sport, Extra snel 15', Snel+mix, Memory 1, Memory 2, Allergie+, voorzichtig centrifugeren, Handdoeken, Wol-handwas, Fijn/Zijde
- Vlekkenautomaat met 16 vlekkenprogramma's
- TFT tekstdisplay voor intuitive bediening
- TouchControl toetsen met LED indicatie: start/pauze, temperatuurkeuze, centrifugetoerentalkeuze, Vlekkenautomaat, ecoPerfect, speedPerfect, Opties, Basisinstellingen und 24 u eindtijdkeuze
- LED programmaknop met aan/uitschakelaar
- Koudwas mogelijkheid op alle programma's
- Doorstroomsensor voor optimaal waterverbruik
- Multitoon geluidssignalen
- Opties: Extra water, Voorwas, Stil wassen, Licht strijken, Extra spoelen, Geen eindcentrifugeren
- Zelfreinigende wasmiddellade
- Uitgestelde eindtijd 24 uur en resttijdindicatie
- Kinderbeveiliging op de deur
- Bijvulfunctie
- Soepel deurslot voor makkelijk openen en sluiten
- Geluidsisolatie
- Waterniveau-automaat
- Schuimherkenning

Technische specificaties:
- Energieverbruik 117 kWh per jaar, gebaseerd op 220 standaard katoenwasprogramma's volgens norm energielabel
- Waterverbruik 10500 liter per jaar, gebaseerd op 220 standaard katoenwasprogramma's volgens norm energielabel
- Geluidsniveau wassen : 51 dB (A)

Toebehoren

Optionele accessoires

- WMZ20430 ONDERBOUWTOEBEHOREN VR ALLE WASMACH
- WMZ20490 Voetstuk met onderlade
- WMZ2200 Onderbouwset
- WMZ2380 AquaStop verlengslang

In andere kleuren leverbaar

Technische Data

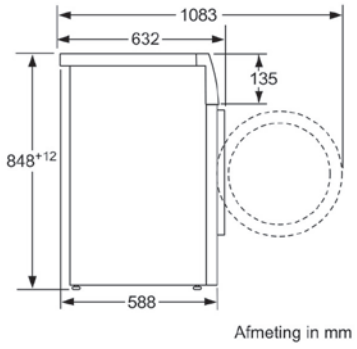
Kenmerken
Uitvoering : Vrijstaand
Links-/rechtsdraaiend : Links
Kleur en materiaal ombouw : Wit
Lengte aansluitkabel (cm) : 210.0
Hoogte voor onderbouw : 850.00
Hoogte apparaat (mm) : 850
Afmetingen van het apparaat hxbxd (mm) : 850 x 600 x 590
Verrijdbaar : Nee
Nettogewicht (kg) : 78.000
Trommelinhoud (l) : 65
Kleur : Wit
Deur frame : chroom, wit
Kleur toetsen : chroom, Geborstelde metaal-look
Kleur draaiknop : chroom
Geluidsemissie wassen (dB) : 51
Aansluitwaarde (W) : 2300
Minimale smeltveiligheid (A) : 10
Spanning min-max (V) : 220-240
Netfrequentie min-max (Hz) : 50
Inclusief kabel : Ja
Aansluitstekker : Schuko-/Gardy. met aarding
Lengte afvoerslang (in) : 59.05
Lengte toevoerslang (in) : 59.05
Afmetingen apparaat inclusief verpakking (in) : 34.44 x 25.98 x 27.16
Nettogewicht (lbs) : 173
Brutogewicht (lbs) : 175
Lengte afvoerslang : 150.00
Lengte toevoerslang : 150.00
Brutogewicht (kg) : 80

Verbruiks- en aansluitwaarde
Aansluitwaarde (W) : 2300
Minimale smeltveiligheid (A) : 10
Spanning min-max (V) : 220-240
Netfrequentie min-max (Hz) : 50
Keurmerken : CE, VDE
Waterbeveiligingssysteem : AQUASTOP
Aantal toetsen : 13
Opties centrifugesnelheid : Variabel
Intern verwarmingselement : Nee
Digitale resttijdweergave : Ja

BOSCH

WAY28770NL
HomeProfessional
Wasmachine





Afmeting in mm

BOSCH



WTY88782NL
HomeProfessional SelfCleaning Condenser
Wasdroger - warmtepomp

Algemeen:
- Energieklasse: A+++
- Capaciteit: 1 - 8 kg
- Warmtepomp technologie
- Zelfreinigende condensor: behoudt van energieklasse gedurende de hele levensduur (A+++).
- TFT tekstdisplay voor intuitive bediening

Comfort / Zekerheid:
- ActiveAir technologie
- AntiVibration Design: stabiliteit en stilte
- Grote roestvijstalen trommel Sensitive trommelbinnenwand, wasgoedmeenemers met Soft-design
-
- Speciale programma's: mix, wol in korf, Schoenen drogen, Handdoeken, Synthetische dekens, Jeans, Tijdprogramma warm, Tijdprogramma koud, Sport, Dons, Superkort 40, Blouses/Overhemden
- LED programmaknop met aan/uitschakelaar
- Anti-kreukfase 120 min
- TouchControl toetsen met LED indicatie: Start/Pauze, licht strijken, Opties, Droogtegraad, Memory 1, Memory 2, Basisinstellingen, 24 u eindtijduitstel
- DUO-Tronic vochtmeting
- Kinderbeveiliging op de deur
- Inclusief condenswaterafvoersysteem
- Signaal bij einde van het programma
- Soepel deurslot voor makkelijk openen en sluiten
- Multitoon geluidssignalen
- EcoSilence compressor
- Afwijkende programma benaming
- Speciale wolkorf, Schoenenkorf
- Design met ronde glazen vuldeur chroom, wit

Technische specificaties:
- Energieverbruik 172,0 kWh per jaar, bij 160 droogcycli van het standaard katoenprogramma bij volle en halve belading. Het energieverbruik per droogbeurt is afhankelijk van het gebruik van het apparaat.
- Energieverbruik van het standaard katoenprogramma bij volle belading 1.37 kWh en bij halve belading 0.84 kWh
- Stroomverbruik in de uitgeschakelde stand 0.13 W en in niet-uitgeschakelde stand 0.13 W
- De standaard droogprogramma's, waarop de informatie op het energielabel is gebaseerd, is katoen kastdroog bij volle en halve belading. Dit programma is geschikt om normale natte katoenen was te drogen en is het meest efficiente programma betreffende energieverbruik.
- Gewogen duur van het standaard programma bij volle en gedeeltelijke belading: 148 min

Toebehoren

Optionele accessoires
- WMZ20500 Voetstuk met onderlade
- WTZ20410 Verbindingsset
- WZ20300 Verbindingsset met werkvlak
- WZ20310 Verbindingsset
- WZ20460 Onderbouwset met lade

In andere kleuren leverbaar

Technische Data

Kenmerken
Uitvoering : Vrijstaand
Afneembaar bovenblad : Nee
Links-/rechtsdraaiend : Rechts, verwisselbaar
Kleur en materiaal ombouw : Wit
Lengte aansluitkabel (cm) : 145.0
Hoogte apparaat zonder bovenblad (mm) : 842
Afmetingen van het apparaat h(min/max)xbxd (mm) : 842 x 597 x 634
Nettogewicht (kg) : 56
Trommelinhoud (l) : 112

Verbruiks- en aansluitwaarde
Aansluitwaarde (W) : 1000
Minimale smeltveiligheid (A) : 10
Spanning min-max (V) : 220-240
Netfrequentie min-max (Hz) : 50
Keurmerken : CE, VDE
en: Drying process : automatische droogtrommel
Vulgewicht katoen : 8.0
Standaardprogramma katoen : Katoen kastdroog
Energie-efficiëntieklasse - nieuw (2010/30/EC) : A+++
Energieverbruik elektrische droger, maximale belading - nieuw (2010/30/EC) : 1.41
Programmaduur katoen, maximale belading : 187
Energieverbruik elektrische droger, gedeeltelijke belading - nieuw (2010/30/EC) : 0.84
Programmaduur katoen, gedeeltelijke belading : 118
Gewogen jaarlijks energieverbruik - NEW (2010/30/EC) : 175.0
Stroomverbruik in de uitstand stand - NEW (2010/30/EC) : 0.13
Stroomverbruik in de sluimerstand - NEW (2010/30/EC) : 0.13
Duur van de standby tijd : 30
Gewogen programmaduur : 148
Condensatie-efficiëntieklasse - nieuw (2010/30/EC) : A
Gemiddelde condensatie-efficiëntie, maximale belading : 91
Gemiddelde condensatie-efficiëntie, gedeeltelijke belading : 91
Gewogen condensatie-efficiëntie : 91

Bosch
WTY88782NL
Wasdroger

Voorganger:

Opvolger:

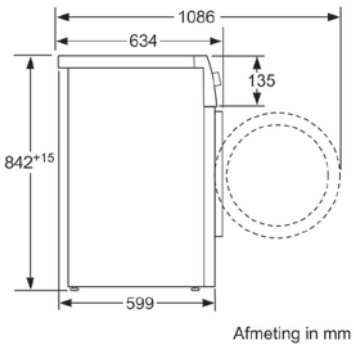
EAN-code:
4242002764733

Verkoopprogramma:

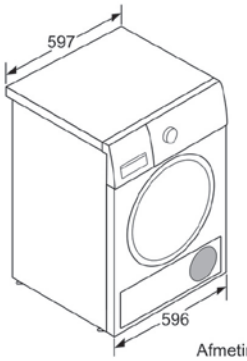
BOSCH

WTY88782NL
HomeProfessional SelfCleaning Condenser
Wasdroger - warmtepomp





Afmeting in mm



Afmeting in mm



BOSCH

Wasmachine
WAY28770NL

nl Gebruiksaanwijzing en installatievoorschrift

Uw nieuwe wasautomaat

U hebt gekozen voor een premium wasmachine van het merk Bosch. Dankzij de innovatieve technologie onderscheidt deze wasmachine zich door perfecte wasprestaties en zuinigheid bij het water- en energieverbruik.

Neem a.u.b. een paar minuten de tijd om dit te lezen en zo de voordelen van uw wasmachine te leren kennen.

Om aan de hoge kwaliteitsstandaard van het merk Bosch te voldoen, is de werking en de onberispelijke toestand van elke wasmachine die onze fabriek verlaat, zorgvuldig getest.

Verdere informatie over onze producten, toebehoren, reserveonderdelen en Service onder: www.bosch-home.com of neem contact op met onze Servicedienst.

Waar de gebruiksaanwijzing/installatievoorschrift verschillende modellen beschrijft, wordt op de desbetreffende punten op de verschillen gewezen.

Toelichting bij de symbolen

⚠ Waarschuwing!

Deze combinatie van symbool en signaalwoord wijst op een mogelijk gevaarlijke situatie die de dood of ernstig letsel kan veroorzaken wanneer deze niet wordt vermeden.

⚠ Attentie!

Deze combinatie van symbool en signaalwoord wijst op een mogelijk gevaarlijke situatie die tot licht letsel, materiële schade of milieuschade kan leiden.

ⓘ

Aanwijzingen voor optimaal gebruik van het apparaat en andere nuttige informatie.

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Bestemming van het apparaat

- Uitsluitend voor huishoudelijk gebruik.
- Voor het wassen van in de machine wasbaar textiel en met de hand wasbare wol in sop.
- Gebruik voor het wassen van uw wasgoed koud leidingwater en in de handel verkrijgbare wasmiddelen die voor wasmachines geschikt zijn.
- Bij dosering van alle wasmiddelen de aanwijzingen van de fabrikant in acht nemen.
- De wasmachine kan worden bediend door kinderen vanaf 8 jaar, door personen met fysieke, sensorische of psychische beperkingen of door personen met gebrekkige ervaring of kennis, indien deze **onder toezicht staan** of door een verantwoordelijke persoon **zijn geïnstrueerd**.
- Huisdieren uit de buurt van het apparaat houden!

Lees a.u.b. de gebruiksaanwijzing, het installatievoorschrift en alle meegeleverde informatie over uw wasautomaat door en handel zoals is beschreven.

Bewaar alle gegevens voor later gebruik.

Aanwijzingen voor de veiligheid

⚠ Waarschuwing!
Levensgevaar door elektrische stroom!
Bij contact met onder spanning staande onderdelen bestaat er levensgevaar.
– Alleen aan de stekker, nooit aan de kabel trekken.
– Stekker alleen met droge handen in het stopcontact steken en eruit trekken.

⚠ Waarschuwing!
Gevaren voor kinderen!
– Kinderen nooit zonder toezicht bij de wasmachine laten!
– Kinderen mogen niet met de wasmachine spelen.
– Kinderen kunnen zichzelf opsluiten in apparaten en in levensgevaar komen.
  Bij afgedankte apparaten:
  – Stekker uit het stopcontact trekken.
  – Aansluitkabel doorknippen en samen met de stekker verwijderen.
  – Slot van de vuldeur onklaar maken.
– Kinderen mogen zonder toezicht geen reinigings- en onderhoudswerkzaamheden uitvoeren.
– Kinderen kunnen zich bij het spelen in verpakkingen/folie en verpakkingsdelen wikkelen of deze over hun hoofd trekken en stikken.
  Kinderen uit de buurt van verpakkingsmateriaal, folie en verpakkingsonderdelen houden.
– Bij het wassen op hoge temperaturen wordt het glas van de vuldeur heet.
  Voorkom dat kinderen de hete vuldeur aanraken.
– Was- en wasverzorgingsmiddelen kunnen bij consumptie leiden tot vergiftiging en bij contact tot irritatie van ogen/huid.
  Was- en wasverzorgingsmiddelen buiten bereik van kinderen bewaren.

⚠ Waarschuwing!
Gevaar door explosie!
Wasgoed dat vóór het wassen met een reinigingsmiddel met oplosmiddel (bijv. vlekkenmiddel of wasbenzine) is behandeld, kan na vullen in de wastrommel tot een explosie leiden.
Het wasgoed tevoren met de hand grondig uitspoelen.

⚠ Attentie!
Gevaar van brandwonden!
Wanneer men bij het wassen op hoge temperaturen in contact komt met heet zeepsop, kan dit leiden tot brandwonden (bijv. bij het afvoeren van heet zeepsop via een wastafel of bij een noodlediging).
Het sop laten afkoelen.

⚠ Attentie!
Gevaar door beschadiging van het apparaat!
- **De afdekplaat kan breken!**
  Niet op de wasmachine klimmen.
- **Een geopende vuldeur kan afbreken of de wasmachine kan kantelen!**
  Niet op de geopende vuldeur gaan zitten.

⚠ Attentie!
Gevaar bij uw hand in een hete trommel steken!
Wanneer u in de draaiende trommel uw hand erin steekt, kunt u handletsel oplopen.
Wij raden u aan niet uw handen in de trommel te steken als deze nog draait. Wacht tot de trommel niet meer draait.

⚠ Attentie!
Gevaar bij contact met vloeibare was-/wasverzorgingsmiddelen!
Als de wasmiddellade tijdens het gebruik wordt geopend, kan er was-/wasverzorgingsmiddel uitspuiten.
Wees voorzichtig bij het openen van de wasmiddellade!
Bij contact met ogen/huid deze grondig uit-/afspoelen.
Bij per ongeluk inslikken een arts raadplegen.

Milieubescherming

Verpakking/Oude apparaat



De verpakking milieuvriendelijk (laten) afvoeren.

Op dit apparaat is de Europese richtlijn 2002/96/EG voor afgedankte elektrische en elektronische apparaten van toepassing (waste electrical and electronic equipment – WEEE).

Deze richtlijn geeft het kader voor de in de hele EU geldende terugname en het hergebruik van afgedankte apparaten.

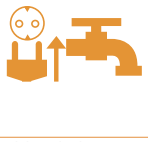
Besparingstips

- Maximale hoeveelheid wasgoed van het betreffende programma benutten.
- Normaal vervuild wasgoed zonder voorwas wassen.
- In plaats van **Katoen 90 °C** programma **Katoen 60 °C** en toets **Eco**Perfect kiezen. Een vergelijkbaar wasresultaat met aanzienlijk minder energieverbruik.
- **Energiebesparings-modus:** de verlichting van het display gaat na enkele minuten uit, **Start/Pauze** ▷II knippert. Om de verlichting te activeren een willekeurige toets kiezen.

  De energiebesparings-modus wordt niet geactiveerd wanneer er een programma loopt.
- **Automatische uitschakeling:** Wanneer het apparaat langere tijd niet wordt bediend, schakelt het zichzelf voor de programmastart en na het programma-einde automatisch uit om energie te besparen. Om het apparaat in te schakelen, drukt u opnieuw op de hoofdschakelaar-toets ⏻ .
- Als het wasgoed aansluitend in de wasdroger wordt gedroogd: centrifugetoerental overeenkomstig de gebruiksaanwijzing bij de droogautomaat kiezen.

Het belangrijkste in het kort

1



Stekker in het stopcontact steken.
Kraan opendraaien.



Vuldeur openen.



Om in te schakelen toets ⏻ indrukken.

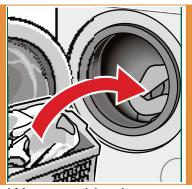


Programma kiezen, bijv. **Katoen**.

2

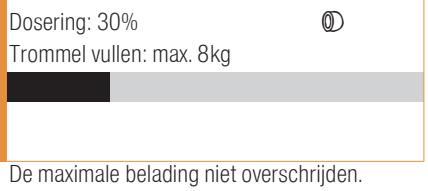


Wasgoed sorteren.



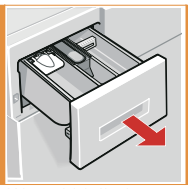
Wasgoed in de trommel doen.

Dosering: 30%
Trommel vullen: max. 8kg



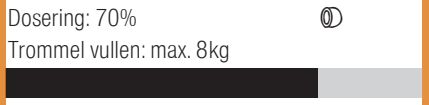
De maximale belading niet overschrijden.

3



Wasmiddellade openen.

Dosering: 70%
Trommel vullen: max. 8kg

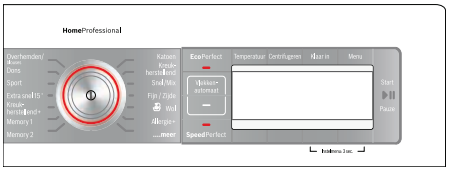


Wasmiddel doseren volgens het doseeradvies.



Vuldeur sluiten.

4



Eventueel programma-instellingen van het gekozen programma wijzigen en extra programma-instellingen/opties kiezen.



⏵⏸ Start/Pauze kiezen.

5

◎ Klaar, wasgoed uitnemen

Einde van het programma

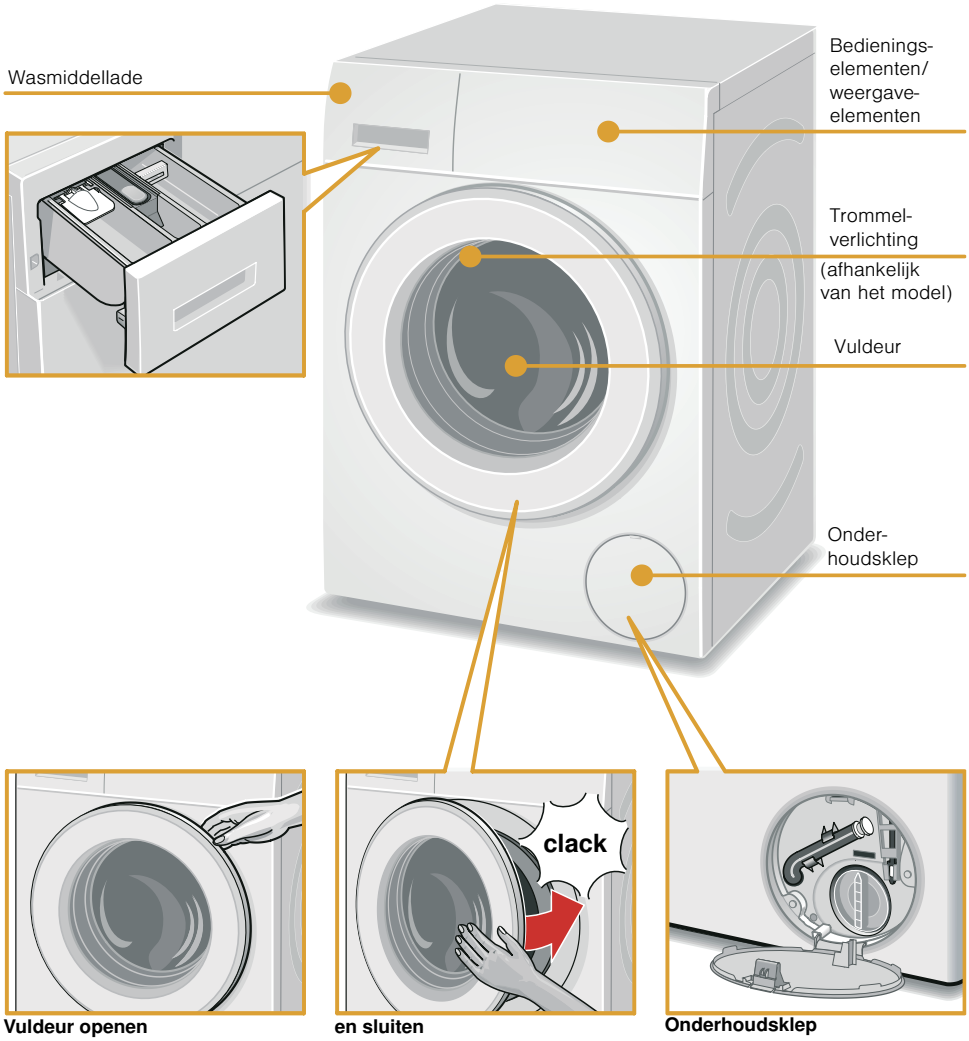


Om de wasmachine uit te schakelen, toets ⏻ indrukken.



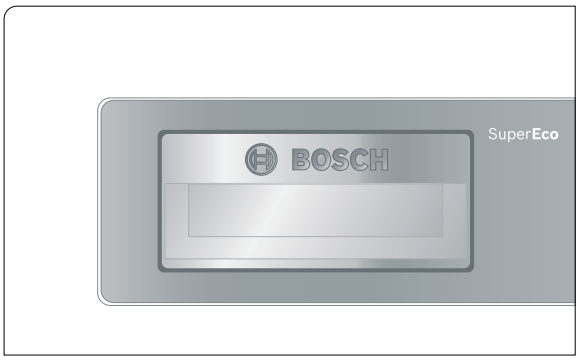
Kraan dichtdraaien (bij modellen zonder Aqua-Stop).

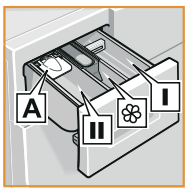
Het apparaat leren kennen



Vuldeur openen **en sluiten** **Onderhoudsklep**

Wasmiddellade



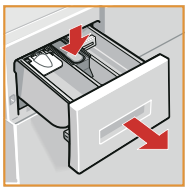


Wasmiddelbakje **I**	Wasmiddel voor de voorwas
Wasmiddelbakje ❀	Wasverzachter, stijfsel; max niet overschrijden
Wasmiddelbakje **II**	Wasmiddel voor de hoofdwas, waterontharder, bleekmiddel, vlekkenzout
Inzetstuk **A**	voor de dosering van vloeibaar wasmiddel (niet bij alle modellen)

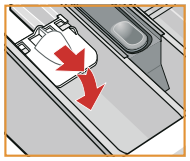
Bij modellen met inzetstuk voor vloeibaar wasmiddel:
In de wasmiddellade bevindt zich een inzetstuk als doseerhulp voor vloeibaar wasmiddel.

i Inzetstuk niet gebruiken:
- bij gel-achtige wasmiddelen en waspoeder,
- bij programma's met Voorwas en wanneer Klaar in is gekozen.

Voor de dosering van vloeibaar wasmiddel het inzetstuk positioneren:



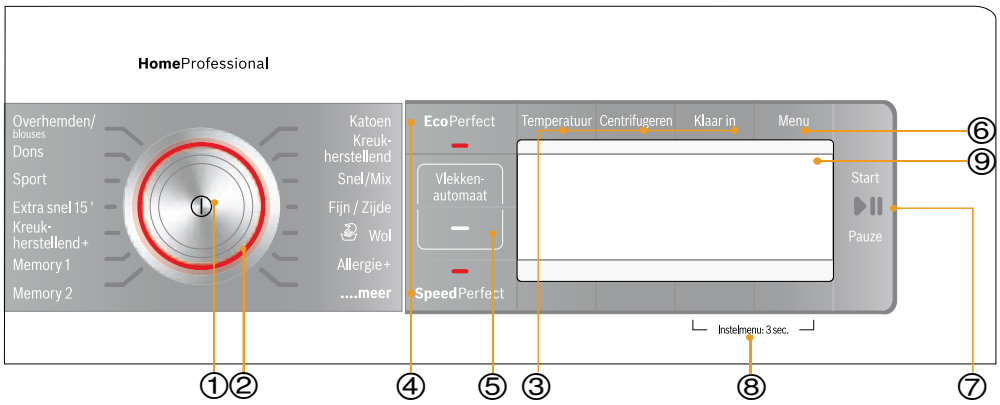
de wasmiddellade helemaal eruit halen.



Inzetstuk naar voren schuiven.

Bij modellen zonder inzetstuk voor vloeibaar wasmiddel:
Vloeibaar wasmiddel doseren volgens de aanwijzingen van de fabrikant.

Bedieningselementen/ weergave-elementen



Alle toetsen zijn gevoelig, aantippen is voldoende!

① Wasmachine in-/uitschakelen. Hoofdschakelaar ① indrukken.

② Programma kiezen. Draaien in beide richtingen mogelijk. *Programma-overzicht, zie ⟶ Blz. 23*

Programma-instellingen van het gekozen programma wijzigen en extra programma opties kiezen:

③ Toetsen **Temperatuur**, **Centrifugeren**, **Klaar in**-tijd kiezen en wijzigen. *⟶ Blz. 16*, *⟶ Blz. 28*

④ Toets **Eco**Perfect of **Speed**Perfect kiezen. *⟶ Blz. 16*, *⟶ Blz. 28*

⑤ Toets **Vlekkenautomaat** voor het kiezen van het soort vlek; *⟶ Blz. 17* *Overzicht van alle vlekken ⟶ Blz. 30*

⑥ Toets **Menu** voor het kiezen van extra Programma opties; *⟶ Blz. 17* *Overzicht van alle Opties ⟶ Blz. 29*

⑦ Wasprogramma starten. **Start**/Pauze kunt kiezen voor het starten, onderbreken en annuleren van het programma (bijv. wasgoed bijvullen).

⑧ Apparaatinstellingen wijzigen. Toetsen **Instelmenu: 3 sec.** voor apparaatinstellingen (eindsignaal, toetssignaal, taal, autom. uitschakelen) ca. 3 seconden ingedrukt houden; Overzicht van alle instellingen *⟶ Blz. 32*

⑨ Display voor instellingen en informatie

Voor elke was

– Wasmachine **correct plaatsen** en **aansluiten**.
Zie Blz. ⟶ Blz. 45 en verder.
– Vóór de eerste was één keer **zonder** wasgoed wassen.
⟶ *Blz. 54*

1. Wasgoed voorbereiden



Wasgoed sorteren aan de hand van:

- Soort weefsel/vezels
- Kleur
- Mate van vervuiling
- Neem de aanwijzingen van de fabrikant op de verpakking in acht.
- Wasgoed sorteren volgens de gegevens op de wasmerkjes:

95 90 Witte was 95 °C, 90 °C

60 40 30 Bonte was 60 °C, 40 °C, 30 °C

60 40 30 Kreukherstellend 60 °C, 40 °C, 30 °C

40 30 Fijne was 40 °C, 30 °C

40 30 Textiel dat met de hand of in de machine gewassen mag worden van zijde en wol koud, 40 °C, 30 °C

Wasgoed niet in de wasmachine wassen.

Wasgoed en machine ontzien:

– Bij dosering van alle was-, hulp-, verzorgings- en reinigingsmiddelen beslist de aanwijzingen van de fabrikant in acht nemen.
– Reinigingsmiddelen en middelen voor de voorbehandeling van wasgoed (bijv. vlekkenmiddelen, voorwassprays, ...) niet in contact laten komen met de oppervlakken van de wasmachine. Eventuele sprayresten en andere resten/ druppels direct met een zachte doek afvegen.



– Zakken leegmaken.
– Metalen voorwerpen (zoals paperclips etc.) verwijderen.
– Tere weefsels in een wasnet wassen (panty's, BH's met beugel).
– Ritssluitingen sluiten, overtrekken dichtknopen.
– Zand uit zakken en omslagen borstelen.
– Rollertjes van vitrage verwijderen of vastbinden in een netje.
– Nieuw wasgoed apart wassen.

2. Apparaat voorbereiden



Stekker in het stopcontact steken.

Kraan opendraaien.

3. Programma kiezen en wasgoed in de trommel doen



1. Vuldeur openen.

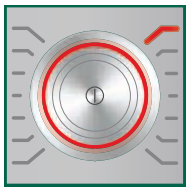


2. Controleren of de trommel geheel leeg is. Alleen dan is een foutloze werking van de beladingsindicatie gewaarborgd.



3. Toets ⏻ indrukken. Het apparaat is ingeschakeld.
Op het display verschijnt het Siemens-logo en alle indicatielampjes van de programma's gaan branden.

Daarna wordt altijd het in de fabriek ingestelde programma **Katoen** weergegeven.
Indicaties van het programma **Katoen**:

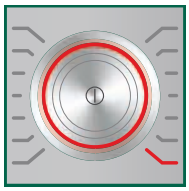




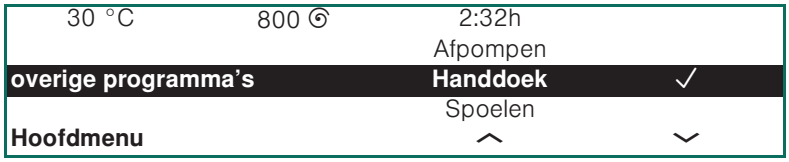
– Het indicatielampje van de programmakiezer brandt en het hoofdmenu van het gekozen programma verschijnt op het display.

– Bij apparaten met **Trommelverlichting**:
Na inschakeling van het apparaat, na het openen en sluiten van de vuldeur en na de programmastart gaat de trommelverlichting aan. De verlichting gaat automatisch weer uit.

4. Programma kiezen.
U kunt het opgeslagen programma gebruiken
of een ander programma kiezen, *Programmaoverzicht*, zie ⟶ *Blz. 23* kiezen
of ... meer programma's kiezen en een programma als volgt selecteren:



... meer programma's gekozen en bijv. **Handdoeken** selecteren:



– Het programma kiezen met de toetsen onder de pijlen. De gemaakte keuze wordt aangevinkt.
– Wachten of terug met de toets **Hoofdmenu**; het gekozen programma wordt aangegeven op het display.



– Om van programma te veranderen, drukt u op de toets onder het zwart weergegeven programma en wijzigt u het programma.



5. Wasgoed in de trommel doen.



Op het display verschijnt het beladingsscherm van het gekozen programma (bijv. Katoen). Het beladingsscherm wordt weergegeven bij het openen van de vuldeur en bij het wijzigen van de wasgoedhoeveelheid.

- Het gesorteerde wasgoed opengevouwen in de trommel doen. Grote en kleine stukken door elkaar. Hierdoor wordt het wasgoed tijdens het centrifugeren beter verdeeld. Losse stukken wasgoed kunnen balansverstoringen veroorzaken. ⟶ *Blz. 33*
- Doe het wasgoed pas in de machine wanneer na het Bosch-logo het hoofdmenu van het opgeslagen programma wordt weergegeven.
- De beladingsbalk vult zich tijdens het vullen. Wanneer de max. belading is overschreden, knippert de balk. De aangegeven max. belading niet overschrijden. Overbelading vermindert het wasresultaat en bevordert kreukvorming.

4. Vullen met was- en wasverzorgingsmiddelen

1. Wasmiddellade uittrekken.
2. Doseren in de bakjes volgens:
   - Het doseeradvies op het display, bijv. bij **Katoen**:



   Afhankelijk van de geladen hoeveelheid wasgoed toont het display een doseeradvies.
   - mate van vervuiling,
   - waterhardheid (informeer bij uw waterleidingbedrijf),
   - de gegevens van de fabrikant op de verpakking.

- Bij dosering van alle wasmiddelen de aanwijzingen van de fabrikant in acht nemen.
- Dikvloeibare wasverzachter en textielversteviger met wat water aanlengen.
  Voorkomt verstopping!

5. Instellingen van het gekozen programma wijzigen

Let erop dat tussen de vuldeur en de rubber afdichting geen wasgoed beklemd is geraakt.



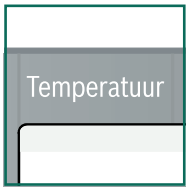
Vuldeur sluiten.



Op het display verschijnt weer het hoofdmenu van het gekozen programma.

U kunt de weergegeven standaardinstellingen gebruiken of het gekozen programma optimaal aan het wasgoed aanpassen door de standaardinstellingen te wijzigen of door extra instellingen/opties te kiezen.

- Temperatuur, Centrifugeren, Klaar in-tijd wijzigen. *Zie* ⟶ *Blz. 28*:



bijv. toets **Temperatuur** kiezen en wijzigen:



De pijlen op het display geven aan met welke toetsen u de instellingen kunt wijzigen. De instellingen worden zonder bevestiging geactiveerd en worden weergegeven in het hoofdmenu.

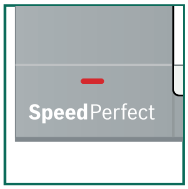
i
- Door de toetsen langer ingedrukt te houden, lopen de instelwaarden automatisch verder.
- Door een programma te kiezen wordt de bijbehorende programmaduur aangegeven. De programmaduur van het lopende programma wordt automatisch aangepast, wanneer bijv. door wijzigingen in de programma-instellingen/opties, schuimherkenning, onbalansherkenning, lading of vervuiling een wijziging van de programmaduur nodig is.



- **Eco**Perfect :

Energiezuinig wassen door temperatuurreductie bij gelijkblijvend wasresultaat.

i De wastemperatuur is lager dan de geselecteerde temperatuur. Bij bijzondere hygiënische vereisten is het programma **Allergie+** aan te raden. ⟶ *Blz. 24*

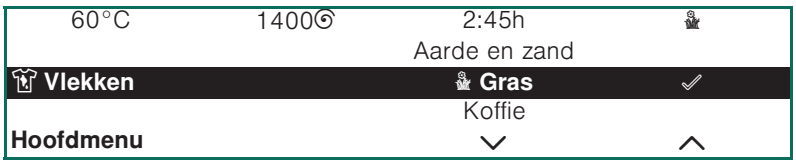


- **Speed**Perfect ⏱:
  om in kortere tijd te wassen bij een wasresultaat vergelijkbaar met het standaardprogramma. Maximale belading in acht nemen! ⟶ *Blz. 23*
  Door te kiezen gaat het indicatielampje branden.

- **Vlekkenautomaat** 👕. *Overzicht van alle vlekken ⟶ Blz. 30*
  Wij raden u aan om de vlekken niet laten indrogen. Voor u het wasgoed in de wasmachine doet eerst de vaste bestanddelen verwijderen. Het wasgoed zoals gebruikelijk samenstellen en in de wasmachine doen. En hierbij het soort vlek kiezen (afhankelijk van het programma).

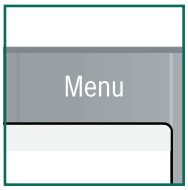


Op toets **Vlekkenautomaat** 👕 drukken en bijv. **Gras** kiezen:



  – Met de weergegeven toetsen de vlek selecteren/ deselecteren. De optie Vlek is direct actief en wordt weergegeven op het display.
  – Wachten of met de toets **Hoofdmenu** of **Vlekkenautomaat** 👕 terug.

- **Menu**; *Overzicht van alle opties ⟶ Blz. 29*



Toets **Menu** indrukken en bijv. **Extra water** kiezen:



  – Met de twee links afgebeelde toetsen een optie selecteren.
  – Met de twee rechts afgebeelde toetsen een optie selecteren/deselecteren. De geselecteerde opties zijn direct actief.
    Bij meerstaps-instellingen worden bij langer aanraken van de toetsen de instellingen automatisch doorlopen.
  – Wachten of met toets **Menu** terug naar het hoofdmenu.

6. Programma starten



- **Start**/Pause ▷II kiezen. Het indicatielampje brandt.

Wassen

De programmavoortgang wordt tijdens het wassen weergegeven door een balk op het display. De balk vult zich tijdens de wascyclus en geeft informatie over de huidige programmavoortgang.
De pijlen worden weergegeven/verborgen afhankelijk van de programmavoortgang. Ze tonen de programma-instellingen/-opties die tijdens de programmavoortgang gewijzigd/ toegevoegd kunnen worden.

Toelichting bij enkele programmastappen:

- Beladingsautomaat actief ⟶ *Blz. 33*



- **Voorwassen, Wassen, Spoelen, Centrifugeren, Afpompen** ... worden weergegeven tijdens de wascyclus.
- **Extra spoelen: schuim**⟶ *Blz. 21*
- meer indicaties ⟶ *Blz. 39*

Tijdens het wassen

- **Kinderbeveiliging**
  Om de wasmachine te beschermen tegen ongewenste verandering van de ingestelde functies, kan de kinderbeveiliging worden geactiveerd.
  activeren/deactiveren: ca. 5 seconden **Klaar in** indrukken.





Na ca. 3 seconden geeft het display het hoofdmenu opnieuw weer.
Wanneer bij actieve kinderbeveiliging de programmakiezer wordt gedraaid of een toets wordt ingedrukt, gaat het symbool ⚿ kort branden.

Wasgoed bijvullen

Na de programmastart kan men naar wens was toevoegen of uitnemen.

▷II Start/**Pauze** kiezen.





i
- Bij een hoge waterstand, een hoge temperatuur of een draaiende trommel blijft de vuldeur om veiligheidsredenen vergrendeld en kan men geen was toevoegen. Instructies op het display in acht nemen. Om het programma voort te zetten toets ▷II **Start**/Pauze kiezen. De vuldeur wordt vergrendeld en het programma wordt automatisch voortgezet.
- De beladingsindicatie is tijdens het bijvullen niet actief.
- Vuldeur niet te lang open laten staan – er kan water uit het wasgoed naar buiten lopen.

Programma wijzigen

Wanneer men per ongeluk een verkeerd programma heeft gestart.

1. ▷II Start/**Pauze** kiezen.
2. Een ander programma kiezen.
3. ▷II **Start**/Pauze kiezen. Het nieuwe programma begint van voor af aan.

Programma afbreken

Bij programma's met hoge temperatuur:

1. ▷II Start/**Pauze** kiezen.
2. Wasgoed laten afkoelen: **Spoelen** kiezen (zie **... meer** programma's).
3. ▷II **Start**/Pauze kiezen.

Bij programma's met lage temperatuur:

1. ▷II Start/**Pauze** kiezen.
2. **Centrifugeren** * of **Afpompen** * kiezen. (* zie **... meer** programma's)
3. ▷II **Start**/Pauze kiezen.

■ **Programma-einde met instelling Spoelstop**

Spoelstop bereikt: Selecteer "centrifugeren" of "afpompen" en vervolgens "Start". Centrifugeren Afpompen ⌄ ⌄

1. **Centrifugeren** (eventueel een centrifugetoerental aanpassen) of **Afpompen** kiezen.
2. ▷II **Start**/Pauze kiezen.

Einde van het programma

Op het display verschijnt: **Klaar, wasgoed uitnemen**.

◎ Klaar, wasgoed uitnemen

Wanneer het display bovendien **Schuimvorming geconstateerd** meldt, heeft de wasmachine tijdens het wasprogramma teveel schuim geconstateerd en automatisch een extra aantal spoelbeurten toegevoegd om het schuim tegen te gaan.

ⓘ Als dit is geconstateerd raden wij aan om bij de volgende wasbeurt met dezelfde belading minder wasmiddel te doseren.

Na het wassen



1. Vuldeur openen en wasgoed eruit halen.

⓪	Wasgoed uitnemen,
⏻	apparaat uitschakelen

- Geen wasgoed achterlaten in de trommel. Het kan bij de volgende wasbeurt krimpen of iets verkleuren.



- Eventuele ongewenste voorwerpen uit de trommel en de rubbermanchet verwijderen – roestgevaar.
- Vuldeur en wasmiddellade open laten zodat het restwater kan opdrogen.

Vóór het uitschakelen:

- Altijd wasgoed eruit halen. Alleen dan is een foutloze werking van de beladingsindicatie gewaarborgd.
- Altijd wachten tot het programma is afgelopen, omdat anders het apparaat nog vergrendeld kan zijn. Dan het apparaat inschakelen en wachten op de ontgrendeling.



2. Toets ⏻ indrukken. Het apparaat is uitgeschakeld.

3. Kraan dichtdraaien.
Niet nodig bij modellen met Aqua-Stop. ⟶ *Blz. 60*

Programma-overzicht



De standaardinstellingen van de programma's zijn **vet** gedrukt.

Programma/Soort wasgoed	Opties/Aanwijzingen
Programma *Korte toelichting bij het programma, bijv. voor welke textielsoorten het geschikt is.*	*Maximale belading* *kiesbare temperatuur in °C* *kiesbare centrifugetoerentallen in toeren/min; het max. centrifugetoerental is afhankelijk van het model* *mogelijke programmaopties* *bij de programmaoptie Anti-kreuk: mogelijke centrifugetoerentallen in toeren/min*
Katoen stevig textiel, kookvast textiel van katoen of linnen. i.* gereduceerde belading bij optie **Speed**Perfect	max. **8** kg/5 kg * koud – **60** – 90 °C 0 ... **1400** rpm ,,,,,,,,, bij : 0 ... **800** rpm
Kreukherstellend textiel van synthetische of gemengde weefsels.	max. 4 kg koud – **40** – 60 °C 0 ... **1200** rpm ,,,,,,,,, bij : 0 ...**600** ...800 rpm
Snel + Mix gemengde lading van katoen en synthetisch textiel.	max. 3,5 kg koud – **40** °C 0 ... **1400** rpm ,,,,,,,,, bij : 0 ... **600** ... 800 rpm



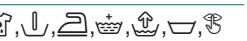
De standaardinstellingen van de programma's zijn **vet** gedrukt.

Programma/Soort wasgoed	Opties/Aanwijzingen
Fijn/Zijde voor gevoelig, wasbaar textiel, bijv. van zijde, satijn, synthetische of gemengde weefsels (bijv. zijden blouses of -sjaals). ⓘ.Een machinewasmiddel gebruiken dat geschikt is voor fijne was en/of zijde.	max. 2 kg koud – **30** – 40 °C 0 ... **600** ... 800 rpm 🔍,⏲,👕,👖,🧺,🧼,🧼,🪣,🌀 bij 🧺: 0 ... **600** rpm
Wol textiel van wol of met wol gemengde weefsels dat met de hand of in de wasmachine gewassen mag worden. bijzonder voorzichtig wasprogramma om krimpen van het wasgoed te voorkomen, langere programmapauzes (het wasgoed rust in het sop). ⓘ.Wol is een dierlijk product, bijv. angora, alpaca, lama, schaap. ⓘ.Een machinewasmiddel gebruiken dat geschikt is voor wol.	max. 2 kg koud – **30** – 40 °C 0 ... **800** rpm 🪣,🌀
Allergie + stevig textiel. ⓘ.langer wassen en spoelen bij hogeren waterniveau voor een bijzonder gevoelige huid. ⓘ.* gereduceerde belading bij optie **Speed**Perfect	max. **8** kg/5 kg * koud – **40** – 60 °C 0 ... **1200** ... 1400 rpm 🔍,⏲,👕,🧺,🧼,🧼,🪣,🌀 bij 🧺: 0 ... **800** rpm
Memory 1 en 2 voor het opslaan van vaak gebruikte individuele programma-instellingen. opslaan ⟶ *Blz. 27*	Instellingen zoals gekozen programma.
Kreukherstellend+ donker gekleurd textiel van katoen en donker gekleurd, kreukherstellend textiel. Textiel binnenstebuiten wassen.	max. 3,5 kg koud – **30** – 40 °C 0 ... **800** ... 1200 rpm 🔍,⏲,👕,👖,🧺,🧼,🧼,🪣,🌀 bij 🧺: 0 ... **600** ... 800 rpm



De standaardinstellingen van de programma's zijn **vet** gedrukt.

Programma/Soort wasgoed	Opties/Aanwijzingen
Extra snel15' extra snel programma ca. 15 minuten, geschikt voor licht vervuild kleine hoeveelheden wasgoed.	max. 2 kg koud – **30** – 40 °C 0 ... **800** ... 1200 rpm ,
Sport textiel van microvezels voor sport en vrije tijd. i.Het wasgoed mag niet met wasverzachter gespoeld zijn. i.Voor het wassen de wasmiddellade (alle bakjes) grondig ontdoen van wasverzachterresten.	max. 2 kg koud – **30** – 40 °C 0 ... **800** rpm ,,,,,,,,, bij : 0 ... **600** ... 800 rpm
Dons machinewas geschikt textiel met donsvulling, kussens, dekens of donsbedden. i.Grote stukken afzonderlijk wassen. Fijne was wasmiddel gebruiken. Wasmiddel spaarzaam doseren.	max. 2 kg koud – **40** – 60 °C 0 ... **1200** rpm ,,,,,,
Overhemden/blouses strijkvrije overhemden/blouses van katoen, linnen, synthetische of gemengde weefsels. Bij de optie **Anti-kreuk** worden hemden/ blouses slechts kort gecentrifugeerd; druipnat ophangen. ⟶ Zelfstrijkend effect i.Hemden/blouses van fijn materiaal/zijde wassen met het fijn/zijde-programma.	max. 2 kg koud – **40** – 60 °C 0 ... **800** rpm ,,,,,,,,, bij : 0 ... **400** rpm

	onder overige programma's	
		De standaardinstellingen van de programma's zijn **vet** gedrukt.
	Programma/Soort wasgoed	**Opties/Aanwijzingen**
	Handdoeken stevig, kookvast handdoeken van katoen. bijzonder zacht handdoeken	max. 3,5 kg Koud - **60** – 90 °C 0 ... **1200** ... 1400 rpm  bij  : 0 ... **800** rpm
	Spoelen Extra spoelen met centrifugeren	- - 0 ... **1200** ... 1400 rpm  bij  : 0 ... **800** rpm
	Centrifugeren Extra centrifugeren met te kiezen centrifugetoerental	- - 0 ... **1200** ... 1400 rpm  bij  : 0 ... **800** rpm
	Centrifugeren/Programma voor voorzichtige behandeling Extra centrifugeren op een lager toerental en met een bijzonder voorzichtig centrifugemechanisme	- - 0 ... **800** ... 1400 rpm  bij  : 0 ... **600** rpm
	Afpompen van het spoelwater bij Spoelstop (zonder eindcentrifugeren)	- - - -

Memory 1 en 2

Onder **Memory 1** en **Memory 2** blijven het programma en alle instellingen duurzaam opgeslagen.

Voor het opslaan:

1. Het progamma **Memory 1** of **2** kiezen.
2. Wanneer voor dit memory-programma nog geen programma is gekozen, kiest u een programma volgens de aanwijzingen op het display. Het gekozen programma wordt automatisch aangevinkt.
3. Eventueel kunt u in het hoofdmenu de temperatuur, het centrifugetoerental en de Klaar in-tijd wijzigen en/of extra programmaopties kiezen met.

Het programma wordt automatisch opgeslagen en weergegeven:



Het opgeslagen programma kan met de toets onder het programma worden gewijzigd zolang de pijl wordt weergegeven.

Stijven

Het wasgoed mag niet met wasverzachter gespoeld zijn.

Stijven is in alle wasprogramma's met vloeibaar stijfsel mogelijk. Het stijfsel volgens de gegevens op de verpakking in het bakje ❀ gieten (het bakje indien nodig eerst schoonmaken).

Verven/Ontkleuren

Als u uw wasgoed wilt verven raden wij u aan de aanwijzigingen van de fabrikant van het verfmiddel in acht te nemen. Verven kan alleen in het huishouden met gebruikelijke hoeveelheden, zout kan namelijk roestvrij staal aantasten. Het is **niet mogelijk** om uw wasgoed in de wasmachine te ontkleuren!

Inweken

Wekenmiddel/wasmiddel volgens de gegevens van de fabrikant in bakje **II** doen. Programmakiezer op **Katoen 30 °C** zetten en ▷II **Start**/Pauze kiezen. Na ca. 10 minuten ▷II Start/**Pauze** kiezen. Na de gewenste inweektijd opnieuw ▷II **Start**/Pauze kiezen als het programma voortgezet of gewijzigd moet worden.

Wasgoed van gelijke kleur in de trommel doen. Extra wasmiddel is niet nodig. Het inweeksop wordt voor het wassen gebruikt.

Instellingen van het programma/Opties

Afhankelijk van het programma kunt u met behulp van de programmaopties het wasproces nog beter aanpassen aan uw wasgoed.

i
- zijn zonder bevestiging actief.
- blijven niet bewaard na het uitschakelen.
- kunnen afhankelijk van de programmavoortgang geselecteerd/gedeselecteerd of gewijzigd worden.

Toetsen		Aanwijzingen
Temperatuur	**Temperatuur**	Voor en tijdens het programma, zolang er pijlen worden weergegeven, kunnen de standaardinstellingen worden gewijzigd. Het maximum centrifugetoerental is afhankelijk van het programma en het model.
Centrifugeren	**Centrifugeren**	
Klaar in	**Klaar in**	voor vertraging van de Klaar in-tijd (programma-einde). Voor de programmastart kan het programma-einde in stappen van 1 uur worden ingesteld tot maximaal 24h (24 uur). Na de start wordt de ingestelde tijd (bijv. 8 uur) weergegeven en begint deze af te lopen totdat het wasprogramma begint. Daarna wordt de programmaduur weergegeven (bijv. 2:30h). De ingestelde tijd kan na de programmastart als volgt worden gewijzigd: 1. ▷II Start/**Pauze** kiezen. 2. Op de toets **Klaar in** drukken en de Klaar in-tijd wijzigen. 3. ▷II **Start**/Pauze kiezen.
EcoPerfect	**Eco**Perfect	om energie te besparen. ⟶ *Blz. 16*
SpeedPerfect	**Speed**Perfect	om sneller te wassen. ⟶ *Blz. 17*
Vlekken-automaat	**Vlekkenautomaat**	om wasgoed met vlekken te wassen. ⟶ *Blz. 17*

Met toets Menu kiezen:		Aanwijzingen
	**Voorwas** Aan – Uit	voor sterk vervuild wasgoed. Wasmiddel over bakje **I** en **II** verdelen.
	**Anti-kreuk** Aan – Uit	beperkt de kreukvorming door een speciale centrifugewijze met aansluitend losser maken en een verlaagd centrifugetoerental. i.Restvocht in het wasgoed iets verhoogd.
	**Extra spoelen** +1 + 1 spoelbeurt +2 + 2 spoelbeurten +3 + 3 spoelbeurten	extra spoelbeurten afhankelijk van het programma, langere programmaduur. i.Aanbevolen voor een bijzonder gevoelige huid of/en in gebieden met heel zacht water.
	**Extra water** Aan – Uit	verhoogd waterniveau, voorzichtiger behandeling van het wasgoed.
	**Spoelstop** Aan – Uit	Na de laatste spoelbeurt blijft het wasgoed in het water liggen. Programma beëindigen. ⟶ *Blz. 21*
	**Stille was** Aan – Uit	Lagere geluidswaarden door een speciaal was- en centrifugeritme en uitgeschakeld eindsignaal. Bijzonder geschikt om 's nachts te wassen. i.Restvocht in het wasgoed iets verhoogd.

Vlekkenautomaat

Algemene informatie over vlekken

In totaal kunt u kiezen uit 16 verschillende vlekkenprogramma's. De wasmachine past de wastemperatuur, trommelbeweging en inweektijd doelgericht aan het soort vlek aan. De vlekken worden optimaal behandeld.

De behandeling van twee vlekken toegelicht met voorbeelden

Bloed — Bloed wordt eerst in koud water „opgelost", vervolgens wordt het gekozen wasprogramma gestart.

Ei — Eideeltjes worden verwijderd door inweken in een lauw waterbad en een gekozen wasprogramma met een hogere waterstand en extra spoelbeurten.

Voor andere vlekken hebben wij in intensieve onderzoeken vergelijkbare oplossingen verkregen.

Kiesbare vlekbehandelingen

Babyvoeding	Aarde en zand	Sinaasappel	Vuile sokken
Bloed	Gras	Rode wijn	Boter/olie
Ei	Koffie	Chocolade	Thee
Aardbeien	Make up	Zweet	Tomaten

Verbruikswaarden

Programma	Belading	Energieverbruik ***	Water ***	Programmaduur ***
Katoen 20 °C	8 kg	0,25 kWh	76 l	2 ½ h
Katoen 40 °C *	8 kg	1,09 kWh	76 l	2 ¾ h
Katoen 60 °C	8 kg	1,43 kWh	76 l	2 ¾ h
Katoen 90 °C	8 kg	2,40 kWh	87 l	2 ½ h
Kreukherstellend 40 °C *	4 kg	0,56 kWh	55 l	1 ¾ h
Snel/Mix 40 °C	3,5 kg	0,58 kWh	49 l	1 h
Fijn/Zijde 30 °C	2 kg	0,15 kWh	34 l	¾ h
Wol 30 °C	2 kg	0,19 kWh	39 l	¾ h

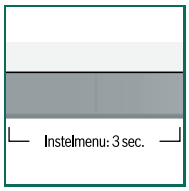
* Programma-instelling voor tests volgens de geldende richtlijn EN60456. Aanwijzing voor vergelijkende tests: Om de testprogramma's te testen de aangegeven hoeveelheid wasgoed met het hoogste centrifugetoerental wassen.

Programma	Programma-verfijning	Belading	Jaarlijks energieverbruik	Jaarlijks waterverbruik
Katoen 40/60 °C	**Eco**Perfect **	8/4 kg	117 kWh	10500 l

** Programma-instelling voor keuring en energie-etikettering conform richtlijn 2010/30/EU met koud water (15 °C).

*** De waarden wijken afhankelijk van de waterdruk, waterhardheid, temperatuur van het instromende water, de omgevingstemperatuur, soort en hoeveelheid wasgoed, mate van vervuiling, het gebruikte wasmiddel, schommelingen in de netspanning en de gekozen programmaverfijningen van de aangegeven waarden af.

Instellingen van het apparaat



Met de toetsen **Instelmenu 3 sec.** kunnen de instellingen van het apparaat worden gewijzigd, bijv. de toetssignalen.

De toetsen **Instelmenu 3 sec.** tegelijkertijd ca. 3 seconden ingedrukt houden:



- Door de toetsen langer ingedrukt te houden, lopen de instellingen automatisch verder.
- Met de twee linkertoetsen de instelling kiezen.
- Met de twee rechtertoetsen een waarde kiezen (de gemaakte keuze wordt aangevinkt).
- Wachten of opnieuw de toetsen **Instelmenu: 3 sec.** ingedrukt houden.

De instellingen blijven bewaard na uitschakeling van het apparaat.

Instellingen	Instelwaarden	Aanwijzingen
Signaal	uit – zacht – gemiddeld – luid – zeer luid	Geluidssterkte van de signalen aanpassen.
Toetssignaal	uit – zacht – gemiddeld – luid – zeer luid	Geluidssterkte van de toetssignalen aanpassen.
Auto uitschakeling van het apparaat	na 15 – 30 – 60 min. – nooit	Het apparaat wordt na ... min. automatisch uitgeschakeld (= 0 kWh energieverbruik); om het in te schakelen op de hoofdschakelaartoets ⏻ drukken.
Taal	Nederlands GB English ...	Aangegeven taal veranderen.

Sensorsysteem – zo intelligent is uw wasmachine

Beladingsautomaat

Afhankelijk van het soort textiel en de belading past de beladingsautomaat het waterverbruik optimaal aan elk programma.

Aquasensor *afhankelijk van het model*

De Aquasensor controleert tijdens het spoelen de vertroebelingsgraad van het spoelwater (troebelheid wordt veroorzaakt door vuil en wasmiddelresten). Afhankelijk van de vertroebeling van het water worden het aantal en de duur van de spoelbeurten vastgesteld.

Beladingssensor/Beladingsindicatie

Wanneer de vuldeur open is, registreert de beladingssensor de hoeveelheid wasgoed in de machine. Dit wordt weergegeven op het display met een balk.

i De wastrommel moet vóór het inschakelen van de wasmachine leeg zijn, zodat de beladingssensor de hoeveelheid wasgoed volledig kan registreren.

Doseeradvies

Het doseeradvies geeft – afhankelijk van het gekozen programma en de geregistreerde belading – een aanbeveling voor de wasmiddeldosering in % aan. De % indicatie heeft betrekking op de aanbeveling van de wasmiddelfabrikant.

i Door u te houden aan de aanbevolen dosering ontziet u het milieu en uw portemonnee.

Onbalans-controlesysteem

Het automatische onbalans-controlesysteem herkent onbalans en zorgt door meermaals aanloopcentrifugeren voor een gelijkmatige verdeling van het wasgoed.

Bij een heel ongunstige verdeling van het wasgoed wordt om veiligheidsredenen het eindtoerental verlaagd of niet gecentrifugeerd.

i Kleine en grote stukken wasgoed in de trommel verdelen.
Storingen, wat te doen? ⟶ Blz. 40

Schoonmaken en onderhoud

⚠ **Waarschuwing!**
Levensgevaar door elektrische stroom!
Bij contact met onder spanning staande onderdelen bestaat er levensgevaar.
Apparaat uitschakelen. Stekker uit het stopcontact trekken.

⚠ **Attentie!**
Gevaar door brand en explosie!
Bij gebruik van oplosmiddelhoudende reinigingsmiddelen in de wasmachine, bijv. wasbenzine, kunnen er onderdelen beschadigd raken en giftige dampen ontstaan.
Geen oplosmiddelhoudende reinigingsmiddelen gebruiken.

⚠ **Attentie!**
De wasmachine kan beschadigd worden!
Bij gebruik van oplosmiddelhoudende reinigingsmiddelen op de wasmachine, bijv. wasbenzine, kunnen de oppervlakken beschadigd raken.
Geen oplosmiddelhoudende reinigingsmiddelen gebruiken.

Buitenkant van het apparaat/Bedieningspaneel

- Resten wasmiddel onmiddellijk verwijderen.
- Met een zacht, vochtig doekje schoonwrijven.
- Reinigen met waterstraal verboden.

Wastrommel

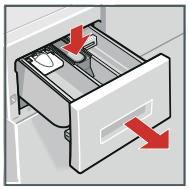
Schoonmaakmiddel zonder chloor gebruiken, geen staalwol.
Bij geurvorming in de wasmachine het programma **Katoen 90 °C** uitvoeren. Gebruik hiervoor een totaalwasmiddel.

Ontkalken

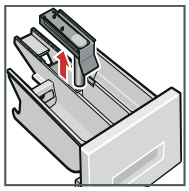
Bij een juiste dosering van het wasmiddel niet nodig. Indien toch: te werk gaan volgens de aanwijzingen van de fabrikant van het ontkalkingsmiddel. Geschikte ontkalkers zijn verkrijgbaar via onze website of via de klantenservice, ⟶ *Blz. 42*.

Schoonmaken van de wasmiddellade

Als er resten wasmiddel of wasverzachter aanwezig zijn kunt u dit als volgt schoonmaken:



1. Lade uittrekken, inzetstuk naar beneden drukken en de lade er helemaal uithalen.



2. Inzetstuk eruit halen: met de vinger het inzetstuk van onder naar boven drukken.
3. Inspoellade en inzetstuk met water en een borstel reinigen en afdrogen.
4. Inzetstuk plaatsen en vastklikken (cilinder op geleidestift steken).
5. Wasmiddellade erin schuiven.

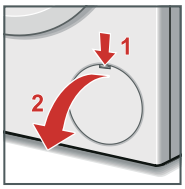
ⓘ Wasmiddellade open laten zodat het resterende vocht kan opdrogen.

Afvoerpomp verstopt

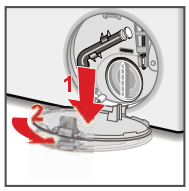
⚠ **Waarschuwing!**
Gevaar van brandwonden!
Zeepsop wordt heet bij het wassen op hoge temperaturen. Door contact met heet zeepsop kunnen brandwonden ontstaan.
Het sop laten afkoelen.

ⓘ De waterkraan dichtdraaien, zodat er geen water meer toestroomt dat via de afvoerpomp afgevoerd moet worden.

1. Apparaat uitschakelen. Stekker uit het stopcontact trekken.



2. Onderhoudsklep openen.

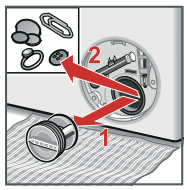


3. Onderhoudsklep eraf halen.



4. Aftapslang uit de houder halen. Stopje verwijderen, zeepsop in een geschikte opvangbak laten stromen.
Stopje erin drukken en aftapslang in de houder zetten.

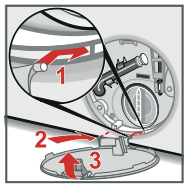
Aanwijzing: Resterend water kan lopen!



5. Pompdeksel voorzichtig eraf schroeven. Binnenruimte, schroefdraad van het pompdeksel en pomphuis schoonmaken. (Vleugels van de afvoerpomp moeten gedraaid kunnen worden.)



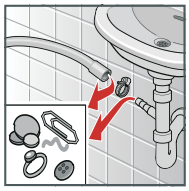
6. Pompdeksel weer plaatsen en vastschroeven. De handgreep staat verticaal.



7. Onderhoudsklep insteken (1), bevestigen (2) en sluiten (3).

Om te voorkomen dat bij de volgende wasbeurt ongebruikt wasmiddel in de afvoer loopt raden wij u het volgende aan:
ca. 1 liter water in wasmiddelbakje **II** gieten en het programma **Afpompen** starten.

Afvoerslang aan de sifon verstopt



1. Apparaat uitschakelen. Stekker uit het stopcontact trekken.

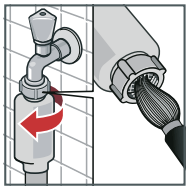
Aanwijzing: Resterend water kan lopen!

2. Slangklem losmaken, afvoerslang voorzichtig eraf trekken.
3. Afvoerslang en aansluitstuk op de sifon schoonmaken.
4. Afvoerslang weer erop steken en de aansluiting met een slangklem vastzetten.

Zeef in de watertoevoer is verstopt

Verlaag eerst de waterdruk in de toevoerslang.

1. Kraan dichtdraaien!
2. Willekeurig programma kiezen (behalve Centrifugeren/ Afpompen).
3. ▷II **Start**/Pauze kiezen. Programma ca. 40 seconden laten draaien.
4. Toets ⏻ indrukken. Het apparaat is uitgeschakeld. Stekker uit het stopcontact trekken.
5. Zeef schoonmaken:



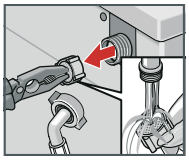
Slang loskoppelen van de kraan.

Zeef met een borsteltje reinigen.

en/of bij de modellen Standaard en Aqua-Secure:



Slang aan de achterkant van het apparaat eraf halen.



Zeef met een tang eruit halen en schoonmaken.

6. Slang weer aansluiten en op dichtheid controleren.

SOS Noodontgrendeling, bijv. bij stroomstoring

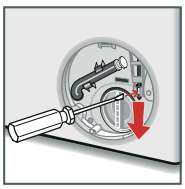
Das Programm läuft weiter, wenn die Netzversorgung wieder hergestellt ist. Soll dennoch die Wäsche entnommen werden, kann das Einfüllfenster wie nachfolgend beschrieben geöffnet werden:

⚠ **Waarschuwing!**
Gefahr durch Verbrühen!
Waschlauge und Wäsche können heiß sein. Bei Berührung besteht Verbrühungsgefahr.
Evtl. erst abkühlen lassen.

⚠ **Attentie!**
Gefahr beim Eingreifen/Einfassen in die drehende Trommel!
Beim Eingreifen in die drehende Trommel können Sie sich die Hände verletzen.
Nicht in die drehende Trommel fassen. Warten bis sich die Trommel nicht mehr dreht.

⚠ **Attentie!**
Wasserschäden möglich!
Auslaufendes Wasser kann zu Wasserschäden führen.
Nicht das Einfüllfenster öffnen, sofern Wasser am Glas zu sehen ist.

1. Gerät ausschalten. Netzstecker ziehen.
2. Waschlauge ablassen.
3. Notentriegelung mit einem Werkzeug nach unten ziehen und loslassen.
   Einfüllfenster lässt sich anschließend öffnen.



Aanwijzingen op het display

Indicatie	Oorzaak/Oplossing
De deur kan niet worden vergrendeld, open de deur en sluit deze opnieuw daarna op "Start/ Pauze" drukken.	– Eventueel de vuldeur goed dichtdrukken of controleren of er geen wasgoed vast zit bij de vuldeur en de deur opnieuw dichtdrukken. Druk daarna op **Start**/Pauze ▷II. – – Schakel uw apparaat Uit en Aan, stel uw programma opnieuw in en druk op Start/Pauze.
Kraan openen a.u.b.	– Kraan helemaal opendraaien. – Toevoerslang is geknikt of zit klem. – De waterdruk is te laag. Zeef schoonmaken. ⟶ *Blz. 37*
Pomp reinigen a.u.b.	– Als uw afvoerpomp verstopt is moet u hem schoonmaken. – Afvoerslang/Afvoerpijp verstopt. Afvoerslang aan de sifon reinigen. ⟶ *Blz. 37*
Pauze: Bijvullen niet mogelijk	Waterniveau of temperatuur is te hoog. Om het programma voort te zetten: **Start**/Pauze ▷II kiezen.
Deur kan niet worden geopend: Waterniveau of temperatuur is te hoog.	Waterniveau of temperatuur is te hoog. Om het programma voort te zetten: **Start**/Pauze ▷II kiezen.
aquaStop geactiveerd! Servicedienst bellen	Deze optie vervalt bij modellen zonder Aqua-Stop. Water in de bodemplaat, ondichtheid van het apparaat. Servicedienst inschakelen! ⟶ *Blz. 42*
Auto uitschakelen in ... seconden.	Het apparaat wordt na ... seconden automatisch uitgeschakeld wanneer het langere tijd niet bediend is. Om dit te annuleren kunt u op een willekeurige toets drukken. ⟶ *Blz. 32*
Sopafkoeling	Het hete zeepsop wordt vóór het afpompen met koud water vermengd en daardoor afgekoeld om de afvoerleidingen te beschermen.
Andere indicaties Error E: XXX	Apparaat uitschakelen, 5 seconden wachten en weer inschakelen. Als de indicatie opnieuw verschijnt: Servicedienst inschakelen. ⟶ *Blz. 42*

? Storingen, wat te doen?

Storingen	Oorzaak/Oplossing
Er loopt water onder de machine uit.	– Afvoerslang goed vastzetten/vervangen. – Schroefkoppeling van de toevoerslang vastdraaien.
Geen waterinstroom. Wasmiddel niet ingespoeld.	– **Start**/Pauze ▷II niet gekozen? – Kraan niet geopend? – Zeef eventueel verstopt? Zeef schoonmaken. ⟶ *Blz. 37* – Toevoerslang geknikt of ingeklemd?
Vuldeur kan niet geopend worden.	– Veiligheidsfunctie actief. Programma-afbreking? – **Spoelstop** ⌓ (zonder eindcentrifugeren) gekozen? – Openen alleen via noodontgrendeling mogelijk? ⟶ *Blz. 38*
Het programma start niet.	– **Start**/Pauze ▷II of **Klaar in**-tijd geselecteerd? – Vuldeur gesloten? – Kinderbeveiliging actief? Zo ja, uitschakelen.
Het sop wordt niet afgepompt.	– **Spoelstop** ⌓ (zonder eindcentrifugeren) gekozen? – Afvoerpomp schoonmaken. – Afvoerpijp en/of afvoerslang schoonmaken.
Het water in de trommel is niet te zien.	Niets aan de hand – Het water bevindt zich onderin en is daardoor niet te zien.
Geen goed centrifugeerresultaat. Wasgoed nat/te vochtig.	– Niets aan de hand – Het onbalansherkenningssysteem heeft het centrifugeren afgebroken wegens ongelijkmatige verdeling van het wasgoed. Kleine en grote stukken wasgoed in de trommel verdelen. – **Licht strijken** gekozen? – Te laag centrifugetoerental gekozen? ⟶ *Blz. 23*
Meermaals aanloop-centrifugeren.	Niets aan de hand – Het onbalans-controlesysteem heft de onbalans op.
Resterend water in het wasmiddelbakje voor wasverzorgingsmiddelen.	– Niets aan de hand – De werking van het wasverzorgingsmiddel is niet verminderd. – Eventueel het inzetstuk reinigen. ⟶ *Blz. 35*
Reukvorming in de wasmachine.	Programma **Katoen 90 °C** zonder wasgoed uitvoeren. Gebruik hiervoor een totaalwasmiddel.
Harde geluiden, trillingen en „wandelen" tijdens het centrifugeren.	– Is het apparaat gesteld? Apparaat stellen. ⟶ *Blz. 52* – Zijn de voetjes vastgezet? Voetjes van het apparaat vastzetten. ⟶ *Blz. 52* – Transportbeveiligingen verwijderd? Transportbeveiligingen verwijderen. ⟶ *Blz. 47*

Storingen	Oorzaak/Oplossing
Display/ indicatielampjes functioneren niet terwijl de machine in bedrijf is.	– Stroomstoring? – Zekeringen geactiveerd? Zekeringen inschakelen/vervangen. – Als de storing vaker optreedt: Servicedienst inschakelen. ⟶ *Blz. 42*
Het programmaverloop duurt langer dan normaal.	– Niets aan de hand – Het onbalans-controlesysteem heft de onbalans op door het wasgoed meermaals te verdelen. – Niets aan de hand – Schuimcontrolesysteem actief – er worden spoelbeurten bijgeschakeld.
Wasmiddelresten op het wasgoed.	– Sommige fosfaatvrije wasmiddelen bevatten in water onoplosbare deeltjes. – **Spoelen** kiezen of het wasgoed na het wassen uitborstelen.
In de pauze-stand knippert **Start/ Pauze** ▷II heel snel en er is een signaal te horen.	– Waterniveau te hoog. Wasgoed bijvullen niet mogelijk. Eventueel vuldeur direct dichtdoen. – Om het programma voort te zetten: **Start**/Pauze ▷II kiezen.
Wanneer een storing niet zelf verholpen kan worden (uit-/inschakelen) of een reparatie noodzakelijk is: – Apparaat uitschakelen en de stekker uit het stopcontact trekken. – Kraan dichtdraaien en de Servicedienst inschakelen. ⟶ *Blz. 42*	

Servicedienst

Als u de storing niet zelf kunt verhelpen, *Storingen, wat te doen?* ⟶ *Blz. 40*, neem dan contact op met de Servicedienst. Wij vinden altijd een passende oplossing, ook om een onnodig bezoek van de monteur te voorkomen.

Geef a.u.b. aan de Servicedienst het typenummer (E-Nr.) en het fabricagenummer (FD) op.

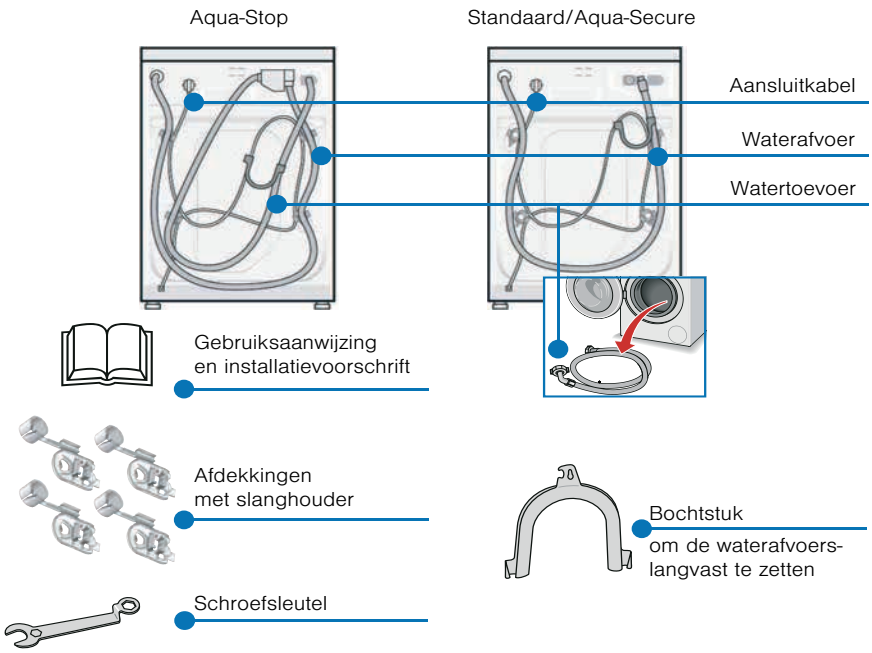
E-Nr. _____ **FD** _____ Typenummer Fabricagenummer	Deze gegevens vindt u op: de binnenkant van de vuldeur */de geopende onderhoudsklep * en de achterkant van het apparaat. * afhankelijk van het model

Vertrouw op de competentie van de fabrikant.

Neem contact met ons op. Zo weet u zeker dat de reparatie door goed opgeleide Servicemonteurs wordt uitgevoerd die de beschikking hebben over de originele reserve-onderdelen.

Toebehoren

afhankelijk van het model:



Extra benodigd bij aansluiting van de waterafvoerslang op een sifon:

1 slangklem Ø 24–40 mm (bij de ijzerhandel of bouwmarkt) om aan een sifon aan te sluiten. *Wateraansluiting* ⟶ *Blz. 51*

Nuttig gereedschap:

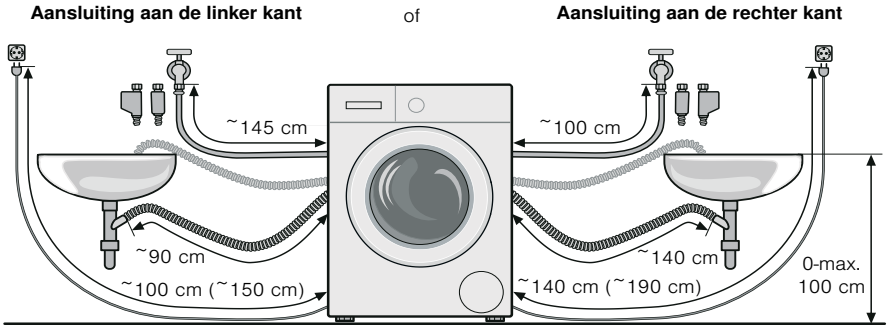
- Waterpas om het apparaat te stellen.
- Steeksleutel met

  SW13: om de transportbeveiligingen los te draaien ⟶ *Blz. 47* en

  SW17: om de voetjes van het apparaat te stellen. ⟶ *Blz. 52*

Lengte van de slangen en de aansluitkabel

afhankelijk van het model



i Bij gebruik van de slanghouders kan de lengte van de slangen eventueel korter worden!

Bij de vakhandel of de Servicedienst tegen meerprijs verkrijgbaar:

- Verlengkabel voor Aqua-Stop- resp. koudwater-toevoerslang (ca. 2,50 m).
  Bestelnummer WMZ2380, WZ10130, CZ11350, Z7070X0
- Langere toevoerslang (ca. 2,20 m) voor model Standaard.

Technische gegevens

Afmetingen (breedte x diepte x hoogte)	60 x 59 x 85 cm
Gewicht	*afhankelijk van het model:* 63–83 kg
Elektrische aansluiting	Nominale spanning 220–240 V, 50 Hz Nominale stroom 10 A Nominaal vermogen 2300 W
Waterdruk	100–1000 kPa (1–10 bar)

Plaatsen

ⓘ Vocht in de wastrommel is te wijten aan de eindcontrole in de fabriek.

Veilig plaatsen

⚠ **Waarschuwing!**
Kans op verwondingen!
- De wasmachine is heel zwaar. Wees voorzichtig bij het optillen.
- Wanneer de wasmachine wordt opgetild aan uitstekende onderdelen (bijv. de vuldeur), kunnen deze onderdelen afbreken en letsel veroorzaken. De wasmachine niet optillen aan uitstekende onderdelen.

⚠ **Attentie!**
Struikelgevaar!
Wanneer de slangleidingen en de aansluitkabel onjuist worden aangelegd, bestaat er struikel- en letselgevaar.
Slangen en kabels zodanig leggen dat u er niet over kunt struikelen.

⚠ **Attentie!**
De wasmachine kan beschadigd worden!
- Bevroren slangen kunnen scheuren/springen. De wasmachine niet op vorstgevoelige plaatsen en/of buiten zetten.
- Wanneer de wasmachine wordt opgetild aan uitstekende onderdelen (bijv. de vuldeur), kunnen deze onderdelen afbreken en de wasmachine beschadigen. De wasmachine niet optillen aan uitstekende onderdelen.

ⓘ
- Naast de hier vermelde aanwijzingen kunnen speciale voorschriften van het waterleiding- en energiebedrijf in uw regio van toepassing zijn.
- In geval van twijfel door een vakkundig monteur laten aansluiten.

De juiste plaats

ⓘ Stabiliteit is belangrijk zodat de wasmachine tijdens het centrifugeren niet „wegloopt”.

- De ondergrond moet stevig en waterpas zijn.
- Niet geschikt voor zachte vloerbedekking.

Bij plaatsing op een verhoging met lade

Verhoging: bestelnummer WMZ 20490, WZ- 20490

Plaatsing op een sokkel of op een houten vloer

⚠ **Waarschuwing!**
De wasmachine kan beschadigd worden!!
De wasmachine kan tijdens het centrifugeren gaan schuiven en van de sokkel kantelen/vallen.
De voetjes van het apparaat in elk geval met bevestigingsbeugels vastzetten.
Bevestigingsbeugels: bestelnummer WMZ 2200, WX 9756, CZ 110600, Z 7080X0

ⓘ Bij plaatsing op een houten vloer:

- De wasmachine liefst in een hoek plaatsen.
- Een watervaste houten plaat (min. 30 mm dik) op de vloer schroeven.

Onderbouw/inbouw van het apparaat in een rij keukenmeubelen

⚠ **Waarschuwing!**
Levensgevaar door elektrische stroom!
Bij contact met onder spanning staande onderdelen bestaat er levensgevaar.
De afdekplaat van het apparaat mag niet worden verwijderd.

ⓘ
- Noodzakelijke nisbreedte 60 cm.
- De wasmachine uitsluitend onder een doorlopend werkblad plaatsen dat met de keukenmeubelen ernaast vast verbonden is.

Transportbeveiligingen verwijderen

⚠ Attentie!

De wasmachine kan beschadigd worden!

Niet verwijderde transportbeveiligingen kunnen bij gebruik van de wasmachine bijv. de trommel beschadigen.

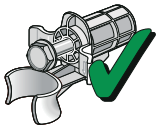
Vóór het eerste gebruik beslist de 4 transportbeveiligingen compleet verwijderen en bewaren.

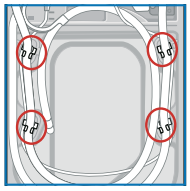
⚠ Attentie!

De wasmachine kan beschadigd worden!

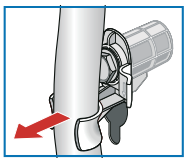
Om bij later transport transportschade te voorkomen, dient men de transportbeveiligingen beslist weer aan te brengen. ⟶ *Blz. 55*

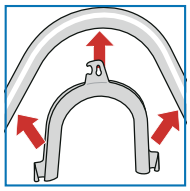
Schroef en huls in elkaar geschroefd bewaren.



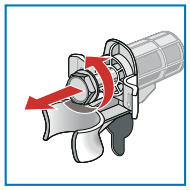


1. Slangen uit de houders halen.

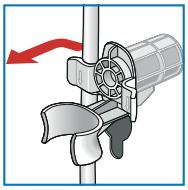




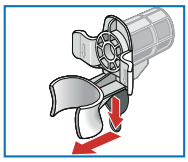
2. Slangen uit het bochtstuk nemen en het bochtstuk verwijderen.

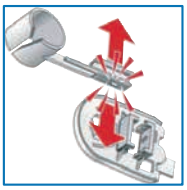


3. Alle 4 de transportbeveiligingsschroeven losdraaien en verwijderen.



4. Aanluitkabel uit de houders halen. Hulzen verwijderen.

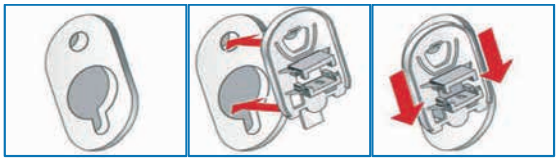




5. Afdekking voorbereiden/verdelen.



6. Afdekkingen erin zetten.



i Afdekkingen vast vergrendelen door op de sluithaak te drukken.



7. Slanghouder erin zetten.



8. Slangen in de slanghouders vastzetten.

Wateraansluiting

⚠ Waarschuwing!
Levensgevaar door elektrische stroom!
Er ontstaat levensgevaar, zodra u contact komt met onder spanning staande onderdelen Aqua-Stop-veiligheidssysteem niet onder water dompelen (heeft een elektrisch ventiel).

ⓘ
- Om lekkage of waterschade te voorkomen de aanwijzingen in dit hoofdstuk beslist in acht nemen!
- De wasmachine alleen met koud leidingwater gebruiken.
- Niet op de mengkraan van een drukloze geiser of boiler aansluiten.
- Alleen met de meegeleverde of bij een geautoriseerde vakhande toevoerslang gebruiken. Geen gebruikt exemplaar!
- In geval van twijfel door een vakkundig monteur laten aansluiten.

Watertoevoer

ⓘ De watertoevoerslangen niet knikken, platdrukken, veranderen of doorsnijden (de sterkte is niet meer gegarandeerd).

Optimale waterdruk in de waterleiding: 100–1000 kPa (1–10 bar)

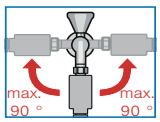
- Uit de geopende kraan stroomt ten minste 8 liter water per minuut.
- Bij hogere waterdruk een drukreduceerventiel inbouwen.

1. Watertoevoerslang aansluiten.

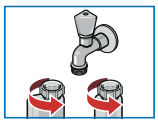
⚠ Waarschuwing!
De schroefdraad van de schroefkoppelingen kan beschadigd raken!
Wanneer de schroefkoppelingen te stevig met gereedschap (tang) worden vastgedraaid, kunnen de schroefdraden beschadigd raken.
Schroefkoppelingen alleen met de hand vastdraaien.

aan de kraan (¾" = 26,4 mm):

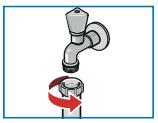




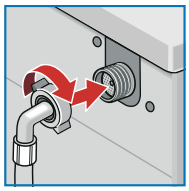
Aqua-Stop en



Aqua-Secure



Standaard



aan het apparaat:
voor modellen Standaard en Aqua-Secure.

2. Kraan voorzichtig opendraaien en daarbij de aansluitingen op dichtheid controleren.

De schroefverbinding staat onder waterdruk van de waterleiding.

Waterafvoer

- De waterafvoerslang niet knikken of aan de slang trekken.
- Verschil in hoogte tussen vloer en afvoer: 0–max. 100 cm

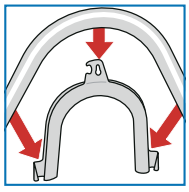
Afvoer in een wastafel

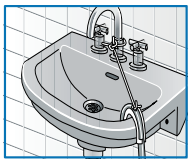
Waarschuwing!
Waterschade mogelijk!
Wanneer de afvoerslang door de hoge waterdruk tijdens het wegpompen uit de wastafel glijdt, kan het wegstromende water waterschade veroorzaken.
De afvoerslang zodanig bevestigen dat deze er niet uit kan schieten.

Attentie!
Dit apparaat kan beschadigd worden!
Wanneer het uiteinde van de afvoerslang in het weggepompte water terechtkomt, kan er water worden teruggezogen in het apparaat!

- De afvoer van de wastafel mag niet met een stop afgesloten worden.
- Tijdens het afpompen controleren of het water snel genoeg wegloopt.
- Het einde van de afvoerslang mag niet in het afgepompte water hangen!

Afvoerslang aanleggen





Afvoer in een sifon

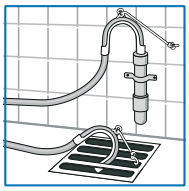
⚠ **Waarschuwing!**
Waterschade mogelijk!
Wij adviseren u om de afvoerslang goed te bevestigen. Als dit niet goed is aangesloten kan de afvoerslang los raken. Uit de afvoerslang komt dan water dat schade kan veroorzaken.
De aansluiting met een slangklem, Ø 24–40 mm (bij de ijzerhandel of bouwmarkt) vastzetten.



Aansluiting

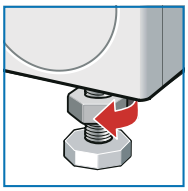
Afvoer in en kunststof standpijp met rubberen mof of in een afvoerputje

⚠ **Waarschuwing!**
Waterschade mogelijk!
Wij adviseren u om de afvoerslang goed te bevestigen. Als dit niet goed is aangesloten kan de afvoerslang los raken. Uit de afvoerslang komt dan water dat schade kan veroorzaken.

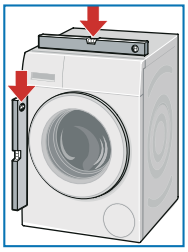


Aansluiting

Stellen

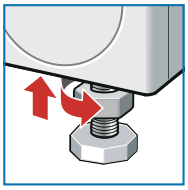


1. Contramoer met een schroefsleutel met de wijzers van de klok mee losdraaien.



2. De stand van de wasmachine met een waterpas controleren, eventueel corrigeren. De hoogte veranderen door het voetje van het apparaat te draaien.

i Alle vier de voetjes moeten stevig op de grond staan.
De wasmachine mag niet wankelen!



3. Contramoer tegen het apparaat vastdraaien.
Het voetje hierbij vasthouden en niet in de hoogte verstellen.

i
- De contramoeren van alle vier de voetjes moeten vast tegen de onderkant van het apparaat zijn geschroefd!
- Sterke geluidsontwikkeling, vibraties en „lopen” kunnen het gevolg zijn van het niet correct stellen van het apparaat!

Elektrische aansluiting

Elektrische veiligheid

⚠ **Waarschuwing!**
Levensgevaar door elektrische stroom!
Bij contact met onder spanning staande onderdelen bestaat er levensgevaar.
- Alleen aan de stekker, nooit aan de kabel trekken.
- Stekker alleen met droge handen in het stopcontact steken en eruit trekken.
- Nooit aan de stekker trekken terwijl de machine draait.
- Het apparaat uitsluitend via een volgens de voorschriften aangebracht, randgeaard stopcontact op wisselstroom aansluiten.
- De netspanning moet overeenkomen met op het typeplaatje aangegeven spanning.
- De aansluitwaarde en de vereiste zekering is op het typeplaatje aangegeven.

Wij verzekeringen u ervan dat:
- de stekker in het stopcontact past.
- de doorsnede van de elektrische kabel groot genoeg is.
- het aardingssysteem volgens de voorschriften is geïnstalleerd.
- Vervanging van de aansluitkabel (indien nodig) alleen door een vakkundig monteur. Een nieuwe kabel is bij de Servicedienst tegen meerprijs verkrijgbaar.
- Geen meervoudige stekkers/contactdozen en/of verlengkabels gebruiken.
- Bij gebruik van een aardlekschakelaar mag alleen een type met dit symbool gebruikt worden: ⎓. Alleen aardlekschakelaars met dit symbool voldoen aan de nu geldende voorschriften.
- De stekker moet altijd bereikbaar zijn.

Vóór de eerste was

De wasmachine is voor het verlaten van de fabriek grondig gekeurd. Door de test kunnen er restjes water achtergebleven zijn. Om deze te verwijderen adviseren wij u om de eerste keer **zonder** wasgoed te wassen.

i De wasmachine moet vakkundig geplaatst en aangesloten zijn. Zie hoofdstuk *Plaatsen* ⟶ *Blz. 52*

1. Apparaat controleren.

i Een beschadigd apparaat nooit in gebruik nemen. Neem contact op met de Servicedienst. ⟶ *Blz. 42*

2. Folie van het bedieningspaneel verwijderen.
3. Stekker in het stopcontact steken.
4. Kraan opendraaien.
5. Apparaat inschakelen.
6. Vuldeur sluiten. Trommel niet vullen met wasgoed.
7. Programma **Katoen** kiezen.
8. Temperatuur **90 °C** instellen.
9. Wasmiddellade openen.
10. Ca. 1 liter water in bakje **II** gieten.
11. Wasmiddel volgens de gegevens van de fabrikant voor licht vervuild wasgoed en desbetreffende waterhardheid in bakje **II** doen.

i Geen wasmiddel voor fijne was of wol gebruiken (schuimontwikkeling).

12. Wasmiddellade sluiten.
13. Druk op de knop ▷II **Start**/Pauze.
14. Aan het einde van het programma apparaat uitschakelen.

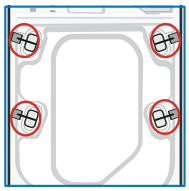
Uw wasmachine is nu startklaar.

Transporteren, bijv. bij verhuizing

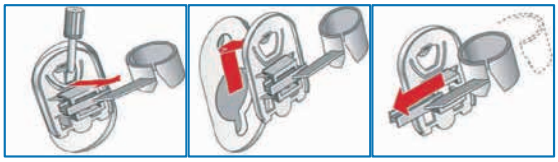
Voorbereiding

1. Kraan dichtdraaien.
2. Waterdruk in de toevoerslang verminderen.
   Onderhoud – Zeef in de watertoevoer ⟶ *Blz. 37*
3. Resten sop laten weglopen.
   Onderhoud – Afvoerpomp verstopt ⟶ *Blz. 35*
4. Stekker van het apparaat uit het stopcontact trekken of de trekschakelaar uitschakelen.
5. Slangen demonteren.

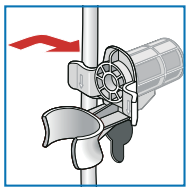
Transportbeveiligingen monteren



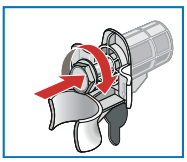
1. Afdekkingen eraf halen en bewaren.



Eventueel een schroevendraaier gebruiken.



2. Alle 4 de hulzen erin zetten.



Aansluitkabel op de houders vastklemmen. Schroeven erin zetten en vastdraaien.

Vóór het eerste gebruik:

- **Transportbeveiligingen verwijderen.** ⟶ *Blz. 47*
- Om te voorkomen dat bij de volgende wasbeurt ongebruikt wasmiddel in de afvoer loopt raden wij u het volgende aan: 1 liter water in wasmiddelbakje **II** gieten en het programma **Afpompen** starten.

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Aqua-Stop-garantie

Alleen voor apparaten met Aqua-Stop

Als aanvulling op de garantieregeling wordt u schadeloos gesteld als aan onderstaande voorwaarden wordt voldaan:

1. Als door een fout in het Aqua-Stop-systeem waterschade wordt veroorzaakt, dan vergoeden wij de schade van particuliere gebruikers.
2. De aansprakelijkheidsgarantie geldt voor de levensduur van het apparaat.
3. Voorwaarde voor aanspraak op garantie is dat het apparaat met Aqua-Stop vakkundig en overeenkomstig ons installatievoorschrift is opgesteld en aangesloten; hiertoe behoort ook de vakkundige verlenging van de Aqua-Stop (origineel toebehoren).
4. Onze garantie heeft geen betrekking op defecte toevoerleidingen of armaturen tot aan de Aqua-Stop-aansluiting op de kraan.
5. Tijdens het gebruik van een apparaat met Aqua-Stop hoeft u er in principe niet bij te blijven resp. na het gebruik om veiligheidsredenen de kraan dicht te draaien.
6. Alleen bij langere afwezigheid, bijv. als u een paar weken op vakantie gaat, moet de kraan worden dichtgedraaid.

Verzoek om reparatie en advies bij storingen

NL 088 424 4010

B 070 222 141

De contactgegevens in alle landen vindt u in de bijgesloten lijst met Servicedienstadressen.

Robert Bosch, Hausgeräte GmbH
Carl-Wery-Straße 34
81739 München
DEUTSCHLAND

9000811778 (9302)

Milieuvriendelijk afvoeren

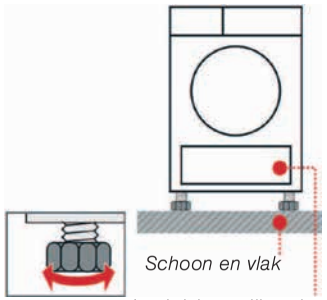
– Verpakking milieuvriendelijk afvoeren.
Dit apparaat is gemarkeerd overeenkomstig de Europese Richtlijn 2002/96/EG over afgedankte elektrische en elektronische apparatuur (waste electrical and electronic equipment - WEEE).
De richtlijn vormt het raamwerk voor een EU-breed geldende terugname en verwerking van oude apparaten.

Installatie

– Leveringsomvang: Droogautomaat, gebruikershandleiding, installatie- en verzorgingshandleiding, kan en wolkorf *(afh. van model)*.
– Droogautomaat controleren op transportschade!
– De droger is zwaar. Niet alleen optillen!
– Voorzichtig, scherpe randen!
– Niet in ruimte plaatsen waar vorst kan optreden! Bevroren water kan tot schade leiden!
– In twijfelgevallen door een vakman laten aansluiten!
Droogautomaat niet aan uitstekende delen (bijv. deur) optillen - kans op breuk!

1. ***Droogautomaat opstellen***
– Op schone, vlakken en vaste ondergrond plaatsen!
– De netstekker moet te allen tijde bereikbaar zijn.
– Luchtinlaat op de droogautomaat vrijhouden.
– Omgeving van de droger schoonhouden.
– Droogautomaat m.b.v. de schroefvoeten horizontaal stellen.
Waterpas gebruiken.
– In geen geval schroefvoeten verwijderen!

Droogautomaat niet opstellen achter een deur of een schuifdeur, welke het openen van de deur van de droogautomaat kan blokkeren of verhinderen!
Kinderen kunnen zich zo niet opsluiten en in levensgevaar geraken.
Alle toebehoren uit de trommel verwijderen.
De trommel moet leeg zijn!



2. ***Netspanningsaansluiting*** *zie veiligheidsinstructie ⟶ blz. 13.*
– Volgens de voorschriften aansluiten op het stopcontact met randaarde, in geval van twijfel het stopcontact door een vakman laten controleren!
– De netspanning en de spanning op het typeplaatje van het apparaat (⟶ *blz. 4*) moeten met elkaar overeenstemmen!
De aansluitwaarde en benodigde zekering zijn aangegeven op het typeplaatje.

Vorstbeveiliging / Transport

Voorbereiding
1. Condenswaterreservoir legen ⟶ *blz. 4.*
2. Programmakiezer op het gewenste programma instellen.
3. Druk op de toets ▷II (**Start**/Pauze) ⟶ Condenswater wordt in het reservoir gepompt.
4. 5 min. wachten, condenswaterreservoir nogmaals legen.
5. Droogautomaat via programmakiezer uitschakelen.
6. Droogautomaat rechtopstaand transporteren.
7. Na het transport de droger twee uur laten staan.

In de droger bevindt zich restwater.
Dit kan bij een schuine stand van de droogautomaat er uit lopen.
In de refresher-tank mag zich geen gedestilleerd water bevinden, eventueel het Stoom/Opfrissen programma laten draaien.

Verzorging en reiniging

Droogautomaatbehuizing, bedieningsveld
Wasmiddelresten direct verwijderen.
Met een zachte, vochtige lap afnemen.
Reinigen met waterstraal niet toegestaan.
Bij het drogen kan er zich tussen het venster en de afdichting af en toe water ophopen.

Vochtigheidssensor
De droger is uitgerust met vochtigheidssensoren van RVS.
Vochtigheidssensoren meten de vochtigheidsgraad van het wasgoed.
Na een langere gebruiksperiode kan er zich op de vochtigheidssensoren een fijne kalklaag vormen. Deze moet regelmatig verwijderd worden:

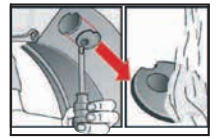
1. Deur openen en vochtigheidssensor met een vochtig gemaakte spons met ruw oppervlak reinigen.



Geen staalwol of schuurmiddel gebruiken!

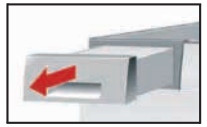
Afdekking voor stoomsproeier *in de trommel (afh. van model)*
Na een langere bedrijfstijd kunnen er zich op de afdekking voor de stoomsproeier kalk en pluizen afzetten. Regelmatig reinigen:

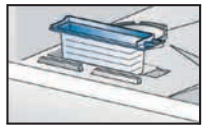
1. Deur openen en afdekking met een schroevendraaier verwijderen.
Afdekking onder stromend water reinigen.
2. Afdekking weer in de borging drukken.



Zeef in refresher-tank reinigen bij verontreinigingen *(afh. van model)*
Fiter regelmatig onder stromend water reinigen ⟶ vermijden van hardnekkige aanslag/ verontreinigingen.

1. Condenswaterreservoir verwijderen.
2. Zeef verwijderen en onder stromend water reinigen.
3. Zeef weer plaatsen en condenswaterreservoir inschuiven tot deze inklikt.





Verzorging en reiniging

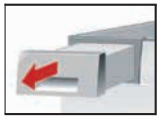
Warmtewisselaar

De warmtewisselaar van de droger wordt bij het drogen automatisch gereinigd, op het display verschijnt **Condensor wordt gereinigd**. Condenswaterreservoir tijdens het reinigings-proces niet er uit trekken.

Filter in het condenswaterreservoir

Bij het legen van het condenswaterreservoir wordt het filter automatisch gereinigd.
Filter desondanks onder stromend water reinigen ⟶ Vermijden van hardnekkige afzettingen en verontreinigingen.
Wanneer de condenswaterafvoer is geïnstalleerd *(afh. van model)*, is reiniging van het filter niet nodig ⟶ afzonderlijke *Handleiding voor condenswater-afvoer*.

1. Condenswaterreservoir er uit trekken.



2. Filter uit de borging trekken.



3. Filter onder stromend water of in vaatwasser reinigen.



4. Filter plaatsen.



5. Condenswaterreservoir er inschuiven totdat deze vastklikt.

Droogautomaat alleen met geplaatst filter gebruiken!

Servicedienst

Kunt u de storing niet zelf verhelpen ⟶ Gebruiksaanwijzing: *Wat te doen wanneer ... blz. 12*, richt u zich tot onze Servicedienst. Wij vinden altijd een passende oplossing, ook om onnodig bezoek van een monteur te vermijden.

De contactgegevens van de dichtstbijzijnde Servicedienst vindt u in de gebruiksaanwijzing op blz. 12 of in de Servicedienst-index.

Wij verzoeken u om de Servicedienst het productnummer (E-nr.) en het productienummer (FD) van de machine door te geven.

E-Nr._____ FD_____

Typenummer Fabricagenummer

Deze gegevens vindt u:
Vulvenster binnenzijde / geopende service-klep* en achterzijde van het apparaat.*
**afh. van model*

Vertrouw op de competentie van de fabrikant. Neem contact op met ons. Zo waarborgt u dat de reparatie door getrainde servicemonteurs wordt uitgevoerd, die beschikken over originele reservedelen.

Optionele toebehoren *(Via Servicedienst bestelnummer)*

WTZ 11400 **Koppelingsset was-droogautomaatzuil**
De droogautomaat kan plaatsbesparend op een geschikte wasautomaat van dezelfde diepte en breedte worden geplaatst. Droogautomaat **absoluut** met deze koppelingsset op de wasautomaat bevestigen.
Met uittrekbaar werkblad.

WMZ 20500 **Ergolade**
Voor het beter be- en ontladen. De mand in het uitschuifbare deel kan worden gebruikt voor transport van het wasgoed.

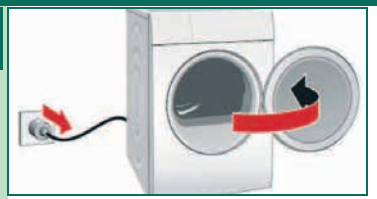
Technische gegevens

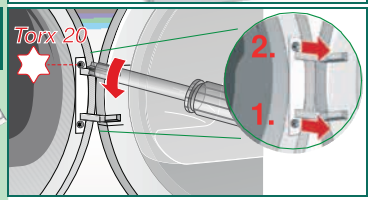
Afmetingen (DxBxH)	60 x 60 x 85 cm (hoogte verstelbaar)
Gewicht	ca. 57 kg
Max. vulgewicht	8 kg
Condenswaterreservoir	4,6 l
Refresher-tank	ca. 0,4 l
Aansluitspanning	220-240 V
Aansluitvermogen	max.1000 W (voor modellen met stoomfunctie max. 1600 W)
Zekering	10 A
Omgevingstemperatuur	5 - 35°C
Typenummer Fabricagenummer	Binnenkant deur

Het typeplaatje vindt u op de achterzijde van de droogautomaat.

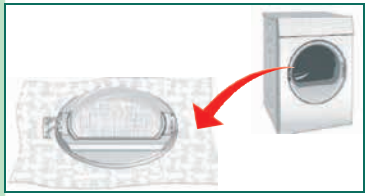
Deuraanslag wisselen

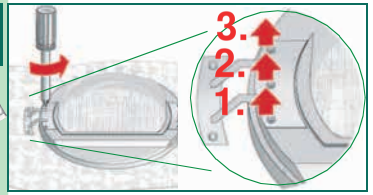
Torx 20

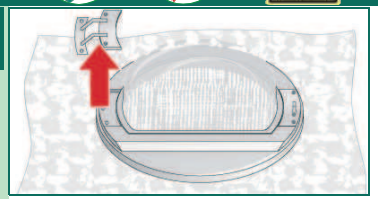


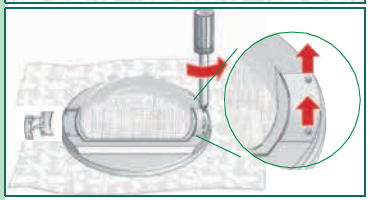


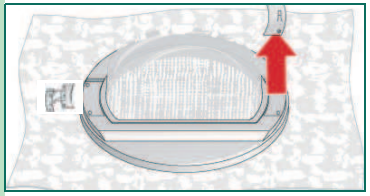


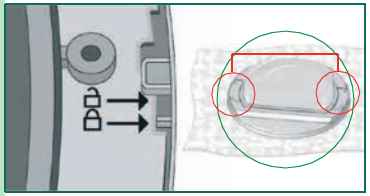


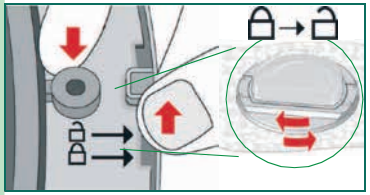






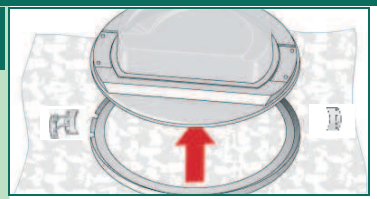


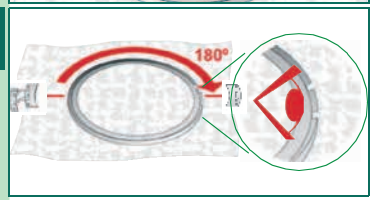


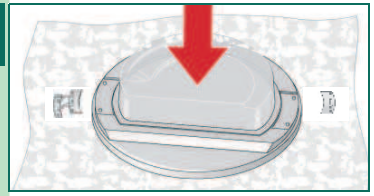


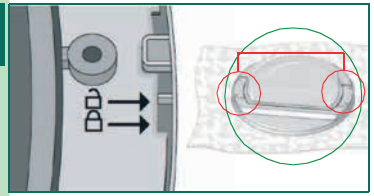
Deuraanslag wisselen

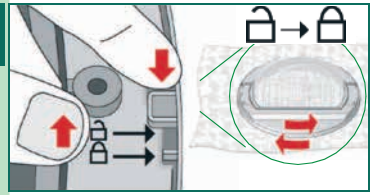
Torx 20



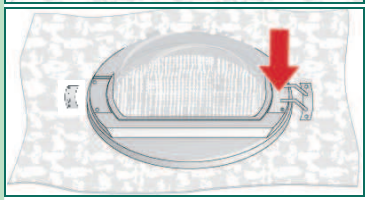


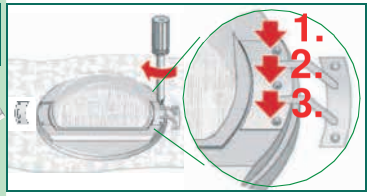


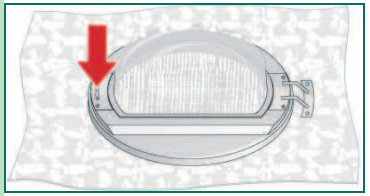


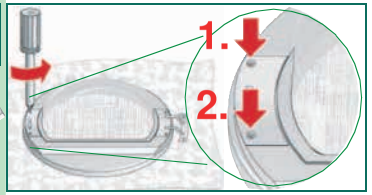






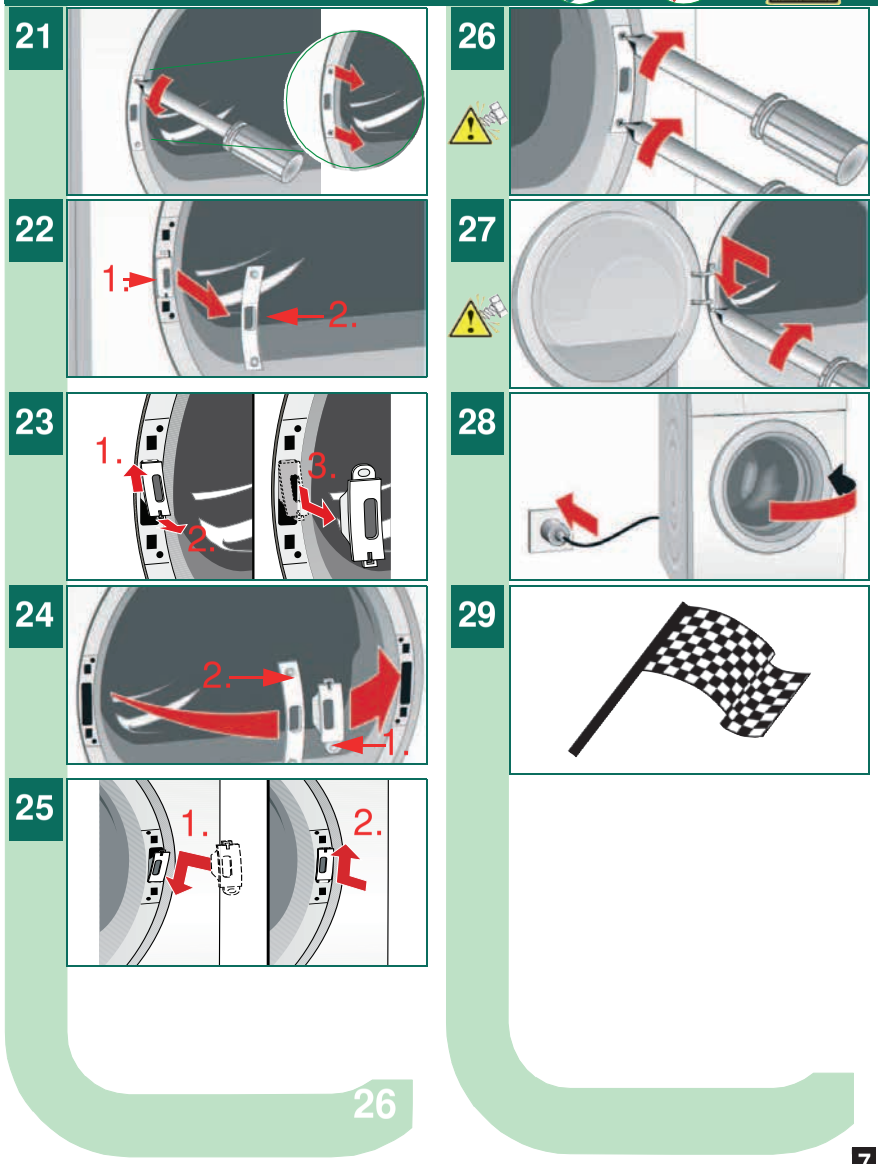




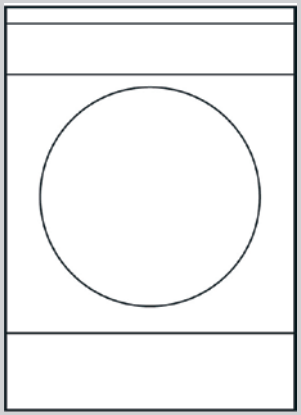


Deuraanslag wisselen

Torx 20



26



Droogautomaat

Installatie- en verzorgingshandleiding nl

Inhoud

	Blz.
Milieuvriendelijk afvoeren	1
Installatie	1
Vorstbeveiliging / Transport	1
Verzorging en reiniging	2/3
Servicedienst	4
Optionele toebehoren	4
Technische gegevens	4
Deuraanslag wisselen	5/7

Droogautomaat pas na het lezen van deze gebruikershandleiding in bedrijf nemen!
Houd ook de aparte gebruikershandleiding aan.
Bewaar alle documentatie voor later gebruik of de volgende eigenaar.

Uw droogautomaat

Gefeliciteerd - u heeft gekozen voor een modern, kwalitatief hoogwaardig huishoudelijk apparaat van Bosch.
De condensdroogautomaat met warmtepomp en automatische reiniging van de warmtewisselaar kenmerkt zich door een spaarzaam energieverbruik.
Iedere droogautomaat, die onze fabriek verlaat, wordt zorgvuldig gecontroleerd op werking en optimale toestand.
Bij vragen staat onze servicedienst graag tot uw beschikking.

Milieuvriendelijk afvoeren
Verpakking milieuvriendelijk afvoeren.
Dit apparaat is gemarkeerd overeenkomstig de Europese Richtlijn 2002/96/EG over afgedankte elektrische en elektronische apparatuur (waste electrical and electronic equipment - WEEE). De richtlijn vormt het raamwerk voor een EU-breed geldende terugname en verwerking van oude apparaten.

Meer informatie over onze producten, toebehoren, reserve-onderdelen en service onder: www.bosch-home.com

Veiligheidsinstructies op blz. 13 aanhouden!

Droogautomaat pas na het lezen van deze gebruiksaanwijzing en de **Installatie- en verzorgingshandleiding** in gebruik nemen!
Bij de installatie van de condenswaterafvoer de afzonderlijke **handleiding voor condenswaterafvoer** aanhouden *(afh. van model)*!

Inhoud

	Blz.
Voorbereiden	2
Bedieningspaneel	2
Drogen	3/4
Display en toetsen	5
Opmerkingen over het wassen	6
Programma-overzicht	7
Waar u absoluut op moet letten	8
Verbruikswaarden	9
Normale geluiden	10
Wat te doen wanneer ... / Servicedienst	11/12
Veiligheidsinstructie	13

Correct gebruik

- alleen in het huishouden,
- alleen voor het drogen van textiel, dat met water is gewassen

Kinderen niet zonder toezicht bij de droogautomaat laten!
Huisdieren op afstand van de droogautomaat houden!
De droogautomaat kan door kinderen vanaf 8 jaar, door personen met beperkte fysieke-, sensorische- of geestelijke vaardigheden en door personen met beperkte ervaring of kennis bediend worden, wanneer ze onder toezicht staan of door een verantwoordelijke persoon worden geïnstrueerd.

Voorbereiden

Installatie ⟶ Installa

Een besch nemen! Neem con

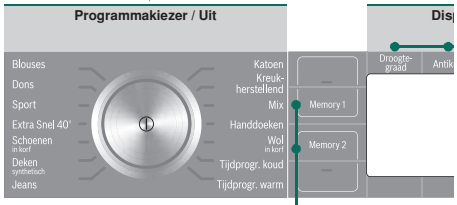


Programma's / Textiel

Gedetailleerd programma- en textieloverzicht
⟶ *programma-overzicht blz. 7.*
Wasvoorschriften op het textiellabel aanhouden.
Droogdoel, tijdvoorkeuze en opties kunnen individueel worden gekozen afhankelijk van het gekozen programma.

Katoen	Stevig textiel
Kreukherstellend	Synthetisch textiel of gemengde weefsels
Mix	Gemengde belading van katoenen en synthetisch textiel
Handdoeken	Badstof bijv. handdoeken en badmantels
Wol in korf	Hand- of machinewasbare textiel van wol of met wolaandeel
Tijdprogr. koud / **Tijdprogr. warm**	Alle textielsoorten behalve wol en zijde
Blouses	Hemden en blouses van katoen en gemengd weefsel
Dons	Textiel met donsvulling
Sport	Functionele kleding van microvezels
Extra Snel 40'	Synthetische stoffen, licht katoen of gemengde stoffen
Schoenen in korf	Schoenen
Deken synthetisch	Groot gewatteerd textiel met synthetisch aandeel
Jeans	Textiel van jeans/denim

In-/uitschakelen van het apparaat door op de ⏻ toets te drukke van de programmakiezer. Programma kiezen door aan de buite de programmakiezer te draaien (beide richtingen mogelijk). Het gekozen programma wordt weergegeven.



Memory 1 / **Memory 2** } Opslaan en oproepen van individuele instellingen

Instelmenu: 3 sec.
Signaal, Toetssignaal, Auto uitschakeling en Taal

Meer informatie ⟶ blz. 5

1

2

...tie- en onderhoudshandleiding blz. 1

...adigde droogautomaat nooit in bedrijf
...tact op met uw servicedienst!

Droogautomaat controleren

Alleen met droge handen!
Alleen aan de stekker vastpakken!

Netstekker insteken

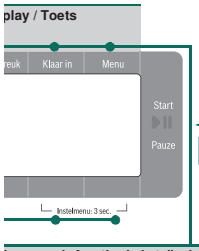
Was sorteren

Alle objecten uit de zakken halen.
Let op aanstekers!
De trommel moet voor het vullen leeg zijn!
Zie programma-overzicht op blz. 7.

Deur openen/was vullen / programmakiezer indrukken / programma instellen 1

...n in het midden ...ste ring van

Deur sluiten 2



Toets ▷II Start/Pauze kiezen 3

...igen van de functies in het display m.b.v. de toetsen ^ v

...ogtegraad	kastdroog +, kastdroog, strijkdroog
...kreuk	Kreukbeschermingsfunctie tot 120 min instelbaar
...r in	Tijdinstelling / Kinderbeveiliging
...u	Centrifuge snelheid, Wijzig droogtegr., Lage temperatuur

Drogen



Drogen

3

7 Condenswaterreservoir leegmaken

Mocht de condenswaterafvoer geïnstalleerd zijn, dan is het legen van het condenswaterreservoir niet nodig. ⟶ afzonderlijke *handleiding voor condenswaterafvoer.*

Reservoir **na iedere** droging legen, niet tijdens het drogen!
1. Reservoir uittrekken en horizontaal houden.
2. Condenswater afgieten. Reservoir er inschuiven totdat deze vastklikt.

Let ook op de ⟶ *Installatie- en verzorgingshandleiding, blz. 3.*

6 Pluizenfilter reinigen

Een schoon pluizenfilter reduceert het stroomverbruik en de droogtijd.

Het pluizenfilter bestaat uit twee delen. Reinig het binnen- en buiten filter **na elk** gebruik van de droogautomaat:

1. Deur openen. Pluizen bij/rond de deur verwijderen.



2. Beide delen van het pluizenfilter er uit trekken.
3. Pluizen van de rand van de schacht verwijderen. Deze mogen niet in de open schacht vallen.



4. Filter openklappen en alle pluizen verwijderen..



5. Beide delen onder stromend water afspoelen en goed afdrogen.
6. Binnen en buitenfilter dichtklappen, in elkaar steken en weer in de droogautomaat plaatsen.



5 Was uitnemen en droogautomaat uitschakelen

4 Programma-einde ...

Programma onderbreken

1 Deur openen of toets ▷II **Start**/Pauze kiezen, het drogen wordt onderbroken.
2 Was bijvullen of uitnemen en deur sluiten.
3 Indien nodig het programma en de extra functies opnieuw kiezen. Toets ▷II **Start**/Pauze kiezen. De **Klaar in** tijd wordt na enkele minuten geactualiseerd.

4

Display en toetsen

Display

Pluizenfilter reinigen a.u.b.	Pluizenfilter reinigen ⟶ *blz. 4.*
Condens-waterreservoir legen a.u.b.	Condenswaterreservoir legen ⟶ *blz. 4* en/of filter in condenswaterreservoir reinigen⟶ *Installatie- en verzorgingshandleiding, blz. 3.*
Condensor wordt gereinigd	Automatische reiniging van de warmtewisselaar. Condenswaterreservoir tijdens deze indicatie niet leegmaken.

Toetsen

Droogtegraad	Kiezen van het droogdoel (bijv. kastdroog) resp. de droogtijd (20 min tot 3 h:30 min, afhankelijk van het model en het programma). **kastdroog +:** Voor wasgoed met dikke, meerlaagse delen. **kastdroog:** Voor eenlaags wasgoed. **strijkdroog:** Toestand van het wasgoed geschikt om te strijken (wasgoed strijken, om kreukels te voorkomen).
Antikreuk	Trommel beweegt na afloop van het programma met regelmatige tussenpozen om kreuken te voorkomen. Automatische functie in stappen van 30 min instelbaar tot 120 min standaard instelling voor ieder programma 60 min.
Klaar in	Bij de keuze van een programma wordt de geschatte droogtijd voor de maximale belading getoond. Tijdens het drogen herkennen de vochtigheidssensoren de werkelijke belading en corrigeren de programmatijd. Dit is herkenbaar door tijdsprongen van de **Klaar in** tijd in het display. De **Klaar in** tijd kan in uren, tot max. 24 uur worden vertraagd. Toets **Klaar in** zo vaak bedienen, tot het gewenste aantal uur wordt getoond (h = uur). **Kinderbeveiliging:** Activeren/Deactiveren ⟶ Programma starten, 5 s lang toets **Klaar in** boven het display indrukken.
Menu	**Centrifuge snelheid; Wijzig droogtegr.; Lage temperatuur** *Afhankelijk van het gekozen programma kunnen afzonderlijke opties niet beschikbaar zijn.* **Centrifuge snelheid:** centrifugetoerental, waarmee de wasautomaat centrifugeert ⟶ uitsluitend voor meer nauwkeurige indicatie van de geschatte droogtijd (**Klaar in** - tijd). **Wijzig droogtegr.:** Het droogresultaat (bijv. kastdroog) kan in drie stappen (+1 - max. +3) worden verhoogd, uitzondering: Tijdprogramma ⟶ voorinstelling = 0. Instelling blijft na fijninstelling van een programma voor de andere programma's behouden. **Lage temperatuur:** Verlaagde temperatuur voor gevoelig textiel, bijv. polyacryl, polyamide of elastaan, bij langere droogtijd.
Memory 1/2	Voor het opslaan van vaak gebruikte individuele programma-instellingen. Het gewenste programma met programmakiezer kiezen. Toets **Memory 1/2** 3 sec. ingedrukt houden tot het gewenste programma is opgeslagen. Om het opgeslagen programma te kiezen, toets **Memory 1/2** kort indrukken. Het opgeroepen programma van **Memory 1/2** wordt op het display weergegeven.
Instelmenu: 3 sec.	**Signaal**, **Toetssignaal**, **Auto uitschakeling** en **Taal**. Beide toetsen gedurende 3 s tegelijkertijd indrukken, om in het menu te komen. **Signaal**, **Toetssignaal:** Signaalvolume instelbaar: uit - zacht - gemiddeld - luid - zeer luid. **Auto uitschakeling:** Activeren/Deactiveren door drukken op de toetsen **Instelmenu: 3 sec.** De droogautomaat schakelt, afhankelijk van de gemaakte keuze, na 15, 30 of 60 min automatisch uit. De instelling ins actief na **Antikreuk** of programma-einde. **Taal:** Selectie van de gewenste taal.

Opmerkingen over het wassen ...

Aanduiding van textiel

Houd de instructies van de fabrikant aan!

- Geschikt voor droogautomaat
- Drogen met normale temperatuur.
- Drogen met lage temperatuur.
- Niet machinaal drogen.

Het volgende textiel niet in de droogautomaat drogen:
- Luchtdicht textiel (bijv. met rubber coating).
- Gevoelig weefsel (zijde, synthetische gordijnen) ⟶ kreukelvorming!
- Met olie vervuilde was.

Tips voor het drogen

- Voor een gelijkmatig droogresultaat, was sorteren op soort weefsel en droogprogramma.
- Zeer klein textiel (bijv. babysokjes) altijd samen met groot textiel (bijv. handdoeken) drogen.
- Ritssluitingen, haken en ogen sluiten, overtrekken dichtknopen. Stoffen riemen, schortbanden enz. samenbinden, evt. een waszak gebruiken.
- Kreukherstellende was niet te veel drogen ⟶ gevaar voor kreukels! Was in de lucht laten nadrogen.
- Was na het drogen niet direct strijken, enkele tijd laten liggen ⟶ het restvocht wordt dan gelijkmatig verdeeld.
- Gebreid textiel (bijv. T-shirts, tricot) krimpt vaak bij de eerste keer drogen. ⟶ Gebruik niet het programma **kastdroog +**.
- Gesteven was is slechts beperkt geschikt voor de droogautomaat⟶ Stijfsel laat een aanslag achter, die invloed heeft op het drogen.
- Wasverzachter bij het wassen van de te drogen was doseren volgens de instructies van de fabrikant.
- Bij weinig belading het tijdprogramma gebruiken.

Milieubescherming / Besparingstips

- Voor het drogen het wasgoed in de wasmachine centrifugeren ⟶ hogere centrifugetoerentallen verkorten de droogtijd en verminderen het energieverbruik, ook kreukherstellende was centrifugeren.
- Maximaal aanbevolen vulgewicht gebruiken, maar niet overschrijden ⟶ *programma-overzicht blz. 7.*
- Tijdens het drogen de ruimte goed beluchten.
- Pluizenfilter na elke droogcyclus reinigen ⟶ *Pluizenfilter reinigen, blz. 4.*
- Toevoer van de koellucht vrijhouden ⟶ luchtinlaat niet afsluiten of dichtplakken.

Programma-overzicht ⟶ *Tabel verbruikswaarden pagina 9 en instructies op pagina 6 aanhouden!*

⟶ Sorteer het wasgoed naar soort textiel en weefsel. Het wasgoed moet in de droogautomaat kunnen.
⟶ Droogdoelen individueel instelbaar ⟶ kastdroog +, kastdroog en strijkdroog (afhankelijk van model en programma). Fijninstelling van de mate van droging mogelijk (afhankelijk van programma). Meerlaags textiel heeft een langere droogduur nodig dan enkellaags kledingstukken. Aanbeveling: gescheiden drogen!

Programma's	Max.	Soort textiel	Opties en instructies
Katoen	**8 kg**	Stevig textiel, kookwasbestendig textiel van katoen of linnen.	
Kreukherstellend	**3,5 kg**	Synthetisch textiel of gemengde weefsels	
Mix	**3,5 kg**	Gemengde belading van katoenen en synthetisch textiel	
Handdoeken	**3,5 kg**	Badstof bijv. handdoeken en badmantels	
Wol in korf	**1 kg**	Hand- of machinewasbare textiel van wol of met wolaandeel	**Alleen met separate mand ⟶ beschrijving wolmand.**
Tijdprogr. koud		Alle textielsoorten behalve wol en zijde	**Voor opfrissen of luchten.**
Tijdprogr. warm			**Voor voorgedroogd, meerlaags textiel of los klein wasgoed. Ook om nat te drogen.**
Blouses	**1,5 kg**	Hemden en blouses van katoen en gemengd weefsel	**Kreuken wordt verminderd. Niet volledig gedroogd.**
Dons	**1,5 kg**	Textiel met donsvulling	**Niet doorgestikte textiel afzonderlijk drogen.**
Sport	**2 kg**	Functionele kleding van microvezels	
Extra Snel 40'	**2 kg**	Synthetische stoffen, licht katoen of gemengde stoffen	**Gemakkelijk te drogen textielsoorten.**
Schoenen in korf	**1 paar**	Schoenen	**Alleen met separate mand ⟶ beschrijving wolmand.**
Deken synthetisch	**2 kg**	Groot gewatteerd textiel met synthetisch aandeel	**Geen donsvulling.**
Jeans	**6 kg**	Textiel van jeans/denim	

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Waar u absoluut op moet letten ...

Uw droogautomaat is bijzonder energiebesparend en kenmerkt zich technisch door een koelcircuit, dat, net zoals bij een koelkast, energie efficiënt gebruikt.
De warmtewisselaar van de droogautomaat wordt bij het drogen automatisch gereinigd.
Pluizenfilter en filter in het condenswaterreservoir moeten regelmatig gereinigd worden.

De droogautomaat nooit zonder pluizenfilter en/of filter in het condenswaterreservoir gebruiken!

Pluizenfilter

Bij het drogen worden pluizen en haren uit het wasgoed opgevangen in het pluizenfilter.
Een verstopt pluizenfilter kan de warmte-uitwisseling reduceren.
Daarom het pluizenfilter absoluut na elke droogcyclus reinigen.
Regelmatig onder stromend water afspoelen ⟶ *blz. 4.*
Let er bij het reinigen van het pluizenfilter op dat geen kleine voorwerpen (veren, vulstof) in de luchtkanaalopening terecht komen. Eventueel de trommel van te voren schoonzuigen met een stofzuiger. Mochten er toch vreemde voorwerpen in het luchtkanaal terecht komen, neem dan contact op met de ⟶ Servicedienst.

Filter in het condenswaterreservoir

Het filter in het condenswaterreservoir reinigt het condenswater. Dit condenswater is nodig voor de automatische reiniging. Het filter moet regelmatig onder stromend water worden gereinigd. Maak het condenswaterreservoir leeg voor het reinigen van het filter ⟶ *Installatie- en verzorgingshandleiding, blz. 3.*

Textiel

Geen textiel drogen, wanneer deze in aanraking is geweest met oplosmiddel, olie, was, vet of verf: bijv. haarversteviger, nagellakremover, vlekkenverwijderaar, wasbenzine enz.
Maak alle zakken leeg.
Droog geen luchtdicht textiel.
Sterk pluizende was vermijden.
Wol alleen met het wolprogramma opfrissen resp. drogen.

Verbruikswaarden

Textiel/Programma	Restvochtgehalte van het textiel na het centrifugeren		Droogtijd**	Energie-verbruik**
Katoen 8 kg				
kastdroog*	1400 tpm	50 %	167 min	1,19 kWh
	1000 tpm	60 %	187 min	1,37 kWh
	800 tpm	70 %	207 min	1,55 kWh
strijkdroog*	1400 tpm	50 %	109 min	0,64 kWh
	1000 tpm	60 %	129 min	0,82 kWh
	800 tpm	70 %	149 min	1,00 kWh
Kreukherstellend 3,5 kg				
kastdroog*	800 tpm	40 %	57 min	0,42 kWh
	600 tpm	50 %	69 min	0,49 kWh

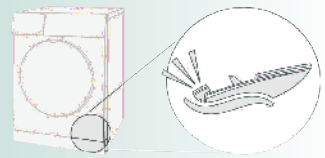
* Programma-instelling voor controle volgens de geldende EN61121.
** De waarden kunnen afhankelijk van de textielsoort, samenstelling van de te drogen was, restvochtgehalte van het textiel alsmede de beladingshoeveelheid afwijken van de vermelde waarden.

Textiel/Programma	Droogtijd	Jaarlijks energie-verbruik
Katoen 8 kg / 4 kg* **		
kastdroog***	148 min / per cyclus	172 kWh / per jaar

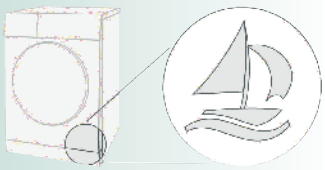
***Programma-instelling voor testen en energielabel conform de richtlijn 2010/30/EU.

Normale geluiden

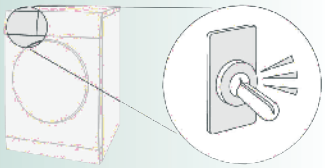
Tijdens het drogen genereren de compressor en de pomp normale geluiden.



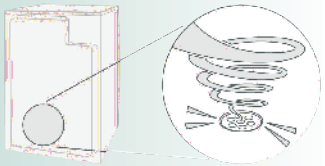
De compressor in de droogautomaat veroorzaakt van tijd tot tijd een bromgeluid. Het volume en de toonhoogte kan daarbij wijzigen, afhankelijk van het gekozen programma en droogfase.



De compressor van de droogautomaat wordt af en toe belucht, daarbij ontstaat een zoemend geluid.



De automatische reiniging van de droogautomaat veroorzaakt klikken.



Het condenswater wordt met een pomp in het condenswaterreservoir gepompt, daarbij ontstaat pompgeluid.

Wat te doen als ...

Wanneer een storing niet zelf kan worden opgelost (bijv. door uit-/inschakelen), neem dan contact op met onze servicedienst.
Wij vinden altijd een passende oplossing, ook om onnodig bezoek van een monteur te vermijden. Vertrouw op de competentie van de fabrikant en waarborg zo dat de reparatie door getrainde servicemonteurs wordt uitgevoerd, die beschikken over originele reservedelen.
De contactgegevens voor de **Servicedienst** bij u in de buurt vindt u in het meegeleverde overzicht:
– **B** 070 222 141
– **NL** 088 424 4010
Geef aan de servicedienst het typenummer (E-nr.) en het fabricagenummer (FD) van het apparaat door (zie binnenkant van de deur).
Droogautomaat via de programmakiezer uitschakelen en netstekker uit het stopcontact trekken.

Condenswaterreservoir legen a.u.b. wordt weergegeven en het droogproces wordt afgebroken.	Condenswaterreservoir legen ⟶ *blz. 4.*
	Condenswaterafvoer geïnstalleerd? ⟶ Condenswater-afvoerslang verstopt ⟶ slang controleren en reinigen. Verstopping in condenswaterreservoir? ⟶ afzonderlijke *handleiding voor condenswater-afvoer*
	Filter in het condenswaterreservoir verontreinigd? ⟶ Filter in het condenswaterreservoir reinigen ⟶ *Installatie en onderhoudshandleiding blz. 3.* Voor het hervatten van het programma een willekeurige toets kiezen. Opnieuw de toets ▷II **Start**/Pauze kiezen.
Pluizenfilter reinigen a.u.b. wordt getoond.	Pluizenfilter reinigen ⟶ *blz. 4.* Opnieuw op de toets ▷II **Start**/Pauze drukken.
Op het display verschijnt **Condensor wordt gereinigd**.	Geen fout! Automatische reiniging van de warmtewisselaar. Condenswaterreservoir tijdens het reinigingsproces niet leeg maken.
Droogautomaat start niet.	Toets ▷II **Start**/Pauze gekozen? Deur gesloten? Omgevingstemperatuur hoger dan 5 °C?
Water ontsnapt.	Droogautomaat horizontaal opstellen. Condenswaterreservoir volledig inschuiven totdat deze vastklikt.

Wat te doen als ...

Droogresultaat wordt niet bereikt (was is te vochtig).	Warme was voelt altijd vochtiger aan dan dat deze in werkelijkheid is! Gekozen programma past niet bij de belading. Ander droogprogramma gebruiken of extra tijdprogramma kiezen ⟶ *programma-overzicht blz. 7.* Optie «⊡ *Wijzig droogtegr.*» gebruiken ⟶ *blz. 5.* Fijne kalklaag op de vochtigheidssensoren? Vochtigheidssensor reinigen ⟶ *Installatie- en verzorgingshandleiding, blz. 2.* Programma-onderbreking, bijv. condenswaterreservoir vol, netspanningsuitval, deur open of maximale droogtijd bereikt.
Droogtijd te lang.	Pluizenfilter onder stromend water reinigen ⟶ *blz. 4.* Onvoldoende luchttoevoer ⟶ voor luchtcirculatie zorgen. Evt. luchtinlaat geblokkeerd? Vrijhouden ⟶ *Installatie- en verzorgingshandleiding, blz. 1.* Omgevingstemperatuur hoger dan 35 °C ⟶ ventileren.
Vochtigheid in de ruimte neemt sterk toe.	Ruimte voldoende ventileren.
Netspanningsuitval.	Door een stroomstoring wordt het programma afgebroken. Wanneer het wasgoed nog vochtig is: Apparaat inschakelen, programma opnieuw starten.
Af en toe extra geluiden of trillingen.	Normale geluiden ⟶ *blz. 10.*

Veiligheidsinstructies

Noodgeval
- Direct de stekker uit het stopcontact trekken of zekering onderbreken.

Droogautomaat ALLEEN...
- in binnenruimten binnen het huishouden gebruiken.
- voor het drogen van textiel gebruiken.

Droogautomaat NOOIT...
- voor andere doeleinden dan hiervoor genoemd gebruiken.
- voor wat betreft techniek of eigenschappen veranderen.

Gevaren
- Kinderen en niet geïnstrueerde personen mogen de droogautomaat niet gebruiken.
- Kinderen niet zonder toezicht bij de droogautomaat laten!
- Huisdieren op afstand van de droogautomaat houden!
- Alle objecten uit de zakken van het wasgoed halen. Let vooral op aanstekers ⟶ **explosiegevaar!**
- Niet op de deur leunen of zitten ⟶ **gevaar voor kantelen!**
- De deur voorzichtig openen. Hete damp kan ontsnappen. Textiel en trommel kunnen heet zijn ⟶ **verbrandingsgevaar!**

Installatie
- Losse leidingen of slangen bevestigen, anders bestaat **gevaar voor struikelen!**
- Onder 0°C is vorstschade mogelijk.

Elektrische aansluiting
- Droogautomaat conform de voorschriften aansluiten op een wisselspanningsstopcontact met randaarde, omdat anders de veiligheid niet is gewaarborgd.
- Aderdiameter moet voldoende zijn.
- Alleen aardlekschakelaars met dit symbool gebruiken: ⊠
- Netstekker en stopcontact moeten bij elkaar passen.
- Geen stekkerdozen/-koppelingen en/of verlengsnoeren gebruiken.
- Netstekker niet met vochtige handen vastpakken ⟶ **elektrocutiegevaar!**
- Netstekker nooit aan de kabel uit het stopcontact trekken.
- Netkabel niet beschadigen ⟶ **elektrocutiegevaar!**

Gebruik
- Belaad de droogautomaat alleen zoals in de programmabeschrijvingen (*Programma's/textiel blz. 1* en *Programma-overzicht blz. 7*) is aanbevolen. Voordat u de droogautomaat inschakelt, moet u de inhoud controleren!
- Droogautomaat niet gebruiken, wanneer de was met oplosmiddel, olie, was, vet of verf in aanraking is gekomen (bijv. haarversteviger, nagellakremover, vlekkenverwijderaar, wasbenzine, enz.) ⟶ **brand-/explosiegevaar!**
- Gevaar door stof (bijv. koolstof, meel): Droogautomaat niet gebruiken ⟶ **explosiegevaar!**
- Droogautomaat niet gebruiken, wanneer het wasgoed schuimstof/-rubber bevat ⟶ elastisch materiaal kan beschadigd raken en de droogautomaat kan door mogelijke vervorming van het schuimmateriaal beschadigd worden.
- Lichte dingen, zoals bijv. lange haren, kunnen door de luchtinlaat van de droogautomaat worden ingezogen ⟶ **gevaar voor lichamelijk letsel!**
- Droogautomaat na afloop programma uitschakelen!
- Gedestilleerd water/condenswater is geen drinkwater en kan worden vervuild met pluizen!

Defect
- De droogautomaat bij een defect of het vermoeden van een defect niet gebruiken, reparatie alleen door de servicedienst.
- Droogautomaat met defecte netkabel niet gebruiken. Defecte netkabel alleen door servicedienst laten vervangen om gevaren te voorkomen.

Reserve-onderdelen
- Gebruik uit veiligheidsoverwegingen alleen originele reserve-onderdelen en -toebehoren.

Afvoeren
- Droogautomaat: netstekker ontkoppelen, **daarna** netkabel bij apparaat afknippen. Bij openbare verzamelplaats inleveren.
- Verpakking: Kinderen niet met de verpakking laten spelen ⟶ **gevaar voor verstikking!**
- Warmtewisselaar bevat door het Kyoto-protocol geregistreerd gefluoriseerd broeikasgas R134a ⟶ volgens de voorschriften afvoeren. Vulgewicht: 0,280 kg.
- Alle materialen zijn milieuvriendelijk en recyclebaar. Milieuvriendelijk afvoeren.







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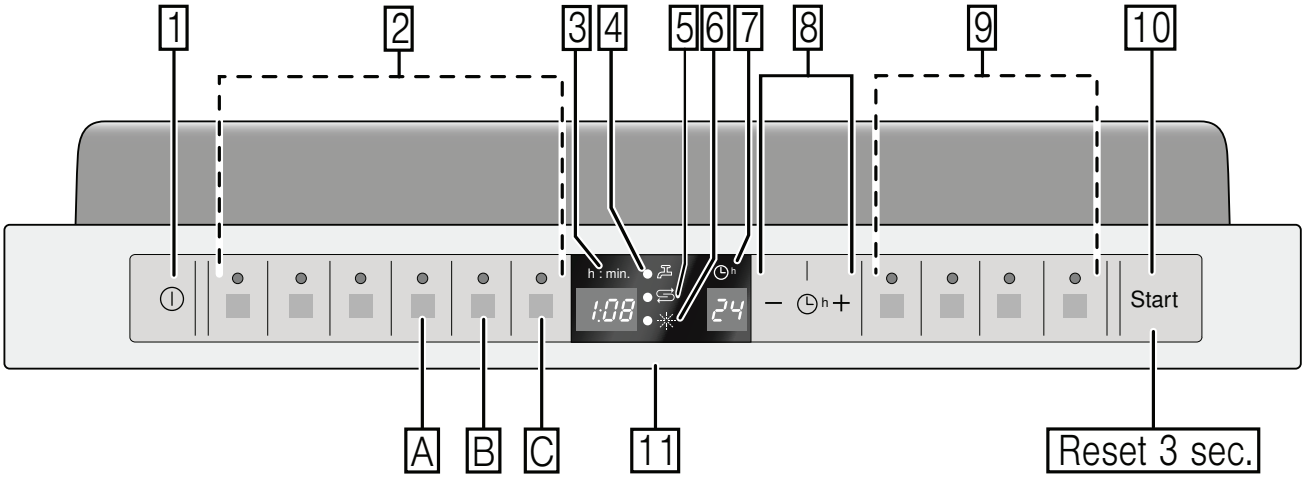


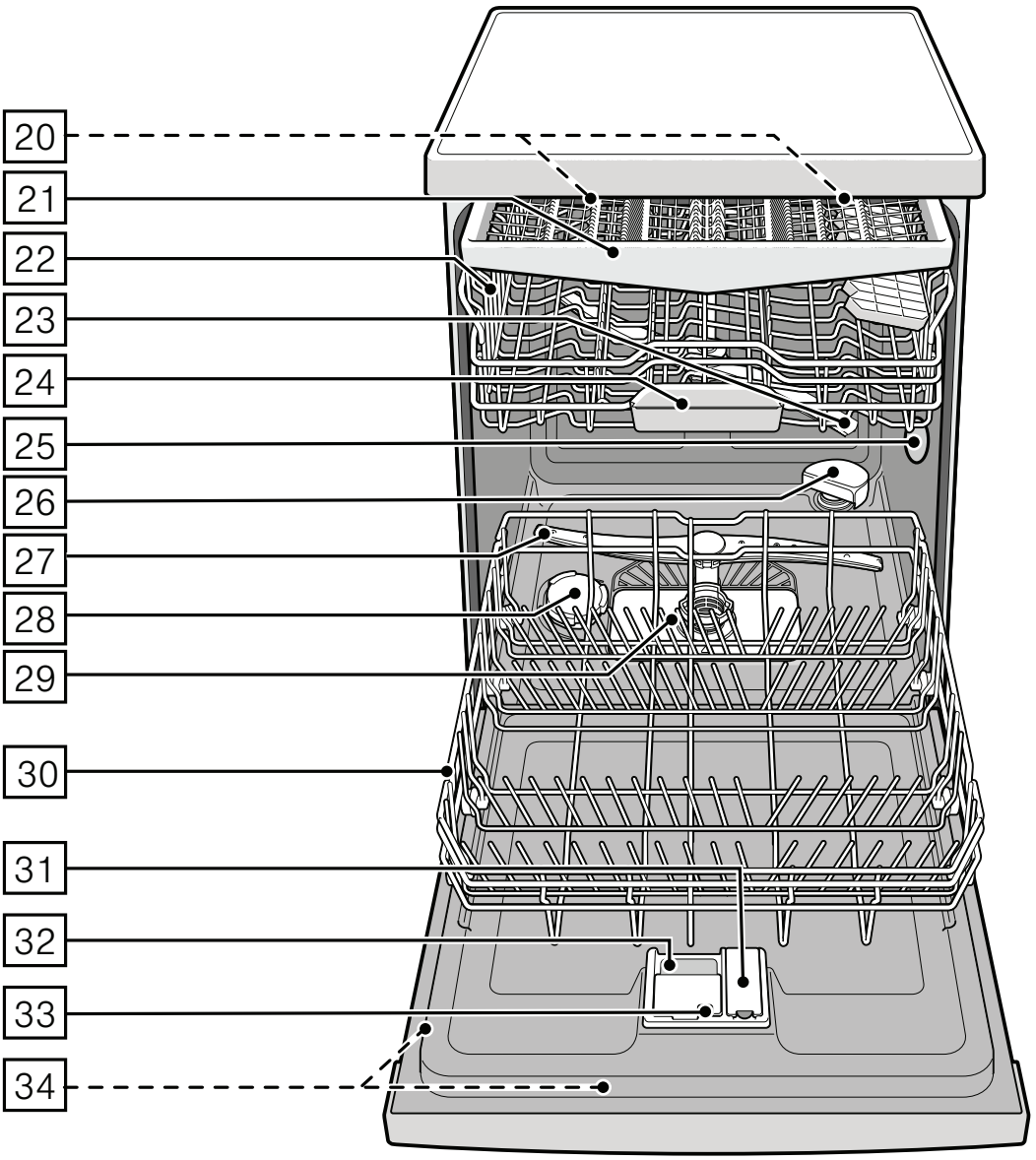
Afwasautomaat

SM...
SB...

BOSCH

nl Gebruiksaanwijzing


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Gebruik volgens de voorschriften

- Dit apparaat is bestemd voor privégebruik in het huishouden en de huiselijke omgeving.
- De afwasautomaat alleen in het huishouden gebruiken en alleen voor het aangegeven doel: het afwassen van huishoudelijk serviesgoed.

Veiligheids-voorschriften

Kinderen vanaf 8 jaar en personen die wegens hun beperkte fysieke, sensorische of geestelijke vaardigheden of hun onervarenheid of onwetendheid niet in staat zijn om het apparaat veilig te bedienen, mogen het apparaat niet zonder toezicht of aanwijzingen van een verantwoordelijke persoon gebruiken.

Voordat u het apparaat in gebruik neemt

Lees de gebruiksaanwijzing en het installatievoorschrift nauwkeurig door. U vindt daarin belangrijke informatie over plaatsing, gebruik en onderhoud van het apparaat.

Bewaar de gebruiksaanwijzing en het montagevoorschrift voor later gebruik of voor een eventuele latere bezitter.

Bij aflevering

1. Controleer onmiddellijk of de verpakking en de afwasautomaat tijdens het transport beschadigd zijn. Een beschadigd apparaat niet in gebruik nemen maar contact opnemen met uw leverancier.
2. Het verpakkingsmateriaal milieuvriendelijk volgens de geldende voorschriften afvoeren.
3. Laat kinderen niet met de verpakking en de onderdelen daarvan spelen. Kans op stikken door vouwdozen en folie.

Bij de installatie

- Zorg ervoor dat de achterzijde van de afwasautomaat na de installatie niet meer vrij toegankelijk is (aanraakbeveiliging wegens hete oppervlakken).
- Het apparaat volgens het installatie- en montagevoorschrift plaatsen en aansluiten.
- Tijdens het installeren mag de afwasautomaat niet op het elektriciteitsnet zijn aangesloten.
- Overtuig u ervan dat het aardingssysteem van de elektrische huisinstallatie volgens de elektrotechnische voorschriften is geïnstalleerd.
- De elektrische aansluitvoorwaarden moeten overeenkomen met de gegevens op het typeplaatje [34] van de afwasautomaat.
- Als de elektrische aansluitkabel van het apparaat beschadigd wordt, dan moet deze door een speciale aansluitkabel vervangen worden.

  Om gevaren te voorkomen mag deze alleen door de Servicedienst vervangen worden.

- Als de afwasmachine in een hoge kast moet worden ingebouwd, dan moet deze volgens de voorschriften bevestigd worden.
- Wanneer u boven de afwasautomaat een magnetron inbouwt, kan deze beschadigd raken.
- Voor een goede stabiliteit van het apparaat mogen integreerbare of onderbouwapparaten alleen onder een doorlopend werkblad worden ingebouwd dat aan de kasten ernaast is vastgeschroefd.
- Het apparaat niet in de buurt van een warmtebron (radiator, boiler, fornuis of andere apparaten die warmte afgeven) installeren en niet onder een kookplateau inbouwen.
- Na het plaatsen van het apparaat moet de stekker gemakkelijk te bereiken zijn. (Zie Elektrische aansluiting)
- Bij sommige modellen: In de kunststof behuizing aan de wateraansluiting bevindt zich een elektrisch ventiel, in de toevoerslang bevinden zich de aansluitingsleidingen. De slang niet doorsnijden, de kunststof behuizing niet in water onderdompelen.

Dagelijks gebruik

Let op de veiligheidsvoorschriften resp. de aanwijzingen bij het gebruik op de verpakkingen van het afwas- en glansspoelmiddel.

Kinderbeveiliging (deurvergrendeling) *

De beschrijving van de kinderbeveiliging bevindt zich achterin in de omslag.

* Afhankelijk van het model

Bij schade

- Reparaties en ingrepen mogen alleen door een vakkundig monteur worden uitgevoerd. Hierbij mag het apparaat niet op het lichtnet zijn aangesloten. Stekker uit het stopcontact trekken of de zekering losdraaien resp. uitschakelen. Kraan dichtdraaien.
- Als het bedieningspaneel is beschadigd (scheuren, gaten, afgebroken toetsen), mag het apparaat niet meer worden gebruikt. Stekker uit het stopcontact trekken of de zekering losdraaien resp. uitschakelen. Kraan dichtdraaien, bel de klantenservice.

Bij het afvoeren van het apparaat

1. Het afgedankte apparaat onmiddellijk onbruikbaar maken om eventuele ongelukken te voorkomen.
2. Het apparaat op een milieuvriendelijke wijze (laten) afvoeren.

⚠ Waarschuwing
Verwondingsgevaar!

- Om verwondingen bijv. door struikelen te voorkomen: de afwasautomaat tijdens het in- en uitladen zo kort mogelijk openen.
- Messen en andere voorwerpen met scherpe punten plat in de besteklade leggen.
- Niet op de geopende deur gaan zitten of staan.
- Let er bij vrijstaande apparaten op dat de korven niet overladen zijn.
- Als het apparaat niet in een nis staat waardoor een zijwand toegankelijk is, dan moeten de deurscharnieren om veiligheidsredenen aan de zijkant afgedekt worden (kans op verwondingen). De afdekkingen zijn als extra toebehoren tegen meerprijs bij de Servicedienst of bij uw leverancier verkrijgbaar.

⚠ Waarschuwing
Gevaar door explosie!

Doe geen oplosmiddel in de spoelruimte. Kans op explosie.

⚠ Waarschuwing
Risico van brandwonden!

Tijdens het programmaverloop de deur alleen heel voorzichtig openen. Er kan namelijk heet water uit het apparaat spuiten.

⚠ Waarschuwing
Gevaren voor kinderen!

- Maak gebruik – indien aanwezig – van de kinderbeveiliging. Een nauwkeurige beschrijving vindt u achter in de omslag.
- Laat kinderen nooit met het apparaat spelen of het bedienen.
- Kinderen uit de buurt van afwasmiddel en glansspoelmiddel houden. Deze kunnen irritaties in mond, keel en ogen veroorzaken of tot verstikking leiden.
- Kinderen uit de buurt van de geopende afwasautomaat houden, Het water in het apparaat is geen drinkwater. Er kunnen nog resten afwasmiddel in het apparaat zijn achtergebleven.



- Let op dat kinderen niet in de tab-opvangschaal [24] grijpen. De vingertjes kunnen in de sleuven beklemd raken.
- Let er bij een op een hoge plaats ingebouwd apparaat op dat er bij het openen en sluiten van de deur geen kinderen klem komen te zitten of bekneld raken tussen de apparaatdeur en de onderliggende kastdeur.
- Kinderen kunnen zich opsluiten in het apparaat (verstikkingsgevaar) of in een andere gevaarlijke situatie terechtkomen.
  Bij uitgediende apparaten daarom: Trek daarom de stekker uit het stopcontact. Aansluitkabel doorknippen en verwijderen. Deurslot onklaar maken zodat de deur niet meer sluit.

Milieubescherming

Zowel de verpakking van het nieuwe apparaat als het oude apparaat bevat waardevolle grondstoffen en materiaal dat hergebruikt kan worden.

De afzonderlijke delen a.u.b. gesorteerd afvoeren.

U kunt bij uw leverancier of bij de gemeente informeren hoe u uw oude apparaat en het verpakkingsmateriaal kunt (laten) afvoeren.

Verpakking

Alle kunststof delen van het apparaat zijn gemerkt met een gestandaardiseerd afkortingsteken (bijv. >PS< polystyreen). Hierdoor is bij het afvoeren van het apparaat een scheiding per soort van de kunststof afvaldelen mogelijk.

Neem a.u.b. de aanwijzingen voor de veiligheid onder „Bij levering” in acht.

Uw oude apparaat

Neem a.u.b. de aanwijzingen voor de veiligheid onder „Bij het afvoeren” in acht.



Dit apparaat is gekenmerkt in overeenstemming met de Europese richtlijn 2002/96/EC afgedankte elektrische en elektronische apparatuur (waste electrical and electronic equipment – WEEE). De richtlijn geeft het kader aan voor de in de EU geldende terugname en verwerking van oude apparaten.

Kennismaking met het apparaat

De afbeeldingen van het bedieningspaneel en van de binnenruimte van het apparaat vindt u vooraan in de omslag van deze gebruiksaanwijzing.

In de tekst wordt op de verschillende posities gewezen.

Bedieningspaneel

1 AAN/UIT-schakelaar
2 Programmatoetsen **
3 Cijferindicatie
4 Indicatie „Watertoevoer controleren”
5 Indicatie zout bijvullen
6 Indicatie glansspoelmiddel bijvullen
7 Indicatie Starttijdkeuze
8 Starttijd kiezen
9 Extra functies **
10 START-toets
11 Toets om de deur te openen
** Aantal afhankelijk van het model

Binnenkant van het apparaat

20 Binnenverlichting *
21 Besteklade
22 Bovenste servieskorf
23 Bovenste sproeiarm
24 Tab-opvangschaal
25 Aanzuigopening
26 Uitblaasopening (zeoliet-reservoir)
27 Onderste sproeiarm
28 Reservoir voor onthardingszout
29 Zeven
30 Onderste servieskorf
31 Voorraadreservoir voor glansspoelmiddel
32 Afwasmiddelbakje
33 Vergrendeling voor afwasmiddelbakje
34 Typeplaatje
* Afhankelijk van het model

Menuoverzicht

De instellingen vindt u in de afzonderlijke hoofdstukken.

H Waterhardheid H:00 - H:07
d Intensief drogen d:00 - d:01
r Glansspoelmiddel r:00 - r:06
A Warmwater A:00 - A:01
b Pieptoon Programma-einde b:00 - b:03
P Automatische uitschakeling P:00 - P:02
S Optische indicatie tijdens het programmaverloop S:00 – S:02

Wateronthardingsinstallatie/Onthardingszout

Voor een goed afwasresultaat heeft de afwasautomaat zacht water, d.w.z. water met weinig kalk nodig. Anders zetten zich witte kalkresten op het serviesgoed en de binnenkant van de spoelruimte af.

Leidingwater is harder dan 7° dH (1,2 mmol/l), moet onthard worden. Dit gebeurt met behulp van onthardingszout (regenereerzout) in de wateronthardingsinstallatie van de afwasmachine.

De instelling en daarmee de benodigde hoeveelheid zout zijn afhankelijk van de hardheidsgraad van het leidingwater.

Instellen

De hoeveelheid onthardingszout is van H:00 tot H:07 instelbaar.

Bij de instelwaarde H:00 is geen onthardingszout nodig.

1. Vraag de hardheidsgraad van het water. Informeer bij het waterleidingbedrijf.
2. De instelwaarde vindt u in de tabel voor de waterhardheid.
3. Deur openen.
4. AAN/UIT-schakelaar [1] inschakelen.
5. Programmatoets [A] ingedrukt houden en de START-toets [10] net zolang indrukken tot de cijferindicatie H:0... brandt.
6. Beide toetsen loslaten.
   De indicatie van toets [A] knippert en op de cijferindicatie [3] brandt de door de fabriek ingestelde waarde H:04.

Om de instelling te wijzigen:

1. Programmatoets [C] indrukken.
   Bij elke druk op de toets wordt de instelwaarde met één cijfer verhoogd. Als de waarde H:07 is bereikt, dan springt de indicatie weer op H:00 (uit).
2. START-toets [10] indrukken.
   De ingestelde waarde is in het geheugen opgeslagen.
3. Deur sluiten.

Tabel voor de waterhardheid

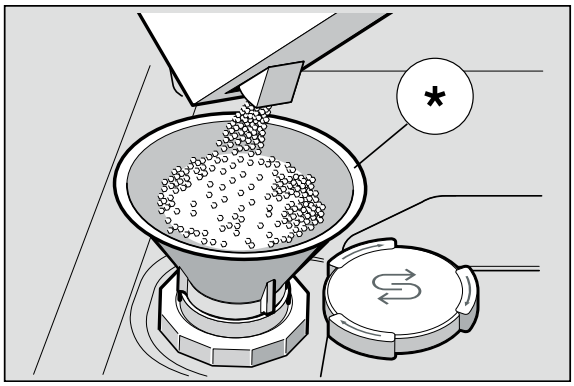
Waterhardheidswaarde °dH	Hardheidsbereik	mmol/l	Instelwaarde op machine
0–6	zacht	0–1,1	H:00
7–8	zacht	1,2–1,4	H:01
9–10	gemiddeld	1,5–1,8	H:02
11–12	gemiddeld	1,9–2,1	H:03
13–16	gemiddeld	2,2–2,9	H:04
17–21	hard	3,0–3,7	H:05
22–30	hard	3,8–5,4	H:06
31–50	hard	5,5–8,9	H:07

Gebruik van onthardingszout

Onmiddellijk vóór het inschakelen van het apparaat zout bijvullen. Hiermee bereikt u dat de overgelopen zoutoplossing onmiddellijk wordt uitgespoeld en corrosie aan het spoelreservoir wordt voorkomen.

1. De schroefdop van het voorraadreservoir 28 eraf draaien.
2. Het reservoir met water vullen (alleen nodig bij het eerste gebruik).
3. Hierna onthardingszout bijvullen **(geen keukenzout of tabletten)**.
   Hierdoor wordt het water verdrongen en loopt weg.

Zodra de indicatie zout bijvullen 5 op het bedieningspaneel brandt, moet opnieuw zout worden bijgevuld.



* Afhankelijk van het model

Gebruik van reinigingsproducten met zoutcomponenten

Bij gebruik van gecombineerde reinigingsproducten met zoutcomponenten hoeft in het algemeen tot een waterhardheid van 21°dH (37°fH, 26°Clarke, 3,7mmol/l) geen onthardingszout gebruikt te worden.
Bij een waterhardheid boven 21° dH is ook hier het gebruik van onhardingszout noodzakelijk.

Indicatie zout bijvullen/ ontharding uitschakelen

Als de indicatie zout bijvullen 5 stoort (bijv. bij gebruik van gecombineerde reinigingsproducten met zoutcomponenten), dan kan deze uitgeschakeld worden.

- Ga te werk zoals onder „Onthardingsinstallatie instellen” is beschreven en de waarde op *H:00* zetten.
  Hiermee zijn de onthardingsinstallatie en de indicatie zout bijvullen uitgeschakeld.

⚠ Attentie

Het zoutreservoir nooit met afwasmiddel vullen. Hierdoor gaat de onthardingsinstallatie kapot.

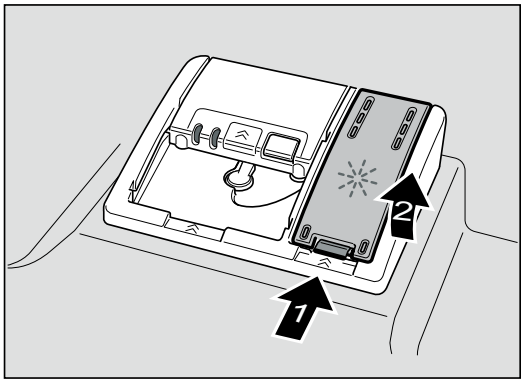
Glansspoelmiddel

Als indicatie Glansspoelmiddel bijvullen [6] op het bedieningspaneel brandt, dan is er nog glansspoelmiddel voor 1-2 afwasbeurten aanwezig. U moet glansspoelmiddel bijvullen.

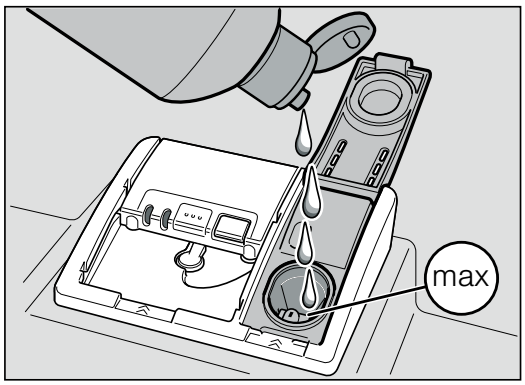
Glansspoelmiddel hebt u nodig voor streeploos gedroogd serviesgoed en heldere glazen. Gebruik alleen glansspoelmiddel voor huishoudelijke afwasautomaten.

Gecombineerde reinigingsproducten met glansspoelcomponenten kunnen alleen tot een waterhardheid van 21° dH (37° fH, 26° Clarke, 3,7 mmol/l) gebruikt worden.
Bij een waterhardheid boven 21° dH is ook hier het gebruik van glansspoelmiddel noodzakelijk.

1. Het voorraadreservoir [31] openen door het lipje op het deksel in te drukken en op te tillen.



2. Glansspoelmiddel voorzichtig tot de max. markering in de vulopening gieten.



3. Deksel sluiten tot u een klik hoort.
4. Eventueel gemorst glansspoelmiddel met een doekje verwijderen om overmatige schuimontwikkeling bij de volgende afwasbeurt te voorkomen.

Hoeveelheid glansspoelmiddel instellen

De hoeveelheid glansspoelmiddel is van r:00 tot r:06 instelbaar. Stel de hoeveelheid wasverzachter in op r:05 voor een bijzonder goed droogresultaat. In de fabriek is niveau r:05 ingesteld.

Verander de hoeveelheid glansspoelmiddel alleen als er strepen (lagere stand instellen) of watervlekken (hogere stand instellen) op het serviesgoed achterblijven.

1. Deur openen.
2. AAN/UIT-schakelaar [1] inschakelen.
3. Programmatoets [A] ingedrukt houden en de START-toets [10] net zolang indrukken tot de cijferindicatie H:0... aangeeft.
4. Beide toetsen loslaten.
   De indicatie van toets [A] knippert en op de cijferindicatie [3] brandt de door de fabriek ingestelde waarde H:04.

5. Programmatoets [A] net zo vaak indrukken tot op de cijferindicatie [3] de in de fabriek ingestelde waarde r:05 verschijnt.

Om de instelling te wijzigen:

1. Programmatoets [C] indrukken.
Bij elke druk op de toets wordt de instelwaarde met één cijfer verhoogd. Als de waarde r:06 is bereikt, dan springt de indicatie weer op r:00 (uit).

2. START-toets [10] indrukken.
De instelwaarde is opgeslagen.

3. Deur sluiten.

Indicatie glansspoelmiddel bijvullen uitschakelen

Als de glansspoelmiddelindicatie [6] stoort (bijv. bij gebruik van gecombineerde reinigingsmiddelen met glansspoelcomponenten) dan kan deze worden uitgeschakeld.

- Ga te werk zoals onder „Dosering glansspoelmiddel instellen” is beschreven en de waarde op r:00 zetten.

Hiermee is de indicatie glansspoelmiddel [6] bijvullen uitgeschakeld.

Serviesgoed

Ongeschikt servies

- Bestek en servies met houten onderdelen.
- Gevoelige gedecoreerde glazen, kunstnijverheidsservies en -vazen en antiek servies. De decoraties zijn niet bestand tegen afwassen in een afwasautomaat.
- Niet hittebestendige kunststof voorwerpen/onderdelen.
- Koperen en tinnen serviesgoed.
- Serviesgoed dat bevuild is met as, kaarsvet, smeerolie of verf.

Geglazuurd serviesgoed en voorwerpen van aluminium en zilver kunnen bij het afwassen gaan verkleuren of verbleken. Ook sommige soorten glas (bijv. voorwerpen van kristal) kunnen dof worden nadat ze vele malen zijn afgewassen.

Schade aan glas en serviesgoed

Oorzaken:

- glassoort en fabricagewijze van het glas.
- chemische samenstelling van het afwasmiddel.
- temperatuur van het water tijdens de afwas.

Advies:

- gebruik alleen glas en porselein dat volgens de fabrikant geschikt is voor de afwasautomaat.
- gebruik afwasmiddel waarop staat aangegeven dat het het serviesgoed ontziet.
- glas en bestek na afloop van het programma zo snel mogelijk uit de afwasmachine halen.



Inruimen

1. Grove etensresten verwijderen. Afspoelen onder stromend water is niet nodig.
2. Het serviesgoed zodanig inruimen dat
   - het stevig staat en niet kan omvallen;
   - alle soorten serviesgoed met de opening naar beneden staan;
   - serviesgoed met een ronding of een holte schuin staat zodat het water er vanaf kan lopen;
   - het de twee sproeiarmen [23] en [27] tijdens het ronddraaien niet belemmert.

Hele kleine voorwerpen niet in de machine afwassen. Ze kunnen gemakkelijk uit de servieskorven vallen.

Uitruimen

Om te vermijden dat waterdruppels van de bovenste servieskorf op het serviesgoed in de onderste servieskorf vallen, is het aan te raden het apparaat van onder naar boven uit te ruimen.

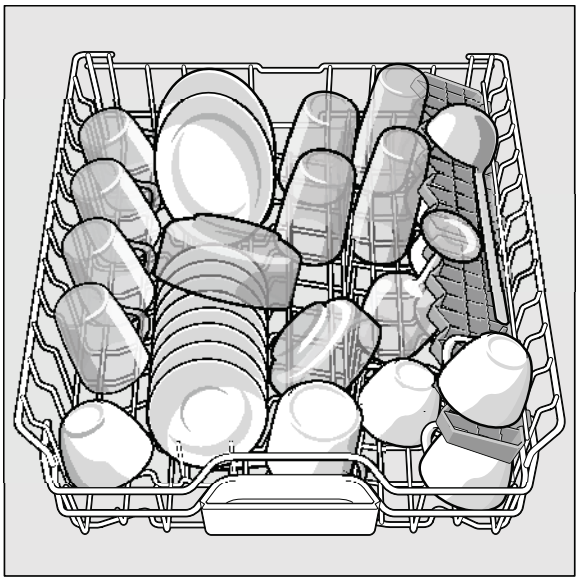
Heet serviesgoed is stootgevoelig! Laat het daarom na afloop van het programma net zo lang in de afwasautomaat afkoelen tot u het goed kunt vastpakken.

Aanwijzing

Na het einde van het programma kunnen er in het apparaat nog waterdruppels zichtbaar zijn. Dit heeft geen invloed op het drogen van het serviesgoed.

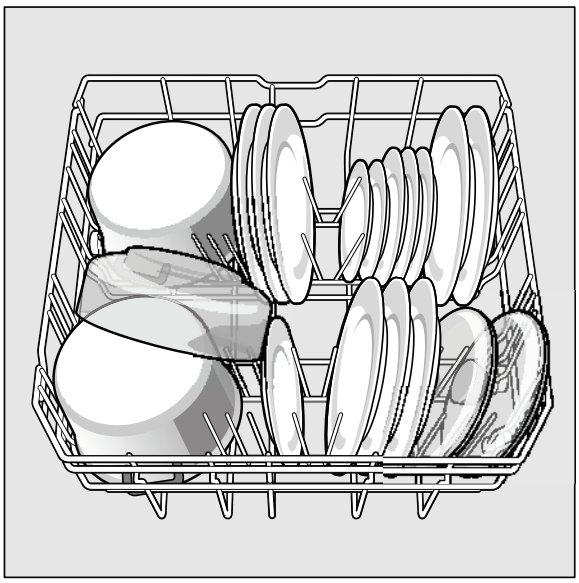
Kopjes en glazen

Bovenste servieskorf [22]



Pannen

Onderste servieskorf [30]



Tip

Erg vervuild serviesgoed (pannen) moet in de onderste korf worden ingeruimd. Door de sterkere sproeistraal verkrijgt u zo een beter afwasresultaat.

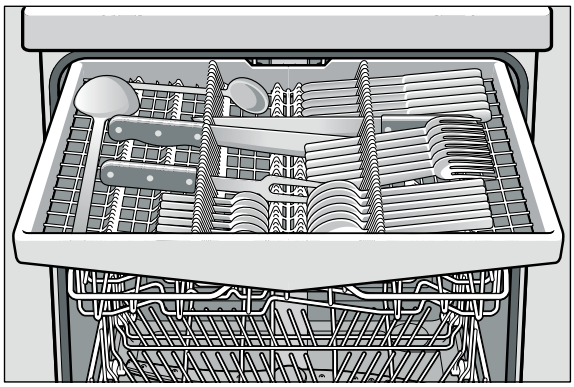
Tip

Andere voorbeelden hoe u uw afwasautomaat optimaal kunt inruimen, vindt u op onze homepage. U kunt deze gratis downloaden. Ons internetadres vindt u op de achterkant van deze gebruiksaanwijzing.

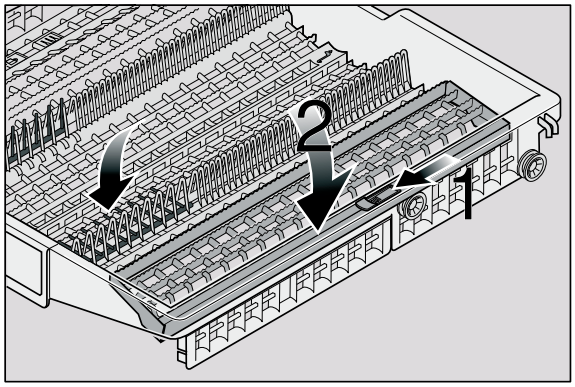
Besteklade

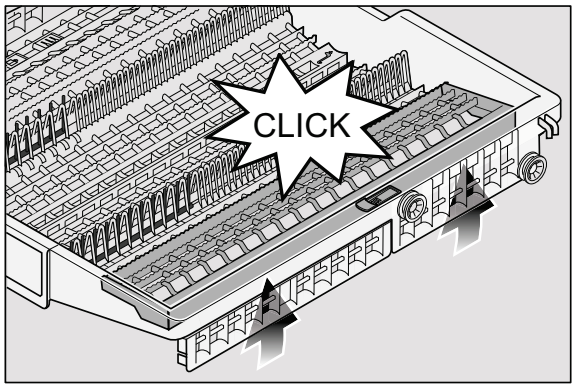
Het bestek zoals afgebeeld in de besteklade [21] inruimen. Apart inruimen van het bestek vergemakkelijkt het uitruimen na het afwassen.

De lade kan eruit gehaald worden.



Afhankelijk van het model kunnen de zijdelen neergeklapt worden om meer ruimte te hebben voor groot bestek. De voorste pennenrijen kunnen neergeklapt worden om bredere handgrepen te kunnen inruimen.

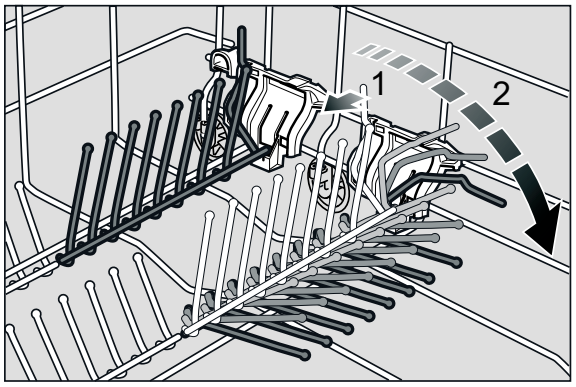




Omklapbare bordensteunen *

* Afhankelijk van het model

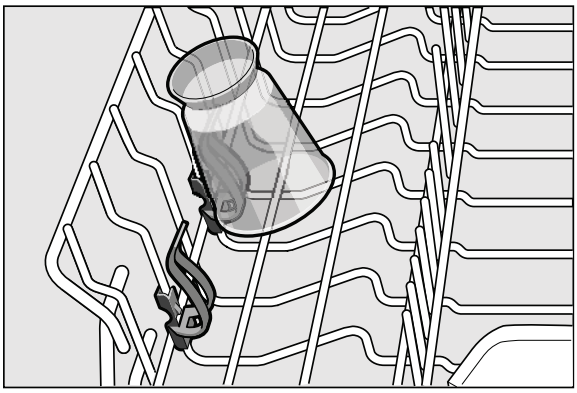
De bordensteunen zijn omklapbaar waardoor pannen, schalen en glazen praktischer kunnen worden ingeruimd.



Houder voor kleingoed *

* Afhankelijk van het model

Hier kunnen lichte voorwerpen van kunststof zoals bekers, deksels enz. vastgeklemd worden.



Verstellen van de korfhoogte

De bovenste servieskorf 22 kan in de hoogte op 3 standen versteld worden om in de bovenste of onderste servieskorf meer plaats te creëren.

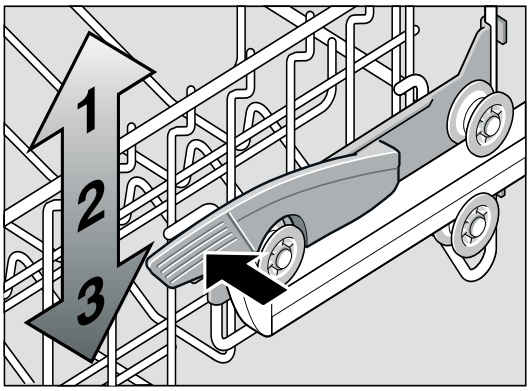
Hoogte van het apparaat 81,5 cm

	Bovenste korf	Onderste korf
Stand 1 max. ø	16 cm	30 cm
Stand 2 max. ø	18,5 cm	27,5 cm
Stand 3 max. ø	21 cm	25 cm

Hoogte van het apparaat 86,5 cm

	Bovenste korf	Onderste korf
Stand 1 max. ø	18 cm	33 cm
Stand 2 max. ø	20,5 cm	30,5 cm
Stand 3 max. ø	23 cm	28 cm

1. De bovenste servieskorf 22 uittrekken.
2. Om de korf te laten **zakken:** de twee hendels links en rechts aan de buitenkant van de korf een voor een naar binnen drukken. Hierbij de korf aan de zijkant aan de bovenste rand vasthouden om te voorkomen dat hij plotseling naar beneden valt.



3. **Om de korf op te tillen:** de korf aan de zijkant aan de bovenste rand vastpakken en naar boven trekken.
4. Overtuig u ervan dat de korf – voordat u hem weer in het apparaat schuift – aan beide zijden op **dezelfde hoogt** ligt. Anders kan de deur van het apparaat niet dicht en heeft de bovenste sproeiarm geen verbinding met het aansluitpunt van de watertoevoer.

Afwasmiddel

U kunt zowel tabletten als poedervormige of vloeibare afwasmiddelen voor de wasmachine gebruiken, maar nooit handafwasmiddel. Afhankelijk van de vervuiling kan met poedervormig of vloeibaar afwasmiddel de dosering individueel worden aangepast. Tabs bevatten voor alle afwasprogramma's voldoende werkzame stoffen. Moderne, krachtige afwasmiddelen hebben meestal een laag alkalische receptuur met fosfaat en enzymen. Fosfaten binden de kalk in het water. Enzymen breken zetmeel af en lossen eiwitten op. Minder voorkomend zijn afwasmiddelen zonder fosfaat. Deze hebben iets minder vermogen om kalk te binden en vereisen een hogere dosering. Om gekleurde vlekken (bijv. thee of ketchup) te verwijderen worden meestal bleekmiddelen op basis van zuurstof gebruikt.

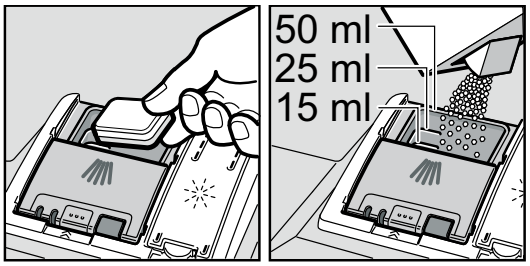
Aanwijzing

Neem voor een goed afwasresultaat altijd de aanwijzingen op de verpakking in acht!
Hebt u nog andere vragen, dan raden wij u aan contact op te nemen met de fabrikant van het afwasmiddel.

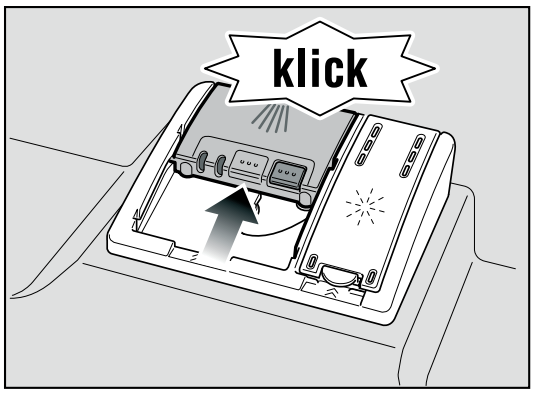
⚠ **Waarschuwing –** Let op de veiligheidsvoorschriften resp. de aanwijzingen bij het gebruik op de verpakkingen van het afwas- en glansspoelmiddel.

Vul afwasmiddel

1. Als het afwasmiddelbakje [32] nog dicht is: vergrendeling [33] bedienen om het te openen.
   Afwasmiddel alleen in het droge afwasmiddelbakje [32] gieten (tablet plat neerleggen, niet op zijn kant).
   Dosering: zie de aanwijzingen van de fabrikant op de verpakking.
   De indeling in het afwasmiddelbakje [32] biedt hulp bij de juiste dosering van poedervormig of vloeibaar afwasmiddel.
   Gewoonlijk volstaat 20 ml–25 ml bij normale vervuiling. Bij gebruik van tabs is één tablet voldoende.



2. Deksel van het bakje omhoog schuiven tot de sluiting hoorbaar vastklikt.



Het afwasmiddelbakje gaat, afhankelijk van het programma, op het juiste tijdstip automatisch open. Het poedervormige of vloeibare afwasmiddel wordt in het apparaat verdeeld en opgelost, het tablet valt in de tab-opvangschaal en wordt daar gedoseerd opgelost.

Tip

Als het serviesgoed niet erg vuil is, kunt u normalerwijze volstaan met minder afwasmiddel dan is aangegeven.

Geschikte reinigings- en onderhoudsmiddelen kunt u online op onze internetsite of bij de Servicedienst bestellen (zie achterkant).

Gecombineerde reinigingsmiddelen

Naast de gebruikelijke afwasmiddelen (Solo) wordt een aantal producten aangeboden met extra functies. Deze producten bevatten behalve afwasmiddel vaak ook glansspoelmiddel en zoutvervangende stoffen (3in1) en, afhankelijk van de combinatie (4in1, 5in1, enz.), ook nog extra componenten zoals glasbescherming of glansmiddel voor roestvrij staal. Gecombineerde reinigingsmiddelen functioneren alleen tot een bepaalde hardheidsgraad (meestal 21°dH). Boven deze grenswaarde moeten zout en glansspoelmiddel worden toegevoegd.

Zodra gecombineerde reinigingsproducten gebruikt worden past het afwasprogramma zich automatisch zodanig aan dat altijd het best mogelijke afwas- en droogresultaat bereikt wordt.

⚠ **Waarschuwing –** Leg **geen** kleine voorwerpen om af te wassen in de tab-opvangschaal 24; hierdoor kan het tablet niet gelijkmatig oplossen.

⚠ **Waarschuwing –** Als u na de start van het programma serviesgoed wilt bijvullen, gebruik de tab-opvangschaal 24 dan **niet** als handgreep voor de bovenste servieskorf. Het tablet kan er al in liggen waardoor u met het gedeeltelijk opgeloste tablet in contact komt.

Aanwijzingen

- Optimale afwas- en droogresultaten bereikt u door het gebruik van losse afwasmiddelen in combinatie met (apart) gebruik van onthardingszout en glansspoelmiddel.
- Bij korte programma's kunnen tabletten door een verschillende manier van oplossen eventueel niet de volle reinigingskracht ontwikkelen waardoor er onopgeloste afwasmiddeldeeltjes achterblijven. Voor deze programma's is een reinigingsmiddel in poedervorm beter geschikt.
- Bij het programma „Intensief" (niet bij alle modellen) is de dosering van één tablet voldoende. Bij gebruik van poedervormig afwasmiddel kunt u nog wat extra afwasmiddel op de binnenkant van de deur strooien.
- Ook als de indicatie glansspoelmiddel en/of zout bijvullen brandt, verloopt het afwasprogramma bij gebruik van gecombineerd reinigingsmiddelen zonder problemen.
- Bij gebruik van afwasmiddelen met in water oplosbaar beschermend omhulsel: het omhulsel alleen met droge handen vastpakken. Het afwasmiddelbakje moet vóór het vullen absoluut droog zijn, anders kan het afwasmiddel eraan vastplakken.
- Als u van gecombineerde reinigingsmiddelen op losse afwasmiddelen omschakelt, let er dan op dat de wateronthardingsinstallatie en de hoeveelheid glansspoelmiddel op de juiste waarde zijn ingesteld.

Programma-overzicht

In dit overzicht staat het maximaal mogelijke aantal programma's vermeld. De bijpassende programma's en hun rangschikking vindt u op het bedieningspaneel.

Soort serviesgoed	Soort vervuiling	Programma	Eventuele extra functies	Programmaverloop
potten, pannen, niet gevoelig serviesgoed en bestek	erg aangekoekte, ingebrande of opgedroogde zetmeel- of eiwithoudende etensresten	auto Auto 65° - 75°	alle	Wordt naar mate van de vervuiling met behulp van het sensorsysteem geoptimaliseerd.
		auto Auto 45° - 65°	alle	
gemengd serviesgoed en bestek	licht opgedroogde, in het huishouden gebruikelijke etensresten	auto Auto 45° - 65°	alle	Wordt naar mate van de vervuiling met behulp van het sensorsysteem geoptimaliseerd.
		/ **eco** Eco 50°	alle	Voorspoelen Reinigen 50° Tussenspoelen Glansspoelen 65° Drogen
gevoelig serviesgoed, bestek, temperatuurgevoelige kunststoffen en glazen	weinig aangekoekte verse etensresten	auto Auto 35° - 45°	Intensief zone Tijd besparen Energy Save Halve belading Glansdrogen	Wordt naar mate van de vervuiling met behulp van het sensorsysteem geoptimaliseerd.
		/ Snel 45°	Glansdrogen	Reinigen 45° Tussenspoelen Glansspoelen 55°
gevoelig serviesgoed, bestek, temperatuurgevoelige kunststoffen en glazen	weinig aangekoekte verse etensresten	/ Zacht 40°	Intensief zone Tijd besparen Halve belading Glansdrogen Energy Save	Voorspoelen Reinigen 40° Tussenspoelen Glansspoelen 55° Drogen

Programmakeuze

Aan de hand van het soort serviesgoed en de mate van vervuiling kunt u een passend programma uitzoeken.

Aanwijzingen voor testinstituten

Testbureaus ontvangen de instructies voor vergelijkingstests (bijv. volgens EN60436).

Hierbij gaat het om de voorwaarden voor het uitvoeren van de tests, niet om de resultaten of de verbruikswaarden.

Aanvraag per e-mail aan:

dishwasher@test-appliances.com

Benodigd zijn het fabrikaatnummer (E-Nr.) en het productnummer (FD), die u op het typeplaatje [34] op de deur van het apparaat vindt.

P+ Extra functies

* afhankelijk van het model

Instelbaar via de toetsen extra functies [9].

Tijd besparen (VarioSpeed+) *

Met de functie >>Tijd besparen<< kan de looptijd – afhankelijk van het gekozen afwasprogramma – met ca. 20% tot 66% verkort worden. Om bij verkorte looptijd optimale reinigings- en droogresultaten te bereiken, wordt het water- en energieverbruik verhoogd.

Halve belading *

Als u maar weinig afwas hebt (bijv. glazen, kopjes, borden), dan kunt u de „Halve belading” bijschakelen. Hiermee bespaart u water, energie en tijd. Vul het afwasmiddelbakje met iets minder afwasmiddel dan zoals aanbevolen bij een volle belading van de machine.

HygiënePlus *

Met deze functie worden de temperaturen verhoogd en extra lang in stand gehouden, om een gedefinieerd desinfectieniveau te bereiken. Hierdoor wordt een verhoogde hygiënestatus bereikt. Deze extra functie is ideaal voor bijv. het afwassen van snijplanken of babyflesjes.

IntensiefZone *

Perfect voor gemengde belading. U kunt erg vuile potten en pannen in de onderste servieskorf samen met normaal vervuild serviesgoed in de bovenste korf afwassen. De sproeidruk in de onderste servieskorf wordt versterkt, de temperatuur van het afwaswater iets verhoogd.

Glansdrogen *

Door de hoeveelheid water tijdens het spoelen te vergroten en de droogtijd te verlengen, worden vlekken voorkomen en verbetert het droogresultaat. Het energieverbruik is iets hoger. Voor de glansdroogfunctie wordt glansspoelmiddel aanbevolen (ook bij gebruik van combireinigers).

Apparaat bedienen

Programmagegevens

De programmagegevens (verbruikswaarden) vindt u in de korte handleiding. Ze hebben betrekking op normale omstandigheden en de instelwaarde van de waterhardheid d H:04. Verschillende factoren zoals de temperatuur van het water en de druk in de waterleiding zijn hierbij van invloed en kunnen tot afwijkingen leiden.

Aqua-Sensor *

* Afhankelijk van het model

De Aqua-Sensor is een optisch meetsysteem (met lichtstraal) waarmee de vertroebeling van het afwaswater wordt gemeten.

Afhankelijk van het programma treedt de Aqua-Sensor in werking.
Als de Aqua-Sensor actief is, kan „schoon" afwaswater in de volgende reinigingsfase gebruikt worden en het waterverbruik daardoor met 3–6 liter verminderd worden. Is het water te vuil, dan wordt het afgepompt en door vers water vervangen. In de automatische programma's worden bovendien temperatuur en looptijd aan de mate van vervuiling aangepast.

Zeoliet-droging

Het apparaat is voorzien van een zeoliet-reservoir. Zeoliet is een mineraal dat vocht en warmte-energie kan opslaan en weer af kan geven.

In de afwasfase wordt deze warmte-energie voor het drogen van het mineraal en voor het verwarmen van het afwaswater gebruikt.

Tijdens de droogfase wordt vocht uit de spoelruimte in het mineraal opgeslagen en komt warmte-energie vrij. Deze vrijgekomen warmte-energie wordt met droge lucht in de spoelruimte uitgeblazen. Hierdoor is een snelle en verbeterde droging mogelijk waarmee u heel veel energie bespaart.

⚠ Attentie

Zorg ervoor dat de aanzuigopening 25 niet is afgedekt en dat er in de onderste servieskorf rechts achter boven de uitblaasopening 26 geen temperatuurgevoelige serviesdelen staan.

⚠ Waarschuwing – Verwondingsgevaar!

De uitblaasopening 26 niet aanraken. De uitblaasopening wordt heet en bovendien leidt elke verandering eraan tot een bezoek van de monteur tegen betaling van de onkosten.

Inschakelen van het apparaat

1. Kraan helemaal opendraaien.
2. Deur openen.
3. AAN/UIT-schakelaar [1] inschakelen.
   De indicatie van het programma Eco 50° knippert. Dit programma blijft gekozen zolang er geen andere programmatoets [2] wordt ingedrukt. Op de cijferindicatie [3] knippert de vermoedelijke programmaduur.
4. START-toets [10] indrukken.
5. Deur sluiten.
   Het programmaverloop start.

Aanwijzing

- voor een milieubesparend gebruik van de afwasautomaat:
Om ecologische redenen is het programma Eco 50° de standaardinstelling bij elke start van het apparaat. Hierdoor spaart u de natuurlijke hulpbronnen en niet op de laatste plaats uw portemonnee.
Het Eco 50° programma is een bijzonder milieubesparend programma. Het is het „standaardprogramma" conform de EU-verordening1016/2010, dat de meest efficiënte standaard reinigingscyclus is voor de reiniging van normaal vervuild serviesgoed en het gecombineerde energie- en waterverbruik voor de reiniging van dit soort serviesgoed.

Optische indicatie tijdens het programmaverloop *

* afhankelijk van het model

Tijdens het programmaverloop verschijnt een optische indicatie bij de vloer onder de deur van het apparaat.

Bij een voorgeschoven sokkelplaat of bij hooginbouw met een vlak afsluitend meubelfront is de indicatie niet zichtbaar.

Mogelijke instellingen van de optische indicatie:

5:00 De indicatie is uitgeschakeld.

5:01 Programma, insteltijd, resttijd, programma-einde en eventueel watergebrek worden weergegeven.

5:02 Zoals 5:01. Bovendien wordt aanvullende programma-informatie weergegeven, bijv. het symbool voor halve lading [½] of glasbeschermingssysteem actief.

De fabrieksinstelling is 5:01.

Om de instelling te wijzigen:

1. Deur openen.
2. AAN/UIT-schakelaar [1] inschakelen.
3. Programmatoets [A] ingedrukt houden en de START-toets [10] net zolang indrukken tot de cijferindicatie H:0... aangeeft.
4. Beide toetsen loslaten.
   Het lampje van toets [A] knippert.
5. Programmatoets [A] meermaals indrukken tot op de cijferindicatie [3] 5:0... (voor de optische indicatie) de tot dusver ingestelde waarde verschijnt, bijv. 5:01.
6. Programmatoets [C] meermaals indrukken tot op de cijferindicatie [3] de gewenste waarde verschijnt, bijv. 5:02.



7. START-toets [10] indrukken.
   De instelwaarde is opgeslagen.
8. Deur sluiten.

Resttijdindicatie

Bij de programmakeuze verschijnt de tijdsduur van het programma op de cijferindicatie [3].
Na de programmastart wordt onderaan bij de vloer de resterende tijd aangegeven (alleen bij de instelling 5:01 en 5:02).

De programmaduur wordt tijdens het programma bepaald door de temperatuur van het water, de hoeveelheid serviesgoed en de mate van vervuiling en kan (afhankelijk van het gekozen programma) variëren.

Starttijd kiezen

U kunt het programma tot 24 uur later (in stappen van een uur) laten starten.

1. Deur openen.
2. AAN/UIT-schakelaar [1] inschakelen.
3. Toets [8] + indrukken tot de indicatie starttijd [7] op 01 knippert.
4. Toets [8] + of – net zo vaak indrukken tot de aangegeven tijd aan uw wens voldoet.
5. START-toets [10] indrukken, de gekozen starttijd is geactiveerd.
6. Om de gekozen starttijd te wissen: de toets [8] + of – net zo vaak indrukken tot op de indicatie starttijd kiezen [7] 00 verschijnt.
   Tot de starttijd kunt u het programma willekeurig wijzigen.
7. Deur sluiten.

Einde van het programma

Het programma-einde →| / 0:00 wordt bij de vloer weergegeven – indien de optische indicatie ingeschakeld en zichtbaar is.

Bovendien wordt het einde van het programma door een zoemtoon akoestisch aangegeven. Deze functie kan als volgt gewijzigd worden:

1. Deur openen.
2. AAN/UIT-schakelaar [1] inschakelen.
3. Programmatoets [A] ingedrukt houden en de START-toets [10] net zolang indrukken tot de cijferindicatie H:0... brandt.
4. Beide toetsen loslaten.
   De indicatie van toets [A] knippert en op de cijferindicatie [3] brandt de door de fabriek ingestelde waarde H:04.
5. Programmatoets [A] net zo vaak indrukken tot op de cijferindicatie [3] de in de fabriek ingestelde waarde b:02 verschijnt.

Om de instelling te wijzigen:

1. programmatoets [C] indrukken. Bij elke druk op de toets wordt de instelwaarde met één cijfer verhoogd. Als de waarde b:03 is bereikt, dan springt de indicatie weer op b:00 (uit).
2. START-toets [10] indrukken, de instelwaarde is opgeslagen.
3. Deur sluiten.

Aanwijzing

Afhankelijk van de instelling bij „Automatisch uitschakelen na programma-einde of binnenverlichting” is de optische indicatie niet of slechts kort zichtbaar.



Automatisch uitschakelen na afloop van het programma of binnenverlichting*

* afhankelijk van het model

Om energie te besparen kan de afwasautomaat 1 min. of 120 min. na afloop van het programma automatisch worden uitgeschakeld.

De instelling is van P:00 tot P:02 kiesbaar.

P:00 Het apparaat wordt niet automatisch uitgeschakeld.

De binnenverlichting [20] brandt als de deur geopend is, onafhankelijk van de in- of uitgeschakelde AAN-/UIT-schakelaar [1]. Bij gesloten deur is de belichting uit. Mocht de deur langer dan 60 min. open staan, dan schakelt de verlichting automatisch uit. De binnenverlichting [20] brandt alleen bij instelwaarde P:00.

P:01 Het apparaat schakelt na 1 min. uit.

P:02 Het apparaat schakelt na 120 min. uit.

1. Deur openen.
2. AAN/UIT-schakelaar [1] inschakelen.
3. Programmatoets [A] ingedrukt houden en de START-toets [10] net zolang indrukken tot de cijferindicatie H:0... brandt.
4. Beide toetsen loslaten.
   De indicatie van toets [A] knippert en op de cijferindicatie [3] brandt de door de fabriek ingestelde waarde H:04.
5. Programmatoets [A] net zo vaak indrukken tot op de cijferindicatie [3] de waarde P:0... verschijnt.

Om de instelling te wijzigen:

1. Programmatoets [C] indrukken.
   Bij elke druk op de toets wordt de instelwaarde met één cijfer verhoogd. Als de waarde P:02 is bereikt, dan springt de indicatie weer op P:00.
2. START-toets [10] indrukken.
   De instelwaarde is opgeslagen.
3. Deur sluiten.

Uitschakelen van het apparaat

Korte tijd na afloop van het programma:

1. Deur openen.
2. AAN/UIT-schakelaar [1] uitschakelen.
3. Kraan dichtdraaien (niet bij Aqua-Stop).
4. Na afkoeling het serviesgoed uit het apparaat halen.

Aanwijzing

Laat het apparaat na het einde van het programma even afkoelen voordat u het opent. Zo voorkomt u dat er stoom vrijkomt die op den duur schade aan uw inbouwmeubelen kan veroorzaken.

Onderbreken van het programma

1. Deur openen.
2. AAN/UIT-schakelaar [1] uitschakelen.
   De indicatielampjes gaan uit. Het programma blijft in het geheugen opgeslagen.
   Als bij aansluiting op warm water of als het apparaat al is opgewarmd de deur van het apparaat geopend werd, de deur eerst een paar minuten op een kier laten staan en dan pas dichtdoen. Anders kan de deur van het apparaat door expansie (overdruk) openspringen of water uit het apparaat komen.
3. Om het programma voort te zetten de AAN/UIT-schakelaar [1] weer inschakelen.
4. Deur sluiten.

Afbreken van het programma (Reset)

1. Deur openen.
2. START-toets [10] gedurende ca. 3 seconden indrukken.
   Op de cijferindicatie [3] verschijnt 0:01.
3. Deur sluiten.
   Het programma is na ca. 1 minuut afgelopen. Op de cijferindicatie [3] verschijnt 0:00.
4. Deur openen.
5. AAN/UIT-schakelaar [1] uitschakelen.
6. Deur sluiten.

Wijzigen van het programma

Na het indrukken van de START-toets [10] kan het programma niet gewijzigd worden.

Wijzigen van het programma is alleen mogelijk door het programma af te breken (Reset).

Intensief drogen

Tijdens het glansspoelen wordt de temperatuur verhoogd waardoor het droogresultaat wordt verbeterd.
De looptijd kan hierdoor iets verlengd worden. (Wees voorzichtig met gevoelig serviesgoed!)

1. Deur openen.
2. AAN/UIT-schakelaar [1] inschakelen.
3. Programmatoets [A] ingedrukt houden en de START-toets [10] net zolang indrukken tot de cijferindicatie H:0... brandt.
4. Beide toetsen loslaten.
   De indicatie van toets [A] knippert en op de cijferindicatie [3] brandt de door de fabriek ingestelde waarde H:04.
5. Programmatoets [A] net zo vaak indrukken tot op de cijferindicatie [3] de in de fabriek ingestelde waarde d:00 verschijnt.

Om de instelling te wijzigen:

1. Door indrukken van de toets [C] kunt u het programma Intensief drogen in- d:01. of uitschakelen d:00.
2. START-toets [10] indrukken.
   De instelwaarde is opgeslagen.
3. Deur sluiten.

Reinigen en onderhouden

Regelmatige controle en onderhoud van het apparaat dragen ertoe bij defecten te voorkomen. Dit bespaart u tijd en ergernis.

Algemene toestand van de machine

- Spoelruimte controleren op kalkaanslag en vetresten.

Als u zulke aanslag aantreft:

- afwasmiddelbakje met afwasmiddel vullen. Het apparaat zonder serviesgoed in het programma met de hoogste afwastemperatuur starten.

Om het apparaat te reinigen alleen speciaal voor afwasautomaten geschikte afwas-/schoonmaakmiddelen gebruiken.

- Om de deurafdichting altijd schoon en hygiënisch te houden, moet deze regelmatig worden gereinigd met een vochtige doek en een beetje afwasmiddel.
- Bij lange standtijd de deur iets open laten staan om te voorkomen dat er onaangename geuren ontstaan.

Gebruik bij het reinigen van uw afwasautomaat nooit een stoomreiniger. De fabrikant kan niet aansprakelijk worden gesteld voor eventuele gevolgen.

De voorkant van het apparaat en het bedieningspaneel regelmatig met een vochtig doekje afnemen. Water met een scheutje afwasmiddel is voldoende. Geen schuursponsjes gebruiken of schoonmaakmiddelen met schuurmiddelen. Dit kan krassen op de oppervlakken veroorzaken.

Bij roestvrijstalen apparaten geen sponsjes gebruiken of deze anders vóór het eerste gebruik een aantal keren grondig uitspoelen om corrosie te voorkomen.

⚠ Waarschuwing – Gezondheidsrisico

Nooit andere, bijv. chloorhoudende, reinigingsmiddelen gebruiken!

Onthardingszout en glansspoelmiddel

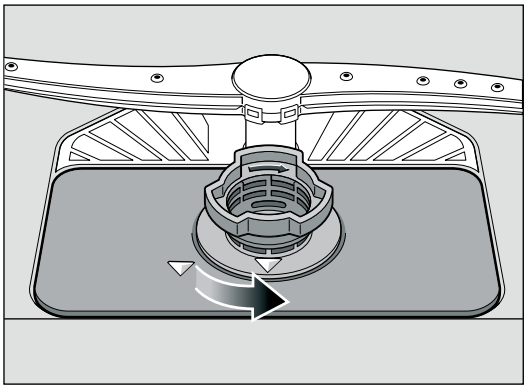
- De bijvulindicaties 5 en 6 controleren. Eventueel zout en/of glansspoelmiddel bijvullen.

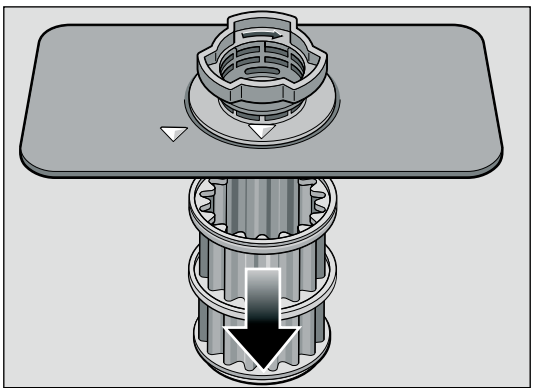
Zeven

De zeven 29 zorgen ervoor dat grove etensresten in het spoelwater niet in de afvoerpomp terechtkomen. Door deze etensresten kunnen de zeven verstopt raken.

Het zevensysteem bestaat uit een grove zeef, een vlakke fijne zeef en een microzeef.

1. Na elke afwasbeurt de zeven op etensresten controleren.
2. Zeefcylinder zoals afgebeeld losdraaien en het zeefsysteem eruit halen.



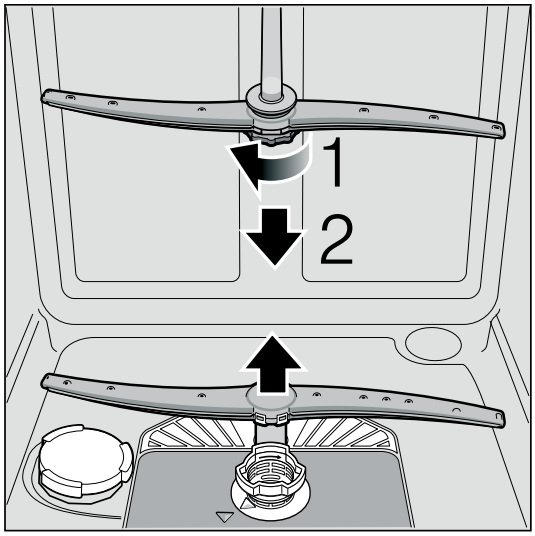


3. Eventuele etensresten verwijderen en de zeven onder stromend water schoonmaken.
4. Zevensysteem in omgekeerde volgorde weer erin zetten en erop letten dat de gemarkeerde pijlen na het sluiten tegenover elkaar staan.

Sproeiarmen

Kalk en etensresten in het afwaswater kunnen de sproeiopeningen en de lagers van de sproeiarmen [23] en [27] blokkeren.

1. Sproeiopeningen van de sproeiarmen op verstopping controleren.
2. Bovenste sproeiarm [23] eraf schroeven.
3. De onderste sproeiarm [27] naar boven eraf trekken.



4. Sproeiarmen onder stromend water schoonmaken.
5. Sproeiarmen weer vastdrukken resp. vastschroeven.

Wat te doen bij storingen?

De ervaring leert dat veel storingen die in het dagelijks gebruik optreden, door u zelf verholpen kunnen worden. Hiermee bespaart u natuurlijk kosten en bent u er zeker van dat de machine snel weer gebruikt kan worden. In het volgende overzicht vindt u eventuele oorzaken van de storingen en nuttige aanwijzingen om deze te verhelpen.

Aanwijzing

Mocht het apparaat tijdens het afwassen om onbekende redenen stil blijven staan of niet starten, dan dient u eerst de functie Programma afbreken (reset) uit te voeren.
(Zie het hoofdstuk Apparaat bedienen)

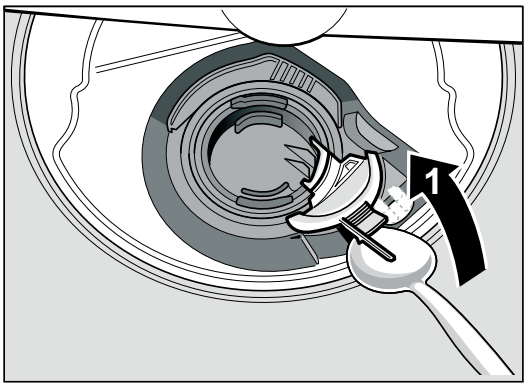
⚠ **Waarschuwing –** Denk eraan: reparaties mogen alleen door een vakkundig monteur worden uitgevoerd. Mocht het uitwisselen van een onderdeel noodzakelijk zijn, let er dan op dat alleen originele onderdelen gebruikt worden. Ondeskundige reparatie of gebruik van niet-originele onderdelen kan aanzienlijke schade en gevaar voor de gebruiker opleveren.

Afvoerpomp

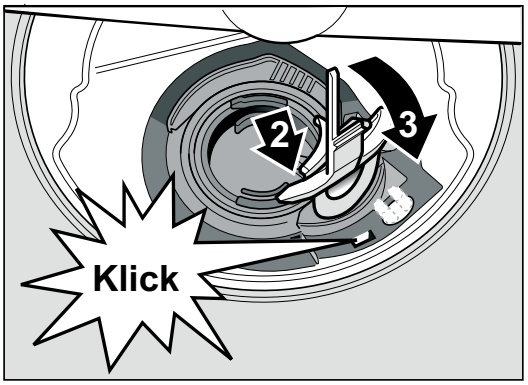
Grote voedselresten of voorwerpen die niet door de zeven zijn tegengehouden, kunnen de afvoerpomp blokkeren. Het spoelwater staat dan tot boven de zeef.

In dit geval:

1. Het apparaat eerst losmaken van het elektriciteitsnet.
2. De boven- [22] en onderzeef [30] verwijderen.
3. Zeven [29] eruit halen.
4. Water eruit scheppen, eventueel met behulp van een spons.
5. De witte pompafdekking (zie afbeelding) met behulp van een lepel opwippen. De afdekking aan de beugel vastpakken en schuin naar binnen optillen. Afdekking geheel verwijderen.

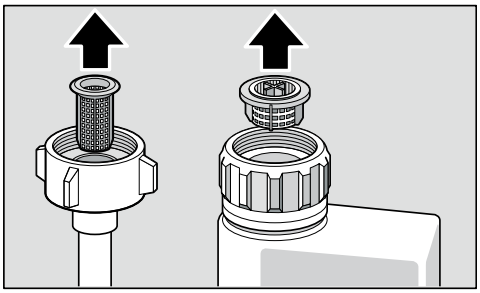


6. Schoepenrad controleren op vreemde voorwerpen en deze eventueel verwijderen.
7. Afdekking weer op de oorspronkelijk positie aanbrengen en omlaagdrukken tot hij vastzit (klik).

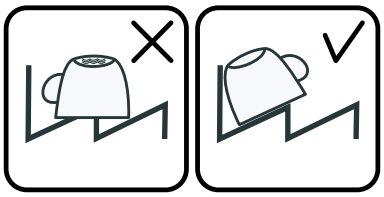


8. Zeven monteren.
9. Zeven weer aanbrengen.

Storingentabel

Storing	Oorzaak	Oplossing
Indicatie „Watertoevoer controleren" 4 brandt.	Watertoevoerslang geknikt.	Watertoevoerslang zonder knikken verleggen.
	Kraan dicht.	Kraan opendraaien.
	Kraan verstopt of verkalkt.	Kraan opendraaien. Hoeveelheid binnenstromend water bij geopende kraan: minimaal 10 l per min.
	Zeef aan de kraan verstopt.	Apparaat uitschakelen en de stekker uit het stopcontact trekken. Kraan dichtdraaien. Wateraansluiting eraf schroeven.  Zeef in de toevoerslang schoonmaken. Wateraansluiting weer vastschroeven. Controleren op dichtheid. Stroom weer inschakelen. Apparaat inschakelen.
Foutcode E:22 brandt.	Zeven 29 vuil of verstopt.	Zeven reinigen. (Zie Reinigen en onderhouden)
Foutcode E:24 brandt.	Waterafvoerslang verstopt of geknikt.	Slang zonder knikken aanleggen, eventuele resten verwijderen.
	Sifonaansluiting is nog dicht.	Aansluiting bij sifon controleren en eventueel openen.
	Afdekking van de afvoerpomp zit los.	Afdekking goed vastmaken. (zie Afvoerpomp)
Foutcode E:25 brandt.	Waterafvoerpomp geblokkeerd of afdekking van de waterafvoerpomp niet vastgeklikt.	Pomp reinigen en afdekking goed vastmaken. (zie Afvoerpomp)
Foutcode E:27 brandt.	Netspanning te laag.	Geen apparaatfout, netspanning en elektrische installatie laten controleren.

Storing	Oorzaak	Oplossing
Een andere foutcode verschijnt op de cijferindicatie. (E:01 tot E:30)	Er is vermoedelijk een technische storing opgetreden.	Apparaten uitschakelen met de AAN-/UIT-schakelaar [1]. Na korte tijd het apparaat opnieuw starten. Als het probleem opnieuw optreedt, de kraan sluiten en de stekker uit het stopcontact trekken. Bel de klantenservice en vermeld de foutcode.
Display knippert	Deur niet geheel gesloten.	Deur sluiten. Let erop dat er geen voorwerpen (serviesgoed, geurdispenser) uitsteken uit de korf en daardoor de deursluiting hinderen.
Bijvulindicatie voor zout [5] en/ of glansspoelmiddel [6] brandt.	Glansspoelmiddel ontbreekt.	Glansspoelmiddel bijvullen.
	Het zout ontbreekt.	Onthardingszout bijvullen.
	Sensor herkent de zouttabletten niet.	Ander speciaal zout gebruiken.
Bijvulindicatie voor zout [5] en/ of glansspoelmiddel [6] brandt niet.	Bijvulindicatie uitgeschakeld.	Activering/deactivering (zie het hoofdstuk Wateronthardingsinstallatie/ Onthardingszout of Glansspoelmiddel).
	Er is nog voldoende onthardingszout/ glansspoelmiddel aanwezig.	Bijvulindicatie, vulpeilen controleren.
Na afloop van het programma blijft er water in het apparaat staan.	Zeefsysteem of ruimte onder de zeef [29] is verstopt.	Zeven en ruimte eronder reinigen (zie Afvoerpomp).
	Programma nog niet beëindigd	Wachten tot het programma is afgelopen of een reset uitvoeren (zie Programma afbreken).

Storing	Oorzaak	Oplossing
Serviesgoed niet droog.	Geen of te weinig glansspoelmiddel in het voorraadbakje.	Glansspoelmiddel bijvullen.
	Een programma zonder drogen gekozen.	Programma met drogen kiezen (zie Programma-overzicht, Programmaverloop).
	Waterophoping in het serviesgoed en bestek.	Voor een schuine stand zorgen bij het inruimen, de serviesdelen zo mogelijk schuin plaatsen. 
	Het gecombineerde afwasmiddel heeft een slechte droogcapaciteit.	Andere combireiniger met beter droogvermogen gebruiken. Extra gebruik van glansspoelmiddel verbetert het droogvermogen.
	Intensief drogen voor versterkte droging niet geactiveerd.	Intensief drogen activeren (zie Apparaat bedienen)
	Het serviesgoed is te vroeg uitgeruimd of het droogproces was nog niet afgelopen.	Wachten tot het programma is afgelopen of het serviesgoed pas 30 min. na afloop van het programma verwijderen.
	Het gebruikt eco-glansspoelmiddel heeft een slecht droogvermogen.	Een kwaliteitsglansspoelmiddel gebruiken. Eco-producten zijn duidelijk minder effectief.
Kunststofserviesgoed niet droog.	Speciale eigenschappen van kunststof.	Kunststof heeft een lager warmteopslagvermogen en droogt daardoor slechter.
Bestek niet droog.	Bestek niet goed geordend in de bestekkorf.	Bestek zo veel mogelijk los van elkaar plaatsen, aanraakpunten vermijden.
	Bestek niet goed gesorteerd in de besteklade.	Bestek goed sorteren en zoveel mogelijk los van elkaar plaatsen.
Binnenzijden van het apparaat nat na het spoelen.	Geen fout van het apparaat.	Wegens het droogprincipe „condensatiedrogen” zijn waterdruppels in het reservoir noodzakelijk en gewenst. Het vocht in de lucht condenseert tegen de binnenzijden van de afwasautomaat, stroomt omlaag en wordt weggepompt.

Storing	Oorzaak	Oplossing
Etensresten op het serviesgoed.	Serviesgoed te dicht op elkaar ingeruimd, servieskorf te vol.	Het serviesgoed zodanig inruimen dat er voldoende vrije ruimte aanwezig is en de sproeistralen het oppervlak van het serviesgoed kunnen bereiken. Aanraakpunten vermijden.
	Sproeiarmen konden niet ongehinderd ronddraaien.	Het serviesgoed zodanig inruimen dat de draaibeweging van de sproeiarm niet wordt gehinderd.
	Sproeiers van sproeiarmen verstopt.	Sproeiers van de sproeiarm reinigen, (zie Reinigen en onderhouden).
	Zeven [29] vuil.	Zeven schoonmaken, (zie Reinigen en onderhouden).
	Zeef [29] onjuist aangebracht en/of niet vastgezet.	Zeef goed aanbrengen en vastzetten.
	Te zwak afwasprogramma gekozen.	Krachtiger spoelprogramma kiezen.
	Serviesgoed te sterk voorgereinigd, daarom kiest de sensortechniek voor een zwak spoelprogramma. Hardnekkig vuil kan gedeeltelijk niet worden verwijderd.	Serviesgoed niet voorspoelen. Alleen de grotere etensresten verwijderen. Geadviseerd programma Eco 50° of Intensief.
	Hoge, smalle serviesdelen worden in de hoeken onvoldoende uitgespoeld.	Hoge, smalle serviesdelen niet te schuin en niet in de hoeken inruimen.
	Bovenste servieskorf [22] rechts en links niet op dezelfde hoogte erin gezet.	Bovenkorf met hendels aan de zijkant op dezelfde hoogte instellen.

Storing	Oorzaak	Oplossing
Reinigingsmiddelresten	Deksel van het reinigingsmiddelbakje geblokkeerd door serviesgoed, daarom gaat het deksel niet volledig open.	Deksel van het reinigingsmiddelbakje mag niet worden gehinderd door serviesgoed. Geen serviesgoed of geurdispenser in het tablettenbakje doen.
	Deksel van het reinigingsmiddelbakje wordt geblokkeerd door het tablet.	Het tablet moet dwars en niet op de korte kant worden gelegd.
	Tabletten gebruikt in het snelprogramma of korte programma. Oplostijd van het reinigingsmiddel wordt niet bereikt binnen het gekozen korte programma.	Oplostijd van tabletten van een snelprogramma of een kort programma is te lang Reinigingspoeder of een krachtiger programma gebruiken.
	Reinigende werking en oplosgedrag nemen af bij langere opslagtijd, of het reinigingsmiddel klontert sterk.	Ander reinigingsmiddel gebruiken.
Watervlekken op kunststofdelen.	Druppelvorming op kunststof oppervlakken is onvermijdelijk. Na het afdrogen zijn watervlekken zichtbaar.	Krachtiger programma gebruiken (hoger waterverbruik). Schuin zetten bij het inruimen. Glansspoelmiddel gebruiken. Onthardingsinstelling eventueel verhogen.
Afwisbare of in water oplosbare afzettingen in het reservoir of op de deur.	Inhoudstoffen van het reinigingsmiddel zetten zich af. Deze aanslag laat zich meestal niet chemisch verwijderen (apparaatreinigingsmiddel, ...).	Ander merk reinigingmiddel nemen. Apparaat mechanisch reinigen.
	Bij "witte afzetting" op de reservoirbodem is de onthardingsvoorziening ingesteld op een grenswaarde.	Onthardingsinstelling verhogen en eventueel een ander reinigingsmiddel gebruiken.
	Deksel van het zoutreservoir [28] niet dichtgedraaid.	Zoutreservoirdeksel goed dichtdraaien.
	Alleen bij glazen: Witte, moeilijk verwijderbare aanslag op serviesgoed, reservoir of deur.	Zie „Schade aan glas en serviesgoed”.

Storing	Oorzaak	Oplossing
Witte, moeilijk verwijderbare aanslag op serviesgoed, reservoir of deur.	Inhoudstoffen van het reinigingsmiddel zetten zich af. Deze aanslag laat zich meestal niet chemisch verwijderen (apparaatreinigingsmiddel, ...).	Ander merk reinigingmiddel nemen. Apparaat mechanisch reinigen.
	Onjuiste waterhardheid ingesteld of waterhardheid is hoger dan 50°dH (8,9 mmol/l).	Onthardingsvoorziening instellen volgens de gebruiksaanwijzing of zout bijvullen.
	3-in-1-reinigingsmiddel of bio/ eco-reinigingsmiddel onvoldoende effectief.	Onthardingsvoorziening instellen volgens de gebruiksaanwijzing of losse middelen gebruiken (kwaliteitsreinigingsmiddel, zout, glansspoelmiddel).
	Te lage dosering van het reinigingsmiddel.	De reinigingsmiddeldosering verhogen of een ander reinigingsmiddel gebruiken.
	Een te zwak programma gekozen.	Krachtiger spoelprogramma kiezen.
Thee- of lippenstiftresten op het serviesgoed.	Te lage afwaswatertemperatuur.	Programma met hogere spoeltemperatuur kiezen.
	Te weinig of ongeschikt afwasmiddel.	Geschikt reinigingsmiddel in de juiste dosering toevoegen.
	Serviesgoed te sterk voorgereinigd, daarom kiest de sensortechniek voor een zwak spoelprogramma. Hardnekkig vuil kan gedeeltelijk niet worden verwijderd.	Serviesgoed niet voorspoelen. Alleen de grotere etensresten verwijderen. Geadviseerd programma Eco 50°
Gekleurde (blauw, geel, bruin), moeilijk of niet verwijderbare aanslag in het apparaat of op roestvrijstalen bestek.	Laagvorming door inhoudsstoffen van groente (bijv. kool, selderie, aardappels, noedels, ...) of van het leidingwater (bijv. mangaan).	Ten dele verwijderbaar door machinereiningsmiddel of door mechanische reiniging. Deze aanslag is niet schadelijk voor de gezondheid.
	Laagvorming door metalen bestanddelen op zilveren of aluminium serviesgoed.	Ten dele verwijderbaar door machinereiningsmiddel of door mechanische reiniging.
Gekleurde (geel, oranje, bruin), eenvoudig te verwijderen afzettingen in de binnenruimte (vooral op de bodem)	Laagvorming van de inhoudsstoffen van voedselresten en van het leidingwater (kalk), "zeepachtig"	Werking van de onthardingsvoorziening controleren (onthardingszout bijvullen) of bij gebruik van gecombineerde reinigingsmiddelen (tabletten) de ontharding activeren (zie het hoofdstuk Wateronthardingsinstallatie/ Onthardingszout)

Storing	Oorzaak	Oplossing
Verkleuring op kunststofdelen.	Te lage afwaswatertemperatuur.	Programma met hogere spoeltemperatuur kiezen.
	Serviesgoed te sterk voorgereinigd, daarom kiest de sensortechniek voor een zwak spoelprogramma. Hardnekkig vuil kan gedeeltelijk niet worden verwijderd.	Serviesgoed niet voorspoelen. Alleen de grotere etensresten verwijderen. Geadviseerd programma Eco 50°
Verwijderbare vegen op glazen, glaswerk met een metalen uiterlijk en bestek.	Te veel glansspoelmiddel.	Kleinere hoeveelheid glansspoelmiddel instellen.
	Geen glansspoelmiddel toegevoegd of de instelling is te laag.	Glansspoelmiddel toevoegen en de dosering controleren (advies: stand 4-5).
	Reinigingsmiddelresten tijdens het programmagedeelte Glansspoelen. Deksel van het reinigingsmiddelbakje geblokkeerd door serviesgoed (deksel gaat niet volledig open).	Deksel van het reinigingsmiddelbakje mag niet worden gehinderd door serviesgoed. Geen serviesgoed of geurdispenser in het tablettenbakje doen.
	Serviesgoed te sterk voorgereinigd, daarom kiest de sensortechniek voor een zwak spoelprogramma. Hardnekkig vuil kan gedeeltelijk niet worden verwijderd.	Serviesgoed niet voorspoelen. Alleen de grotere etensresten verwijderen. Geadviseerd programma Eco 50°
Beginnende of reeds aanwezige, irreversibele (onherstelbare) vertroebeling van het glas.	Glazen niet vaatwasmachinebestendig, slechts vaatwasmachinegeschikt.	Vaatwasmachinebestendige glazen gebruiken. Lange stoomfase (standtijd na spoeleinde) vermijden. Spoelbehandeling met lagere temperatuur gebruiken. Onthardingsvoorziening correct instellen op de waterhardheid (eventueel 1 niveau lager). Reinigingsmiddel met glasbeschermingscomponenten gebruiken.

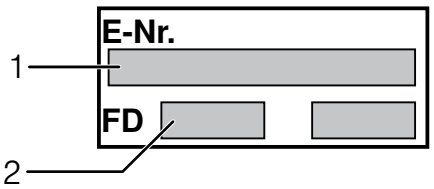
Storing	Oorzaak	Oplossing
Roestsporen op het bestek.	Het bestek is niet voldoende roestbestendig. Messenlemmeten zijn hier vaak sterker door getroffen.	Roestvast bestek gebruiken.
	Bestek roest ook wanneer het samen met roestige voorwerpen wordt afgewassen (handgrepen van pannen, beschadigde servieskorven enz.).	Geen roestende onderdelen afwassen.
	Zoutgehalte in het afwaswater te hoog doordat het deksel van het zoutreservoir niet goed is vastgedraaid of bij het bijvullen zout gemorst werd.	Dop van het zoutreservoir goed vastdraaien of gemorst zout verwijderen.
Het apparaat start niet.	Zekering van de huisinstallatie niet in orde.	Zekering controleren.
	Aansluitsnoer niet aangesloten.	Ervoor zorgen dat het aansluitsnoer goed is aangesloten op de achterkant van het apparaat en op het stopcontact. Controleren of het stopcontact goed werkt.
	De deur van het apparaat is niet goed dicht.	Deur sluiten.
Programma start automatisch.	Einde van het programma niet afgewacht.	Reset uitvoering. (Zie Programma afbreken).
De deur kan niet alleen moeilijk geopend worden.	Kinderbeveiliging is geactiveerd.	Kinderbeveiliging deactiveren. (Zie gebruiksaanwijzing, achteraan in de omslag)
De deur kan niet sluiten.	Het deurslot is omgesprongen.	Deur krachtiger sluiten.
	Deur sluit niet goed door inbouwfout.	Inbouwwijze van het apparaat controleren. Deuren of aanbouwdelen mogen elkaar niet raken bij het sluiten.
Deksel van het afwasmiddelbakje kan niet gesloten worden.	Reinigingsmiddelbakje of dekselgeleiding geblokkeerd door aangekoekte reinigingsmiddelresten.	Reinigingsmiddelresten verwijderen.
Reinigingsmiddelresten in het reinigingsmiddelbakje of in het tablettenbakje.	Sproeiarmen geblokkeerd door serviesgoed, daarom wordt het reinigingsmiddel niet weggespoeld.	Ervoor zorgen dat de sproeiarmen vrij kunnen draaien.
	Afwasmiddelbakje was tijdens het vullen vochtig.	Reinigingsmiddel alleen in droog reinigingsmiddelbakje doen.



Storing	Oorzaak	Oplossing
Apparaat blijft steken tijdens het programma of het programma valt stil.	Deur niet geheel gesloten.	Deur sluiten.
	Geen serviesgoed of geurdispenser in het tablettenbakje doen.	Controleren of de achterwand wordt ingedrukt door bijv. een stopcontact of een niet-gedemonteerde slanghouder.
	Bovenkorf drukt tegen de binnendeur en verhindert een goede sluiting van de deur.	
	Stroom- en/of watertoevoer onderbroken.	Stroom- en/of watertoevoer herstellen.
Klappende geluiden van de vulventielen.	Afhankelijk van de huisinstallatie, daarom geen apparaatfout. Geen invloed op de werking van het apparaat.	Geen oplossing voorhanden.
Kloppend of ratelend geluid.	Sproeiarm slaat tegen het serviesgoed, serviesgoed niet goed ingeruimd.	Serviesgoed zodanig inruimen dat de sproeiarmen niet tegen het serviesgoed slaan.
	Bij geringe belading maken de waterstralen rechtstreeks contact met het reservoir.	Apparaat voller laden of het serviesgoed gelijkmatiger verdelen.
	Lichte serviesdelen bewegen tijdens het spoelen.	Lichte serviesdelen vast staand inruimen.
Abnormale schuimvorming.	Handafwasmiddel in het reservoir voor glansspoelmiddel.	Voorraadbakje voor glansspoelmiddel direct vullen met glansspoelmiddel.
	Glansspoelmiddel gemorst.	Glansspoelmiddel verwijderen met een doek.

Servicedienst

Als u de storing niet zelf kunt verhelpen, neem dan contact op met de Servicedienst. Wij vinden altijd een passende oplossing, ook om onnodige bezoeken van technici te vermijden. De contactgegevens van de dichtstbijzijnde Servicedienst vindt u op de achterkant van deze gebruiksaanwijzing of in de bijgesloten lijst met Servicedienstadressen. Vermeld bij een telefoongesprek a.u.b. het fabrikaatnummer (E-Nr. = 1) en het productnummer (FD = 2); deze nummers vindt u op het typeplaatje [34] op de deur van het apparaat.



Vertrouw op de deskundigheid van de fabrikant. Neem contact met ons op. U bent er dan van verzekerd dat de reparatie door ervaren technici wordt uitgevoerd die gebruik maken van de originele reserveonderdelen voor uw apparaat.

Plaatsen en aansluiten

Om de afwasautomaat goed te laten functioneren moet hij vakkundig worden aangesloten. De gegevens van watertoevoer en waterafvoer en de elektrische aansluitwaarden moeten met de vereiste criteria overeenkomen zoals deze in de volgende alinea's resp. in het montagevoorschrift zijn beschreven.

Bij de montage de juiste volgorde van de handelingen aanhouden:

1. Bij aflevering controleren
2. Plaatsen
3. Aansluiten op de waterafvoer
4. Toevoerslang
5. Elektrische aansluiting

Leveringsomvang

Voor klachten kunt u terecht bij de winkel waar u het apparaat hebt aangeschaft of bij onze klantenservice.

- Afwasautomaat
- Gebruiksaanwijzing
- Montagevoorschrift
- Garantie*
- Montagemateriaal
- Stoombeschermingsplaat*
- Rubberlap*
- Aansluitsnoer

* afhankelijk van het model

Veiligheidsvoorschriften

Neem a.u.b. de aanwijzingen voor de veiligheid onder „Bij de installatie" in acht.

Aflevering

Uw afwasmachine werd in de fabriek grondig gecontroleerd op correct functioneren. Hierbij zijn kleine watervlekken achtergebleven. Deze zijn na de eerste afwas verdwenen.

Technische gegevens

Gewicht:

max. 60 kg

Spanning:

220–240 V, 50 Hz of 60 Hz

Aansluitwaarde:

2,0–2,4 kW

Zekering:

10/16 A (UK 13A)

Stroomverbruik:

uitgeschakeld 0,5 W

niet uitgeschakeld 0,5 W

Waterdruk:

minimaal 0,05 MPa (0,5 bar), maximaal 1 MPa (10 bar). Bij hogere waterdruk: een drukreduceerventiel ervoor installeren.

Hoeveelheid binnenstromend water:

minimaal 10 liter per minuut.

Temperatuur van het water:

Koud water, bij warm water max. temperatuur 60 °C.

Plaatsing

De vereiste inbouwmaten vindt u in het montagevoorschrift. Het apparaat met behulp van de verstelbare voetjes waterpas zetten. Let erop dat het apparaat stevig staat.

- Geïntegreerde en onderbouwapparaten die naderhand als vrijstaand apparaat worden opgesteld, moeten beveiligd worden tegen kantelen, bijv. door vastschroeven aan de wand of door inbouw onder een doorlopend werkblad dat aan de kasten ernaast is vastgeschroefd.
- Het apparaat kan zonder problemen tussen wanden van hout of kunststof in een rij keukenmeubelen worden ingebouwd.

Aansluiten op de waterafvoer

1. De noodzakelijke handelingen vindt u in het montagevoorschrift. Eventueel een sifon met aansluitnippel monteren.
2. Afvoerslang met behulp van de meegeleverde onderdelen op de aansluitnippel van de sifon aansluiten.

   Let erop dat de waterafvoerslang niet geknikt, ingedrukt of ineen gestrengeld is en dat een stop in de afvoer het wegstromen van het water niet belemmert!

Aansluiten op de watertoevoer

1. Aansluiting volgens het montagevoorschrift. De toevoerslang met behulp van de meegeleverde onderdelen op de kraan aansluiten.

   Let erop dat de toevoerslang niet geknikt, platgedrukt of ineengestrengeld is.
2. Bij vervanging van het apparaat moet altijd een nieuwe watertoevoerslang in gebruik worden genomen.

Waterdruk:

minimaal 0,05 MPa (0,5 bar), maximaal 1 MPa (10 bar). Bij hogere waterdruk: een drukreduceerventiel ervoor installeren.

Hoeveelheid binnenstromend water:

minimaal 10 liter per minuut.

Temperatuur van het water:

Koud water, bij warm water max. temperatuur 60 °C.



Warmwateraansluiting *

* Afhankelijk van het model

De afwasautomaat kan op koud of warm water tot max. 60 °C worden aangesloten.

De aansluiting op warm water wordt aanbevolen als dit uit een energetisch gunstige warmwaterbereiding en een geschikte installatie ter beschikking staat, bijv. een zonneënergie-installatie met circulatieleiding.

Hiermee bespaart energie en tijd.

Met de instelling Warmwater *A:01* kunt u uw apparaat optimaal op het gebruik met warm water afstemmen.

Wij adviseren hierbij een watertemperatuur (temperatuur van het instromende water) van minimaal 40 °C en maximaal 60 °C.

De aansluiting op warm water wordt niet aanbevolen als het water uit een elektrische boiler ter beschikking wordt gesteld.

Instelling Warmwater:

1. Deur openen.
2. AAN/UIT-schakelaar [1] inschakelen.
3. Programmatoets [A] ingedrukt houden en de START-toets [10] net zolang indrukken tot de cijferindicatie *H:0*... brandt.
4. Beide toetsen loslaten.
   De indicatie van toets [A] knippert en op de cijferindicatie [3] brandt de door de fabriek ingestelde waarde *H:04*.
5. Programmatoets [A] net zo vaak indrukken tot op de cijferindicatie [3] de in de fabriek ingestelde waarde *A:00* verschijnt.

Om de instelling te wijzigen:

1. Door indrukken van de toets [C] kunt u de instelling Warmwater uit- *A:00* of inschakelen *A:01*.
2. START-toets [10] indrukken.
   De instelwaarde is opgeslagen.
3. Deur sluiten.



Elektrische aansluiting

- Het apparaat uitsluitend via een volgens de voorschriften aangebracht, randgeaard stopcontact op 220 V tot 240 V en 50 Hz of 60 Hz aansluiten. Zie het typeplaatje [34] voor de vereiste zekering.
- Het stopcontact moet zich in de buurt van het apparaat bevinden en ook na het inbouwen gemakkelijk bereikbaar zijn.

  Als de stekker niet gemakkelijk bereikbaar is, dan moet er volgens de veiligheidsvoorschriften een meerpolige scheidingsinstallatie met een contactopening van minimaal 3 mm aanwezig zijn.
- Veranderingen in de aansluiting mogen alleen door een vakkundig monteur worden uitgevoerd.
- Een verlenging van de elektrische aansluitkabel mag alleen door de Servicedienst geleverd worden.
- Bij gebruik van een aardlekschakelaar mag alleen een type met het teken  geïnstalleerd worden. Alleen deze voldoet aan de nu geldende voorwaarden.
- Het apparaat is voorzien van een waterbeveiligingssysteem. Let op: het functioneert **alleen** als het apparaat op de stroom is aangesloten.

Demontage

Neem ook hier de volgorde van de handelingen in acht.

1. Apparaat van het elektriciteitsnet loskoppelen.
2. Kraan dichtdraaien.
3. Aansluiting op de waterafvoer en -toevoer loskoppelen.
4. Bevestigingsschroeven van de meubeldelen losdraaien.
5. De plint – indien aanwezig – demonteren.
6. Apparaat eruit halen en daarbij de slang voorzichtig naar voren trekken.

Transport

Afwasmachine leeg laten lopen en losse onderdelen vastzetten.

Het apparaat in de volgende stappen legen:

1. Kraan opendraaien.
2. Deur openen.
3. AAN/UIT-schakelaar [1] inschakelen.
4. Programma met de hoogste temperatuur kiezen.
   Op de cijferindicatie [3] verschijnt de vermoedelijke duur van het programma.
5. START-toets [10] indrukken.
6. Deur sluiten.
   Programma start.
7. Na ca. 4 minuten de deur openen.
8. Toets [10] indrukken tot de cijferindicatie 0:01 aangeeft.
9. Deur sluiten.
10. Na ca. 1 minuut de deur openen.
    Op de cijferindicatie 0:00 verschijnt .
11. AAN/UIT-schakelaar [1] uitschakelen.
12. Kraan dichtdraaien, toevoerslang losmaken en laten leeglopen.

Apparaat alleen rechtop vervoeren.

(Om te voorkomen dat resterend water in het besturingsmechanisme terechtkomt wat tot een verkeerd programmaverloop leidt.)

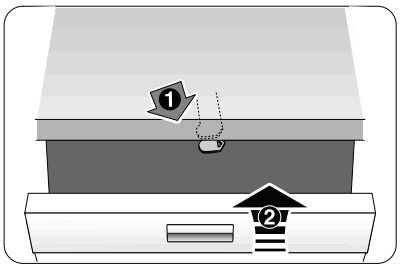
Bescherming tegen vorst

Als het apparaat in een voor vorst gevoelige ruimte staat (bijv. in een vakantiehuisje), dan moet u het apparaat helemaal leeg laten lopen (zie Transport).

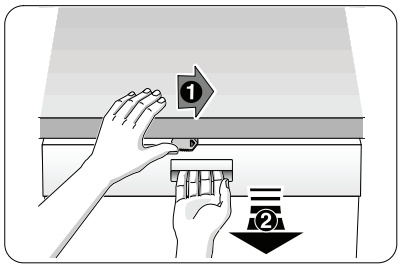
Wijzigingen voorbehouden.



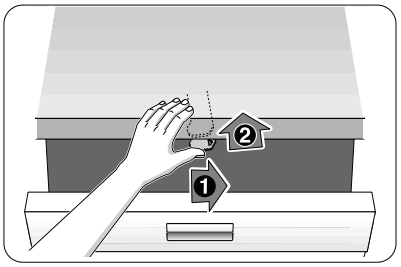
Kinderbeveiliging (deurvergrendeling) *



40



41



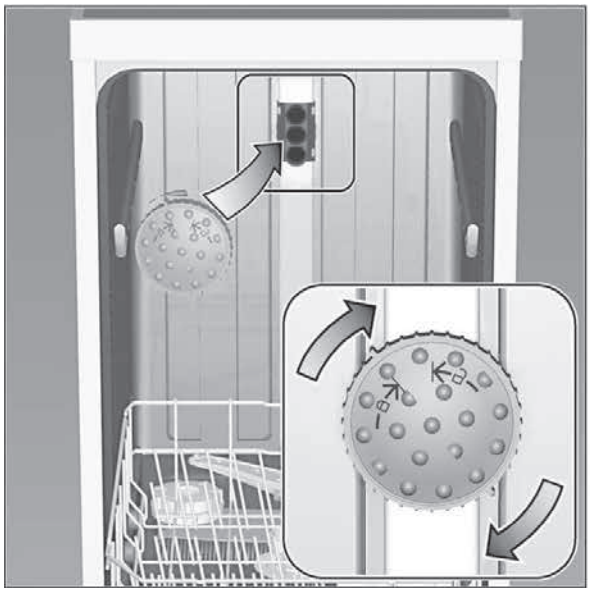
42

40 Kinderbeveiliging activeren.
41 Deur openen bij geactiveerde kinderbeveiliging.
42 Kinderbeveiliging deactiveren.

⚠ Attentie

Zorg dat de deur van het apparaat altijd goed gesloten is als u het apparaat verlaat. Alleen zo kunt u uw kinderen tegen eventuele gevaren beschermen.

Bakplaat-sproeikop *





Grote bakplaten of roosters en borden met een doorsnede van meer dan 30 cm (gourmetborden, pastaborden, onderborden) kunt u met behulp van deze sproeikop reinigen. Hiertoe de bovenste servieskorf eruit halen en de sproeikop zoals afgebeeld erin zetten.

De bakplaten zoals afgebeeld inruimen zodat de sproeistraal alle delen kan bereiken (maximaal 4 bakplaten en 2 roosters).

De afwasautomaat altijd met de bovenste servieskorf of de bakplaat-sproeikop gebruiken!

* niet bij alle modellen

AquaStop garantie (vervalt bij apparaten zonder AquaStop)

Als aanvulling op de garantie-aanspraken tegenover de verkoper in de koopovereenkomst en als aanvulling op onze garantie op het apparaat wordt u schadeloos gesteld als aan onderstaande voorwaarden wordt voldaan:

1. Als door een fout in ons AquaStop-systeem waterschade wordt veroorzaakt, vergoeden wij de schade aan particuliere gebruikers.
   Om het waterbeveiligingssysteem te garanderen moet het apparaat op het elektriciteitsnet zijn aangesloten.
2. Deze aansprakelijkheidsgarantie geldt voor de levensduur van het apparaat.
3. Voorwaarde voor aanspraak op garantie is dat het apparaat met AquaStop vakkundig en overeenkomstig ons installatievoorschrift is opgesteld en aangesloten.
   Hiertoe behoort ook de vakkundig gemonteerde verlenging van de AquaStop (origineel toebehoren). Onze garantie heft geen betrekking op defecte toevoerleidingen of armaturen tot aan de AquaStop-aansluiting op de kraan.
4. Tijdens het gebruik van het apparaat hoeft u er in principe niet bij te blijven resp. na het gebruik om veiligheidsredenen de kraan dicht te draaien.
   Alleen bij langere afwezigheid, bijv. als u een paar weken op vakantie gaat, moet de kraan worden dichtgedraaid.

☎ Verzoek om reparatie en advies bij storingen

NL 088 424 4010

B 070 222 141

De contactgegevens in alle landen vindt u in de bijgesloten lijst met Servicedienstadressen.

Robert Bosch Hausgeräte GmbH
Carl-Wery-Straße 34
81739 München
Germany
www.bosch-home.com

9000888411 nl (9303-1) 640TV

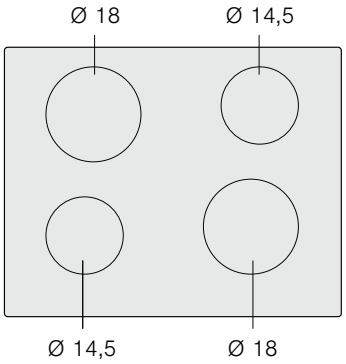


PIA...F...
Hob

BOSCH

[en] Instructions for installation and use

PIA..F...



	9*	b*
Ø 14,5	1.400 W	1.800 W
Ø 18	1.800 W	2.500 W

* IEC 60335-2-6

Ø = cm

en Table of contents

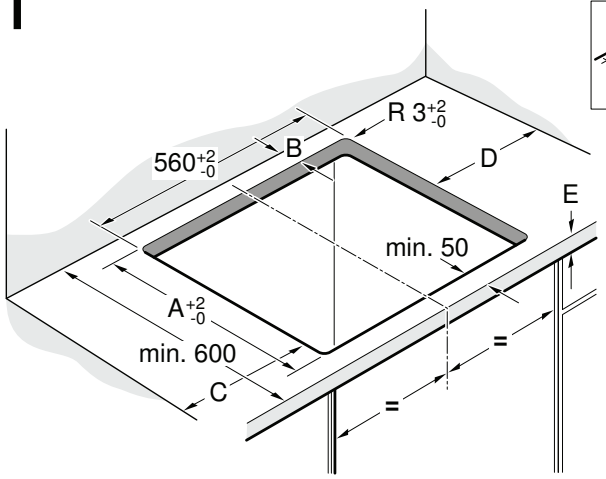
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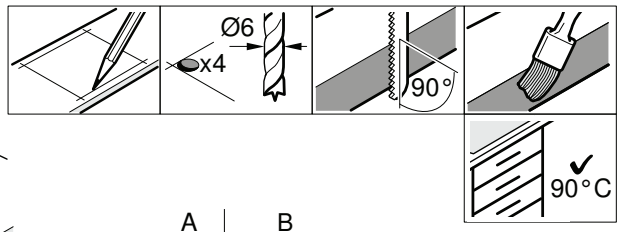
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INSTALLATION INSTRUCTIONS

Assembly

1

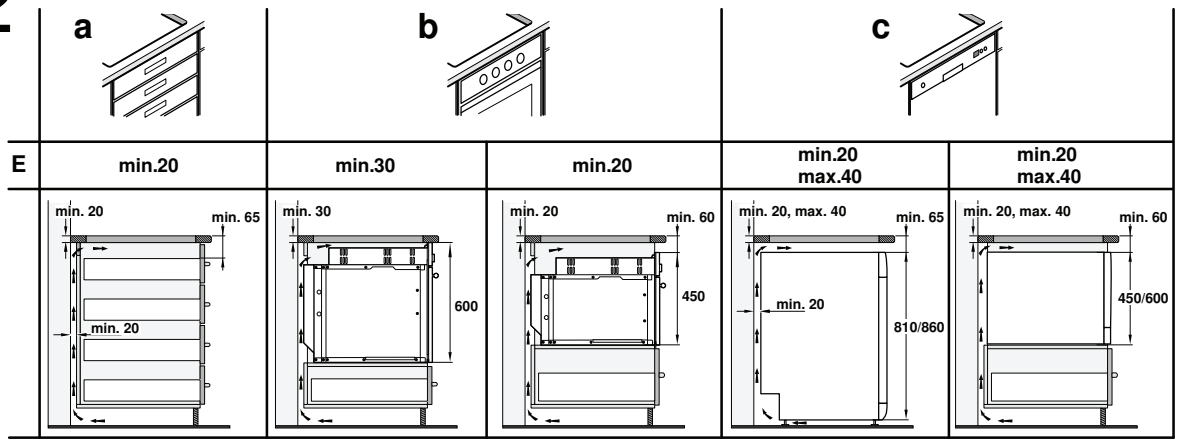




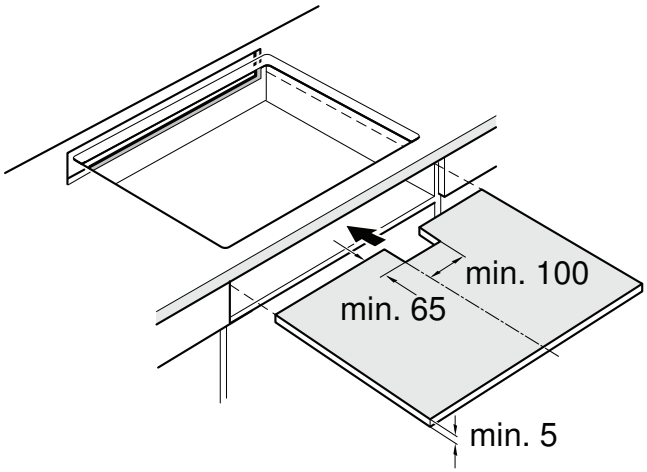
A	B
490	min. 60
500	min. 50

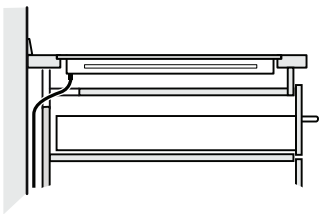
C	D
min. 40	min. 200
min. 200	min. 40

2

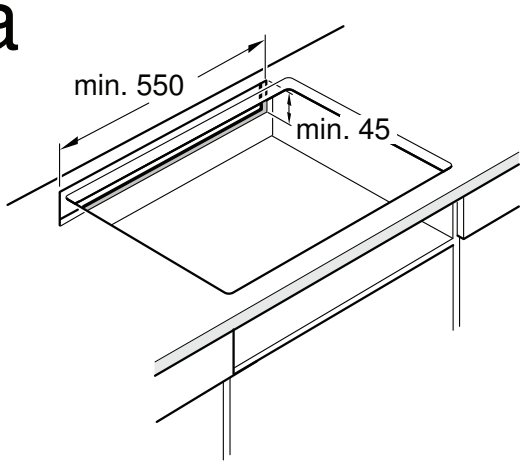


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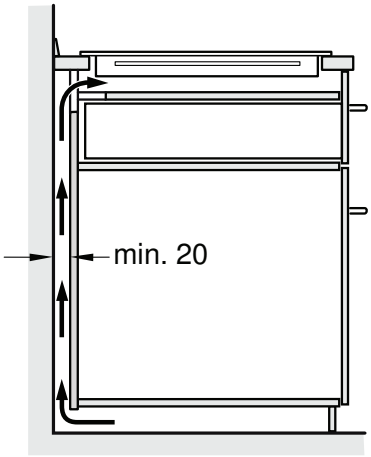




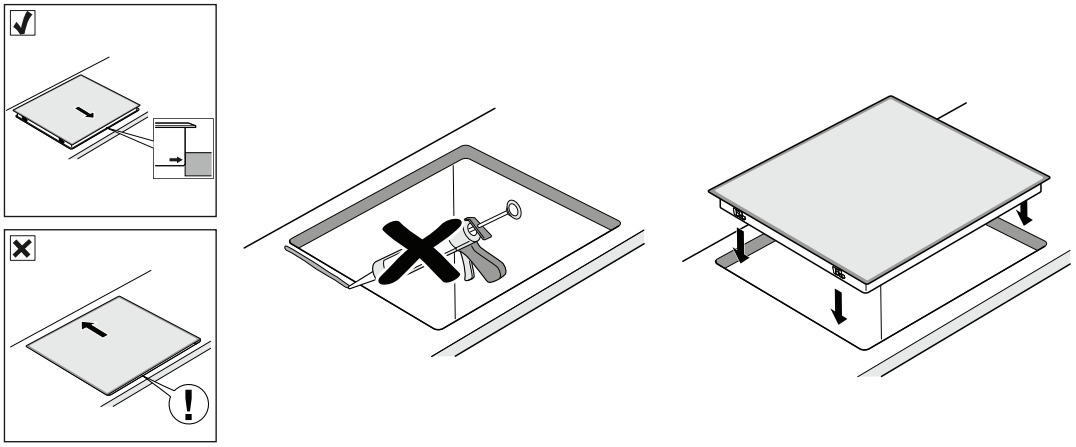
4a



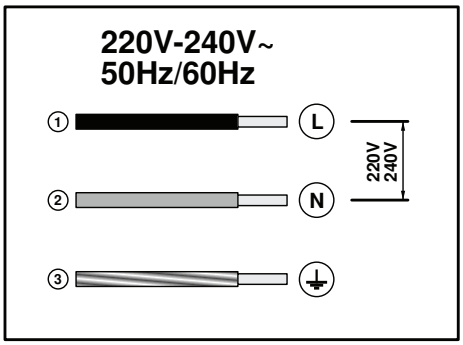
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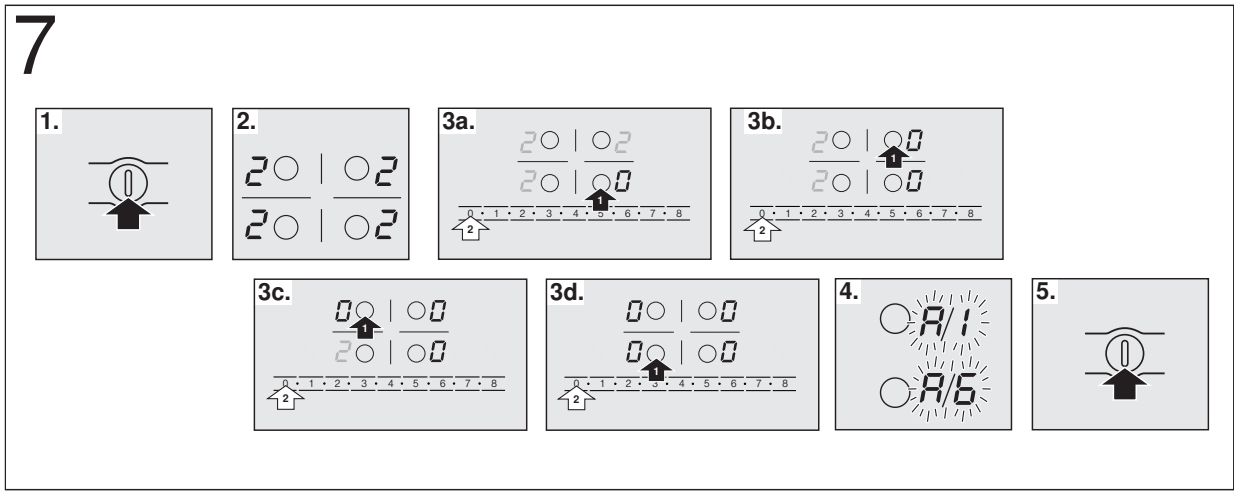


5



6





Important notes

Safety: Safety in use is only guaranteed if the technical installation of the hob has been carried out correctly and in accordance with the assembly instructions. The installation technician shall be liable for any damage caused as a result of unsuitable installation.

Electric connection: Only by an authorised specialist technician. The guidelines set out by the local electricity provider must be observed.

Type of connection: The appliance falls under protection class I and can only be used in combination with a grounding conductor connection.

The manufacturer accepts no responsibility for any malfunction or damage caused by incorrect electrical installations.

Installation: The appliance must be connected to a fixed installation and the means of disconnecting it from the fixed installation must be installed according to the installation instructions.

Built-in assembly under worktop: The induction hobs may only be installed over a drawer, ovens with forced ventilation from the same brand and dishwashers from the same brand. Refrigerators, unventilated ovens and washing machines may not be installed beneath the hob.

Power cable: Do not tie the power cable or pass it along sharp edges. If there is an oven installed below, pass the cable along the rear corners of the oven to the connection box. It must be positioned so that it does not touch any of the hot parts of the hob or the oven.

Hob: flat, horizontal, stable. Follow the hob manufacturer's instructions.

Warranty: an unsuitable installation, connection or assembly will invalidate the product warranty.

Note: Any change to the appliance's interior, including changing the power cable, must only be performed by specially trained members of the Technical Assistance Service.

Preparation of assembly kitchen units, figures 1/2/3/4

Built-in kitchen units: Minimum temperature resistance of 90°C.

Gap: Remove any shavings after performing cutting work.

Cut surfaces: Seal with heat resistant material.

Assembly over drawer, figure 2a

Metal objects stored inside the drawer could become very hot due to the air recirculating from the hob ventilation system. If this occurs, an intermediate support is recommended.

Intermediate support: A wooden panel can be used **(figure 3)** or you may order a suitable accessory from our Technical Assistance Service. The reference code for this accessory is 686002.

Worktop: Must have a minimum thickness of 20 mm.

The distance between the top of the working surface and the top of the drawer must be 65 mm.

Assembly over oven, figure 2b

Worktop: Must have a minimum thickness of:

- 20 mm if installed over a compact oven.
- 30 mm if installed over a full-size oven.

If the hob is installed over a compact oven, there must be a distance of 60 mm between the top of the oven and the top of the working surface.

Assembly over dishwasher, figure 2c

An intermediate accessory must be installed. The accessory may be ordered from our Technical Assistance Service. The reference code for this accessory is 686002.

Worktop: Must have a minimum thickness of 20 mm and maximum thickness of 40 mm.

The space between the top of the working surface and the top of the dishwasher must be:

- 60 mm if installed over a compact dishwasher.
- 65 mm if installed over a full-size dishwasher.

Ventilation, figure 4

Ventilating the hob requires:

- An opening on the upper part of the kitchen unit's rear wall **(figure 4a)**.
- A separation between the rear part of the kitchen unit and kitchen wall **(figure 4b)**.

Installing the appliance, figures 5/6

Connect the appliance to the mains to check its working.

- Voltage, see specifications plate.
- Connect only according to the connection drawing **(figure 6)**.
  1. Brown
  2. Blue
  3. Yellow and green

Changing the intensity of the 13 / 16 / 20 Amp connection current, figure 7

Before using the hob for the first time, the intensity of the hob connection must be tested.

Follow the steps below to change the current of the hob:

1. Turn on the hob with the main switch. Do not place any pans on the hotplates

2. Within the following 60 seconds, adjust all hotplates to the desired power level according to the required connection current (see table).

Power level	Connection current in amperes
1	20 A
2	16 A
3	13 A

3. Turn off all the hotplates in sequence, starting from the lower right and continuing counter-clockwise.

4. The selected connection current is indicated in the display of the right-hand lateral hotplates.

5. Turn off the hob with the main switch.

The selected connection current will have been properly saved.

Uninstalling the appliance

Disconnect the appliance from the mains.

Push the hob upwards from below to remove it.

Caution!

Damage to the appliance! Do not try to remove the appliance by prying it out from above.

INSTRUCTION MANUAL

Additional information on products, accessories, replacement parts and services can be found at **www.bosch-home.com** and in the online shop **www.bosch-eshop.com**

⚠ Safety precautions

Please read this manual carefully. Please keep the instruction and installation manual as well as the appliance certificate in a safe place for later use or for subsequent owners.

Check the appliance after removing it from the packaging. If it has suffered any damage in transport, do not connect the appliance, contact the Technical Assistance Service and provide written notification of the damage caused, otherwise you will lose your right to any type of compensation.

This appliance must be installed according to the installation instructions included.

This appliance is intended for domestic use only. The appliance must only be used for the preparation of food and drink. The appliance must be supervised during operation. Only use this appliance indoors.

Do not use covers. These can cause accidents, due to overheating, catching fire or materials shattering, for example.

Do not use inappropriate child safety shields or hob guards. These can cause accidents.

This appliance is not intended for operation with an external clock timer or a remote control.

This appliance may be used by children over the age of 8 years old and by persons with reduced physical, sensory or mental capabilities or by persons with a lack of experience or knowledge if they are supervised or are instructed by a person responsible for their safety how to use the appliance safely and have understood the associated hazards.

Children must not play with, on, or around the appliance. Children must not clean the appliance or carry out general maintenance unless they are at least 8 years old and are being supervised.

Keep children below the age of 8 years old at a safe distance from the appliance and power cable.

We advise that you exercise caution using or standing near an induction hob while it is in operation, if you wear a pacemaker or a similar medical device. Consult your doctor or the device manufacturer concenring its conformity or any possible incompatibilities,

Risk of fire!

- Hot oil and fat can ignite very quickly. Never leave hot fat or oil unattended. Never use water to put out burning oil or fat. Switch off the hotplate. Extinguish flames carefully using a lid, fire blanket or something similar.
- The hotplates become very hot. Never place combustible items on the hob. Never place objects on the hob.
- The appliance gets hot. Do not keep combustible objects or aerosol cans in drawers directly underneath the hob.
- The hob switches off automatically and can no longer be operated. It may switch on unintentionally at a later point. Switch off the circuit breaker in the fuse box. Contact the after-sales service.

Risk of burns!

- The hotplates and surrounding area (particularly the hob surround, if fitted) become very hot. Never touch the hot surfaces. Keep children at a safe distance.
- The hotplate heats up but the display does not work. Switch off the circuit breaker in the fuse box. Contact the after-sales service.
- Metal objects on the hob quickly become very hot. Never place metal objects (such as knives, forks, spoons and lids) on the hob.
- After each use, always turn off the hob at the main switch. Do not wait until the hob turns off automatically after the pan is removed.

Risk of electric shock!

- Incorrect repairs are dangerous. Repairs may only be carried out and damaged power cables replaced by one of our trained after-sales technicians. If the appliance is defective, unplug the appliance from the mains or switch off the circuit breaker in the fuse box. Contact the after-sales service.
- Do not use any high-pressure cleaners or steam cleaners, which can result in an electric shock.
- A defective appliance may cause electric shock. Never switch on a defective appliance. Unplug the appliance from the mains or switch off the circuit breaker in the fuse box. Contact the after-sales service.
- Cracks or fractures in the glass ceramic may cause electric shocks. Switch off the circuit breaker in the fuse box. Contact the after-sales service.

Malfunction risk!

The hob is equipped with a fan in the lower section. If there is a drawer under the hob it should not be used to store small objects or paper, since they could damage the fan or interfere with the cooling if they are sucked into it.

There should be a minimum of 2 cm between the contents of the drawer and fan intake.

Risk of injury!

- When cooking in a bain marie, the hob and cooking container could shatter due to overheating. The cooking container in the bain marie must not directly touch the bottom of the water-filled pot. Only use heat-resistant cookware.
- Saucepans may suddenly jump due to liquid between the pan base and the hotplate. Always keep the hotplate and saucepan bases dry.

Elements that may damage the appliance

Caution!

- Rough pan bases may scratch the hob.
- Avoid leaving empty pots and pans on the hotplate. Doing so may cause damage.
- Do not place hot pans on the control panel, the indicator area, or the hob frame. Doing so may cause damage.
- Hard or pointed objects dropped on the hob may damage it.
- Aluminium foil and plastic containers will melt if placed on the hotplate while it is hot. The use of laminated sheeting is not recommended on the hob.

Overview

The following table presents the most common damage caused:

Damage	Cause	Measure
Stains	Food spillage	Immediately remove spilt food using a glass scraper.
	Unsuitable cleaning products	Only use cleaning products specifically designed for glass-ceramic hobs.
Scratches	Salt, sugar and sand	Do not use the hob as a tray or working surface.
	Pans with rough bottoms may scratch the glass ceramic	Check pans.
Fading	Unsuitable cleaning products	Only use cleaning products specifically produced for glass-ceramic hobs.
	Contact with pans	Lift pots and pans before moving them around.
Chips	Sugar, substances with a high sugar content	Immediately remove spilt food using a glass scraper.

Protecting the environment

Environmentally-friendly disposal

Dispose of packaging in an environmentally-friendly manner.

This appliance is labelled in accordance with European Directive 2012/19/EU concerning used electrical and electronic appliances (waste electrical and electronic equipment - WEEE). The guideline determines the framework for the return and recycling of used appliances as applicable throughout the EU.

Energy-saving advice

- Always use the correct lid for each pan. Cooking without a lid uses a lot more energy. Use a glass lid to provide visibility and avoid having to lift the lid.
- Use pans with flat bases. Bases that are not flat use a lot more energy.
- The diameter of the pan base must match the size of the hotplate. Please note: pan manufacturers usually provide the diameter for the top of the pan, which is usually larger than the diameter of the pan base.
- Use a small pan for small amounts of food. A large pan which is not full uses a lot of energy.
- Use little water when cooking. This saves energy and preserves all the vitamins and minerals in vegetables.
- Select the lowest power level to maintain cooking. If the power level is too high, energy is wasted.

Induction cooking

Advantages of induction cooking

Induction cooking represents a radical change from the traditional method of heating; the heat is generated directly in the pan. It therefore offers a number of advantages:

- Time savings for cooking and frying; since the pan is heated directly.
- Energy is saved.
- Care and cleaning are simpler. Foods that have spilt do not burn as quickly.
- Heat and safety control; the hob supplies or cuts off power as soon as the control knob is turned on. The induction hotplate stops supplying heat if the pan is removed without having previously switched it off.

Cookware

Only ferromagnetic pans are suitable for induction cooking; these may be made from:

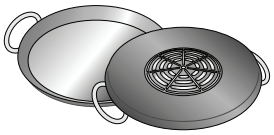
- enamelled steel
- cast iron
- special stainless steel induction pans.

To determine whether a pan is suitable, check to see if a magnet will stick to its base.

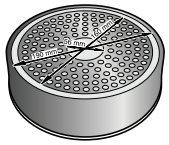
There are other types of cookware for induction whose base is not entirely ferromagnetic.



When using large cookware on a smaller ferromagnetic area, only the ferromagnetic zone heats up, so heat might not be uniformly distributed.



Pans with aluminium areas inserted in the base reduce the ferromagnetic area, so less heat may be supplied and the pan may be difficult to detect or not be detected at all.



For good cooking results, the diameter of the cookware's ferromagnetic area should match the size of the hotplate. If cookware is not detected on a hotplate, try it on the next smaller hotplate down.

Unsuitable pans

Never use diffuser hobs or pans made from:

- common thin steel
- glass
- earthenware
- copper
- aluminium

Characteristics of the pan base

The characteristics of the pan base may affect the uniformity of the cooking results. Pans made from materials which help diffuse heat, such as stainless steel sandwich pans, distribute heat uniformly, saving time and energy.

Absence of pan or unsuitable size

If no pan is placed on the selected hotplate, or if it is made of unsuitable material or is not the correct size, the power level displayed on the hotplate indicator will flash. Place a suitable pan on the hotplate to stop the flashing. If this takes more than 90 seconds, the hotplate will switch off automatically.

Empty pans or those with a thin base

Do not heat empty pans, nor use pans with a thin base. The hob is equipped with an internal safety system. However, an empty pan may heat up so quickly that the "automatic switch off" function may not have time to react and the pan may reach very high temperatures. The base of the pan could melt and damage the glass on the hob. In this case, do not touch the pan and switch the hotplate off. If it fails to work after it has cooled down, please contact the Technical Assistance Service.

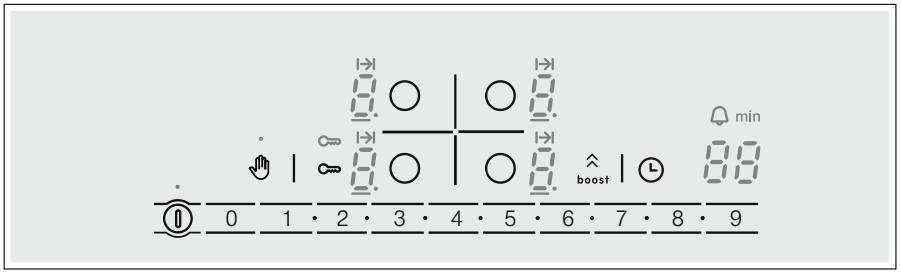
Pan detection

Each hotplate has a minimum limit for detecting pans, which varies depending on the material of the pan being used. You should therefore use the hotplate that is most suitable for the diameter of your pan.

Getting to know your appliance

On *page 2,* you will find information on the dimensions and power of the hotplates.

The control panel



Control panels	
⏼	Main switch
○	Select the hotplate
1•2•...8•9	Programming zone
☜	Cleaning lock function
⚷	Childproof lock
boost	Powerboost Function
◷	Timer programming

Indicators	
0	Functionality
1-9	Power levels
H/h	Residual heat
00	Time program function
🔔	Timer
|→	Automatic shut-off
b	Powerboost Function
⚷	Childproof lock

Control panels

Pressing a symbol activates its corresponding function.

Note: Always keep the control surfaces dry. Moisture can affect proper working.

The hotplates

Hotplate	
○ Single hotplate	Always use cookware of a suitable size.
Use only cookware suitable for induction cooking; see the section on suitable cookware.	

Residual heat indicator

The hob has a residual heat indicator for each hotplate to show those which are still hot. Avoid touching them when this indicator is lit.

Although the hob is switched off, the indicator h or H will remain on for as long as the hotplate is hot.

If the pan is removed before the hotplate is turned off, the indicator h or H and the selected power level will appear alternately.

Programming the hob

This section will show you how to program the hotplates. The table contains power levels and cooking times for several dishes.

Turning the hob on and off

The hob is turned on and off using the main switch.

To turn on: press the ⏻ symbol. A beep sounds. The indicator located next to the main switch and the 0 indicators of the hotplates light up. The hob is ready for use.

To turn off: press the ⏻ symbol until the indicators go out. All hotplates are turned off. The residual heat indicator will remain lit until the hotplates have cooled down sufficiently.

Notes

- The hob switches off automatically when all the hotplates are switched off for more than 20 seconds.
- The settings are memorised for 4 seconds after the hob has been turned off. If the hotplate is switched back on within this time then the previous settings will be applied.

Setting the hotplate

Select the power level required with the 1 to 9 symbols.

Power level 1 = minimum power

Power level 9 = maximum power

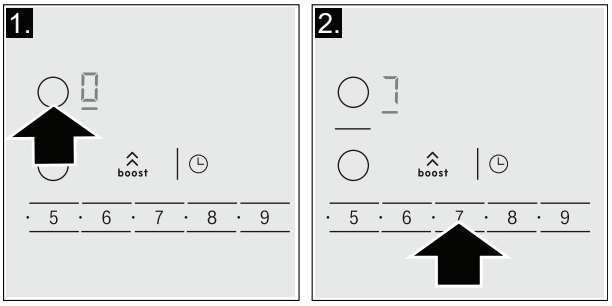
Each power level has an intermediate level. This level is marked with the ● symbol in the programming zone.

Selecting the power level

The hob must be switched on.

1. Press the ○ symbol for the desired hotplate.
The 0 indicator lights up as well as the _ symbol below.

2. Next, select the power level in the programming zone.



The power level has been set.

Changing the power level

Select the hotplate and then press the symbol for the desired power level. To select an intermediate level, press the ● symbol that is between the power level symbols.

Switch off the hotplate

Select the hotplate and set it to 0 in the programming panel. The hotplate turns off and the residual heat indicator appears.

Notes

- If no pan has been placed on the hotplate, the selected power level flashes. After a certain time has elapsed, the hotplate switches off.
- If a pan has been placed on the hotplate before switching on the hob, it will be detected within 20 seconds of pressing the main switch and the hotplate will be selected automatically. Once detected, select the power level within the next 20 seconds or the hotplate will switch off.

  If more than one pan is placed on the hob, only one will be detected when switching it on.

Cooking guidelines table

The table below contains some examples.

Use power level 9 to begin cooking.

When heating purées, creams and thick sauces, stir frequently.

	Power level
Melting	
Chocolate, chocolate coating	1-1.
Butter, honey, gelatin	1-2
Heating and keeping warm	
Stew (e.g., lentils)	1-2
Milk**	1.-2.
Sausages heated in water**	3-4
Defrosting and heating	
Frozen spinach	3-4
Frozen goulash	3-4
Slow cooking, simmering	
Potato dumplings*	4.-5.
Fish*	4-5
White sauces (e.g., bechamel)	1-2
Whipped sauces (e.g., Bearnaise, Hollandaise)	3-4

* Uncovered cooking
** Uncovered
*** Turn frequently

	Power level
Boiling, steaming, sautéing	
Rice (with a double amount of water)	2-3
Rice pudding	1.-2.
Potatoes	4-5
Pasta*	6-7
Soups	3.-4.
Vegetables	2.-3.
Greens, frozen foods	3.-4.
Cooked in a pressure cooker	4.-5.
Stewing	
Meat roll	4-5
Stew	4-5
Goulash	3.-4.
Bake / Fry with a little oil**	
Steaks, chops (plain or breaded)	6-7
Beefsteak (3 cm thick)	7-8
Chicken breast (2 cm thick)***	5-6
Hamburgers, meatballs (3 cm thick)***	4.-5.
Plain fish and fish fillet	5-6
Breaded fish and fish fillet	6-7
Prawns and shrimps	7-8
Frozen meals (e.g., stir-fries)	6-7
Pancakes	6-7
Omelette	3.-4.
Frying** (150-200 g per serving with 1-2 l. of oil)	
Frozen foods (e.g., French fries, chicken nuggets)	8-9
Frozen croquettes	7-8
Meat (e.g., chicken pieces)	6-7
Fish, vegetables or mushrooms, breaded or battered, e.g., baby mushrooms	6-7
Confectionery products (e.g., fritters, fruit in batter)	4-5

* Uncovered cooking
** Uncovered
*** Turn frequently

Childproof lock

The hob can be protected against being accidentally turned on, to ensure that children do not switch on the hotplates.

Activating and deactivating the childproof lock

The hob should be turned off.

To activate: press the symbol for approximately 4 seconds. The indicator next to the symbol lights up for 10 seconds. The hob is locked.

To deactivate: press the symbol for approximately 4 seconds. The lock is now deactivated.

Childproof lock

With this function, the childproof lock automatically activates when a hob is switched off.

Activating and deactivating

All of the relevant information on the automatic childproof lock connection can be found in the *Basic settings* chapter.



Powerboost function

The Powerboost function can be used to heat large amounts of water more quickly than the power level 9.

All the hotplates have this function.

To activate

The hob must be switched on, but no hotplate should be working.

1. Select a hotplate.
2. Press the **boost** symbol.
   The b indicator lights up

The function should be activated.

Note: If any hotplate is switched on when the Powerboost function is working, b and 9 will flash on the hotplate display; the power level 9 will then be set 9. The Powerboost function will be deactivated.

To deactivate

1. Select a hotplate.
2. Press the symbol **boost**.
   The b indicator will no longer appear and the hotplate will return to the power level 9.

The function will be deactivated.

Note: In certain circumstances, the Powerboost function may turn off automatically in order to protect the electronic components inside the hob.

Time programming function

This function may be used in two different ways:

- to automatically switch off a hotplate.
- as a timer.

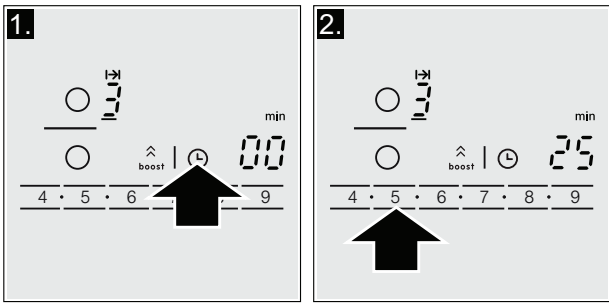
Turning off a hotplate automatically

The zone turns off automatically once the selected time has elapsed.

How to program

The hob must be switched on:

1. Select the desired hotplate and power level.
2. Press the ◷ symbol. The I→I indicator on the hotplate lights up. 00 lights up in the time program function display.
3. Within the next 10 seconds, select the desired cooking time in the programming zone.



The cooking time starts to count down.

Note: The same cooking time can be automatically programmed for the all the hotplates. The programmed time passes independently for each of the hotplates.

The *Basic settings* chapter provides information on automatically programming the cooking time.

Changing or cancelling the time

Select the hotplate and then press the ◷ symbol.

Change the cooking time using the programming zone or set to 00 in order to cancel the time.

Once the time has elapsed

The hotplate switches off. A warning signal sounds. The time program function lights up 00 for 10 seconds in the display.

When the ◷ symbol is pressed, the indications turn off and the beeping stops.

Notes

- To program a cooking time of less than 10 minutes, always press 0 before selecting the desired value.
- If cooking times have been programmed for various zones, the time program function always displays the time of the selected hotplate.
- Cooking times can be programmed for up to 99 minutes.

The timer

The timer can be set for periods of up to 99 minutes. It is independent of the other settings. This function does not automatically switch off a hotplate.

How to program

1. Press the ◷ symbol until the 🔔 indicator lights up. 00 lights up in the time program function display.
2. Adjust the desired time in the programming zone.

The time starts to count down again after a few seconds.

Changing or cancelling the time

Press the ◷ symbol and the 🔔 indicator lights up.

Change the cooking time in the programming zone or press **0** to cancel the time.

Once the time has elapsed

Once the time has elapsed, a beep will sound. 00 and 🔔are displayed in the time program function display. After pressing the ◷ symbol, the indications turn off.

Cleaning lock function

Cleaning the control panel while the hob is switched on may change the settings.

In order to avoid this, the hob has a cleaning lock function. Press the symbol. A signal sounds. The control panel is locked for 35 seconds. The control panel surface can now be cleaned without the risk of changing the settings.

Note: The lock does not affect the main switch. The hob may be turned off when desired.

Automatic time limitation

If the hotplate remains in use for a long time and no changes are made in the settings, the automatic time limitation function is triggered.

The hotplate stops heating. The F, 8 symbol and the residual heat indicator h/H flash alternately in the display.

The indicator goes out when any symbol is pressed. The hotplate can now be reset.

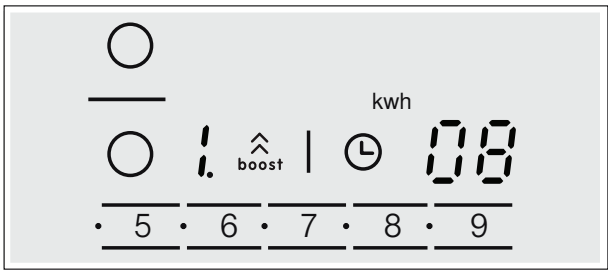
When the automatic time function is used, it is governed by the selected power level (from 1 to 10 hours).

Displaying energy consumption

This function displays total energy consumption for the time the hob has been switched on.

After switching off the hob, the consumption in kWh is displayed for 10 seconds.

An example is shown in the image with a consumption of 1.08 kWh.



The *Basic Settings* chapter provides information on activating this function.

Basic settings

The device has several basic settings. These settings may be adapted to the user's individual needs.

Indicator	Function
c 1	**Childproof lock** 0 Deactivated.* 1 Activated.
c2	**Audible signals** 0 Confirmation and error signals deactivated. 1 Only error signal activated. 2 Only confirmation signal activated. 3 All signals activated.*
c3	**Display energy consumption** 0 Deactivated.* 1 Activated.
c5	**Automatic programming of cooking time.** 0 Switched off.* 1-99 Automatic shut-off time.

*Factory settings

**The maximum power of the hob depends on the configuration of the installation's connection current. To not exceed this maximum value, the hob includes a series of components that automatically control the power, distributing it between the hotplates in use as required.

Indicator	Function
c6	**Duration of the time program function warning signal** 1 10 seconds*. 2 30 seconds. 3 1 minute.
c7	**Power-Management function** 0 = Deactivated.* 1 = 1,000 W. minimum power. 1= 1,500 W. 2 = 2,000 W. etc. 9 or 9. = maximum power of hob.**
c9	**Hotplate time selection** 0 Unlimited: the last hotplate programmed remains selected.* 1 Limited: The hotplate will only remain selected for 10 seconds.
c0	**Return to basic settings** 0 Personal settings.* 1 Return to factory settings.

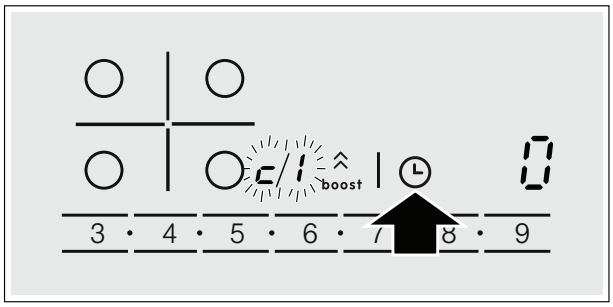
*Factory settings

**The maximum power of the hob depends on the configuration of the installation's connection current. To not exceed this maximum value, the hob includes a series of components that automatically control the power, distributing it between the hotplates in use as required.

Accessing the basic settings

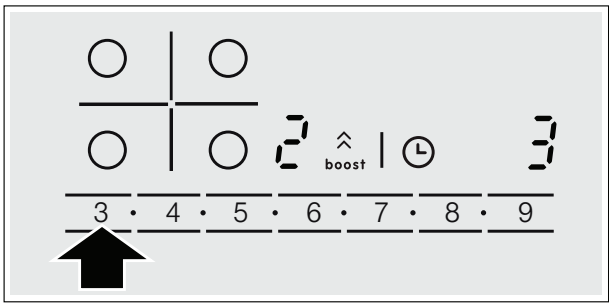
The hob should be turned off.

1. Switch on the hob using the main switch.
2. Within the next 10 seconds, press and hold the ◷ symbol for 4 seconds.



In the display, c and 1 alternately light up and 0 as a default setting.

3. Press the ◷ symbol several times until the desired function indicator appears.
4. Next, select the desired setting in the programming zone.



5. Press the ◷ symbol for 4 seconds.

The settings should be correctly saved.

Leaving the basic settings

Turn off the hob with the main switch.

Care and cleaning

The advice and warnings contained in this section aim to guide you in cleaning and maintaining the hob, so that it is kept in the best possible condition

Hob

Cleaning

Clean the hob after each use. This prevents food remains left on the surface from burning. Wait until the hob is cool enough before attempting to clean it.

Only use cleaning products specifically designed for hobs. Follow the instructions provided on the packaging.

Do not use:

- Undiluted washing-up liquid
- Dishwasher detergent
- Abrasive products
- Corrosive products such as oven sprays or stain removers
- Sponges that may scratch
- High-pressure or steam cleaners

The best way to remove stubborn stains is to use a glass scraper. Follow the manufacturer's instructions.

Suitable glass scrapers can be obtained through the Technical Assistance Service or from our online shop.

Hob frame

In order to avoid damage to the hob frame, follow the indications below:

- Use only slightly soapy hot water
- Do not use sharp or abrasive products
- Do not use a glass scraper

Fixing malfunctions

Malfunctions are usually due to small details. Before calling the Technical Assistance Service you should bear in mind the following advice and warnings.

Indicator	Malfunction	Solution
none	The electric power supply has been cut off.	Use other electrical appliances to check whether there has been a power cut.
	The appliance has not been correctly connected following the connection diagram.	Check that the appliance has been connected correctly according to the connection diagram.
	Electronic system malfunction.	If none of the above checks resolve the malfunction, contact the Technical Assistance Service.
The indicators flash	The control panel is damp or an object is resting on it.	Dry the control panel area or remove the object.
The indicator **-** flashes on the hotplate indicators	A fault has occurred in the electronic system.	Briefly cover the control panel with your hand to confirm the malfunction.
Er + number / d + number / E + number	Electronic system malfunction.	Unplug the hob from the mains. Wait about 30 seconds before plugging it in again.*
F0 / F9	There is an internal operating error.	Unplug the hob from the mains. Wait about 30 seconds before plugging it in again.*
F2	The electronic system has overheated and the corresponding hotplate has been switched off.	Wait until the electronic system has cooled down sufficiently. Then press any symbol on the hob. *
F4	The electronic system has overheated and all hotplates have been switched off.	
F5 + power level and beep	There is a hot pan on the control panel. It is highly likely that the electronic system will overheat.	Remove that pan. The malfunction indicator will switch off shortly afterwards. You can carry on cooking.
F5 and beep	There is a hot pan on the control panel. The hotplate has switched off to protect the electronic system.	Remove that pan. Wait a few seconds. Press any control panel. When the malfunction indicator switches off, you can carry on cooking.
U1	Incorrect supply voltage, outside normal operating limits.	Contact your electricity board.
U2 / U3	The hotplate has overheated and has switched off in order to protect its hob.	Wait until the electronic system has cooled down sufficiently before switching it back on.

* If the warning persists call the Technical Assistance Service.
Do not rest hot pans on the control panel.

Normal noise while the appliance is working

Induction heating technology is based on the creation of electromagnetic fields that generate heat directly at the base of the pan. Depending on how the pan has been manufactured, certain noises or vibrations may be produced such as those described below:

A deep humming sound as in a transformer

This noise is produced when cooking on a high power level. It is caused by the amount of energy transferred from the hob to the pan. The noise disappears or becomes faint when the power level is lowered.

A low whistling sound

This noise is produced when the pan is empty. The noise disappears when water or food is added to the pan.

A crackling sound

This noise occurs in pans which are made from different materials superimposed on one another. It is caused by the vibrations that occur in the adjoining surfaces of the different superimposed materials. The noise comes from the pan. The amount of food and cooking method can vary noise intensity.

A high-pitched whistling sound

This noise is produced mainly in pans made from different materials superimposed on one another, and it occurs when such pans are heated at maximum power on two hotplates at the same time. The whistling disappears or becomes fainter as soon as the power level is lowered.

Noise from the fan

For proper use of the electronic system, the temperature of the hob must be controlled. To do this, the hob has a fan which turns on when a high temperature is detected. The fan may also work by inertia after the hob has been switched off, if the temperature detected is still too high.

Rhythmic sounds similar to the hands of a clock

This noise is only produced when 3 or more hotplates are working and disappears or is reduced when one of the hotplates is switched off.

The noises described are normal, they are part of induction heating technology and not a sign of malfunction.

After-sales service

Our after-sales service is there for you if your appliance should need to be repaired. We are committed fo find the best solution also in order to avoid an unnecessary call-out.

E number and FD number:

Please quote the E number (product number) and the FD number (production number) of your appliance when contacting the after-sales service. The rating plate bearing these numbers can be found on the appliance certificate.

Please note that a visit from an after-sales service engineer is not free of charge, even during the warranty period.

Please find the contact data of all countries in the enclosed customer service list.

To book an engineer visit and product advice

GB 0844 8928979
Calls from a BT landline will be charged at up to 3 pence per minute. A call set-up fee of up to 6 pence may apply.

IE 01450 2655
0.03 € per minute at peak. Off peak 0.0088 € per minute.

Rely on the professionalism of the manufacturer. You can therefore be sure that the repair is carried out by trained service technicians who carry original spare parts for your appliances.

Tested dishes

This table has been prepared for assessment institutions to provide controls for our appliances.

The data in the table refers to our Schulte-Ufer cookware accessories (4 piece cookware set for the HEZ 390042 induction hob) with the following measurements:

- Saucepan Ø 16 cm, 1.2 l for hotplates of Ø 14.5 cm
- Pot Ø 16 cm, 1.7 l for hotplates of Ø 14.5 cm
- Pot Ø 22 cm, 4.2 l for hotplates of Ø 18 cm
- Frying pan Ø 24 cm, for hotplates of Ø 18 cm

		Preheating			Cooking	
Tested dishes	**Hotplate**	**Power level**	**Time (Min:S)**	**Cover**	**Power level**	**Cover**
Melting chocolate						
Cookware: saucepan						
Chocolate coating (e.g. Dr. Oetker brand, dark 55%, 150 g.)	Ø 14.5 cm	-	-	-	1 - 1.	No
Heating lentil stew and keeping it heated						
Cookware: Pot						
Initial temperature 20 °C						
*Lentil stew**						
Amount 450 g.	Ø 14.5 cm	9	1:30 without stirring	Yes	1.	Yes
Amount: 800 g.	Ø 18 cm	9	2:30 without stirring	Yes	1.	Yes
Canned lentil stew, e.g. Erasco lentils with chorizo						
Amount 500 g.	Ø 14.5 cm	9	1:30 stir after approx. 1:00	Yes	1.	Yes
Amount 1 kg.	Ø 18 cm	9	2:30 stir after approx. 1:00	Yes	1.	Yes
Making bechamel sauce						
Cookware: Saucepan						
Milk temperature: 7 °C						
Ingredients: 40 g of butter, 40 g of flour, 0.5 l of milk (3.5% fat) and a pinch of salt	Ø 14.5 cm					
1. Melt butter, mix in flour and salt and heat everything together		1	approx. 3:00	No		
2. Add milk and bring the sauce to a boil, stirring continuously		7	approx. 5:20	No		
3. Keep the bechamel sauce at a boil for two more minutes, stirring continuously					1	No

*Recipe according to DIN 44550

***Recipe according to DIN EN 60350-2

Tested dishes	Hotplate	Preheating			Cooking	
		Power level	Time (Min:S)	Cover	Power level	Cover
Cooking rice pudding						
Cookware: Pot Milk temperature: 7 °C Heat milk until it begins to bubble. Change the recommended heating level and add rice, sugar and salt to the milk						
Ingredients: 190 g. of short-grain rice, 23 g. of sugar, 750 ml. of milk (3.5% fat) and a pinch of salt	Ø 14.5 cm	8.	approx. 6:30	No	2 stir after approx. 10:00	Yes
Ingredients: 250 g. of short-grain rice, 30 g. of sugar, 1 l. of milk (3.5% fat) and a pinch of salt	Ø 18 cm					
Cooking rice*						
Cookware: Pot Water temperature 20 °C						
Ingredients: 125 g of short-grain rice, 300 g of water and a pinch of salt	Ø 14.5 cm	9	approx. 2:30	Yes	2	Yes
Ingredients: 250 g of short-grain rice, 600 g of water and a pinch of salt	Ø 18 cm	9	approx. 2:30	Yes	2.	Yes
Pan-frying pork sirloin						
Cookware: Frying pan Sirloin initial temperature: 7 °C 2 pieces of sirloin (total weight approx. 200 g, 1 cm thick)	Ø 18 cm	9	1:30	No	7	No
Frying crêpes**						
Cookware: Frying pan 55 ml of crêpe batter	Ø 18 cm	9	1:30	No	7	No
Frying frozen potato chips						
Cookware: Pot Ingredients: 1.8 kg of sunflower oil, for cooking: 200 g of frozen potato chips (e.g. McCain 123 Frites Original)	Ø 18 cm	9	Until the temperature of the oil reaches 180 °C	No	9	No

*Recipe according to DIN 44550

***Recipe according to DIN EN 60350-2



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Hotte

BOSCH

[fr] Notice d’utilisation et de montage

fr Table des matières

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NOTICE D'UTILISATION

Vous trouverez des informations supplementaires concernant les produits, accessoires, pièces de rechange et services sur Internet sous : **www.bosch-home.com** et la boutique en ligne : **www.bosch-eshop.com**

⚠ Précautions de sécurité importantes

Lire attentivement ce manuel. Ce n'est qu'alors que vous pourrez utiliser votre appareil correctement et en toute sécurité. Conserver la notice d'utilisation et de montage pour un usage ultérieur ou pour le propriétaire suivant.

La sécurité de l'appareil à l'usage est garantie s'il a été encastré conformément à la notice de montage. Le monteur est responsable du fonctionnement correct sur le lieu où l'appareil est installé.

Cet appareil est destiné exclusivement à une utilisation domestique et non professionnelle. L'appareil n'est pas destiné à une utilisation à l'extérieur. Surveiller l'appareil pendant son fonctionnement. Le fabricant décline toute responsabilité des dommages provoqués par une utilisation inexperte ou des erreurs de manipulation.

Cet appareil peut être utilisé par des enfants de 8 ans ou plus et par des personnes dotées de capacités physiques, sensorielles ou mentales réduites ou disposant de connaissances ou d'expérience insuffisantes, sous la surveillance d'un tiers responsable de leur sécurité ou bien lorsqu'ils ont reçu des instructions liées à l'utilisation de l'appareil en toute sécurité et qu'ils ont intégré les risques qui en résultent.

Les enfants ne doivent pas jouer avec l'appareil. Le nettoyage et l'entretien effectué par l'utilisateur ne doivent pas être accomplis par des enfants, sauf s'ils sont âgés de 8 ans et plus et qu'un adulte les surveille.

Les enfants de moins de 8 ans doivent être tenus à distance de l'appareil et du cordon d'alimentation.

Contrôler l'état de l'appareil après l'avoir déballé. Ne pas le raccorder s'il présente des avaries de transport.

Cet appareil n'est pas conçu pour un fonctionnement avec une minuterie externe ou une commande à distance.

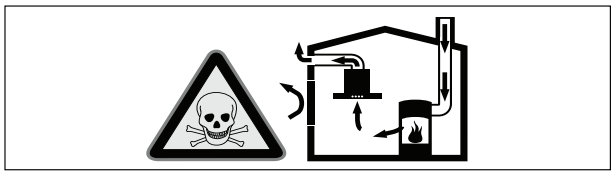
Risque d'asphyxie !

Le matériel d'emballage est dangereux pour les enfants. Ne permettez jamais aux enfants de jouer avec les matériaux d'emballage.

Danger de mort !

Il y a risque d'intoxication par réaspiration des gaz de combustion.

En cas d'utilisation simultanée de l'appareil en mode évacuation de l'air et d'un foyer à combustion alimenté en air ambiant, veillez impérativement à ce que l'apport d'air soit suffisant.

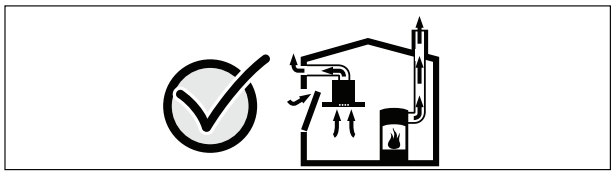


Les foyers à combustion alimentés en air ambiant (par exemple appareils de chauffage, au gaz, au bois, au fioul ou au charbon, les chauffe-eau, chauffe-eau accumulateurs) prélèvent l'air de combustion dans la pièce où ils sont installés et rejettent les gaz de fumée à l'extérieur par le biais d'un système spécifique (cheminée par exemple).

Lorsque la hotte aspirante est en marche, elle prélève de l'air dans la cuisine et dans les pièces voisines ; si l'apport d'air frais est trop faible, une dépression se forme. Des gaz toxiques provenant de la cheminée ou du conduit d'évacuation sont réaspirés dans les pièces d'habitation.

- Il faut donc toujours s'assurer que l'apport d'air frais est suffisant
- La présence d'une ventouse télescopique d'apport et d'évacuation d'air ne suffit pas à assurer le respect de la valeur limite.

Le fonctionnement sûr de l'appareil n'est possible que si la dépression dans la pièce où est installé le foyer ne dépasse pas 4 Pa (0,04 mbar). On y parvient en présence d'ouvertures non obturables ménagées par ex. dans les portes, fenêtres et en association avec des ventouses télescopiques d'admission/évacuation de l'air à travers la maçonnerie ou par d'autres mesures techniques permettant à l'air d'affluer pour assurer la combustion.



Demandez toujours conseil au maître ramoneur compétent qui pourra évaluer l'ensemble du réseau de ventilation de la maison et vous proposer le moyen le mieux adapté pour l'aération.

Si la hotte aspirante est utilisée exclusivement en mode recyclage, le fonctionnement est possible sans restrictions.

Risque d'incendie !

- Les dépôts de graisse dans le filtre à graisse peuvent s'enflammer.

  Nettoyer le filtre à graisse au moins tous les 2 mois.

  Ne jamais faire fonctionner l'appareil sans filtre à graisse.
- Les dépôts de graisse dans le filtre à graisse peuvent s'enflammer. Ne jamais travailler avec une flamme nue à proximité de l'appareil (par ex. flamber). N'installer l'appareil à proximité d'un foyer à combustibles solides (par ex. bois ou charbon) qu'en présence d'un couvercle fermé et non amovible. Aucune projection d'étincelles ne doit avoir lieu.
- L'huile et la graisse chaude s'enflamme rapidement. Ne jamais laisser l'huile et la graisse chaude sans surveillance. Ne jamais éteindre le feu avec de l'eau. Eteindre le foyer. Etouffer les flammes prudemment avec un couvercle, une couverture ou similaire.
- Des foyers à gaz sans qu'un récipient ne soit placé sur le foyer dégagent une forte chaleur lors du fonctionnement. Un appareil de ventilation monté au-dessus peut être endommagé ou prendre feu. Utiliser les foyers à gaz uniquement avec un récipient placé dessus.
- Lors du fonctionnement simultané de plusieurs foyers gaz il y a une forte production de chaleur. Un appareil de ventilation monté au-dessus peut être endommagé ou prendre feu. Ne faites jamais fonctionner en même temps deux foyers gaz à feu vif pendant plus de 15 minutes. Un brûleur grande puissance de plus de 5kW (Wok) chauffe autant que deux brûleurs gaz.

Risque de brûlure !

Les éléments accessibles deviennent chauds pendant le fonctionnement. Ne jamais toucher les éléments chauds. Eloigner les enfants.

Risque de blessure !

- Des pièces à l'intérieur de l'appareil peuvent présenter des arêtes vives. Porter des gants de protection.
- Des objets déposés sur l'appareil peuvent tomber. Ne pas déposer d'objets sur l'appareil.
- La lumière des lampes LED est très éblouissante et peut causer des dommages aux yeux (groupe de risque 1). Ne pas regarder plus longtemps que 100 secondes directement les lampes LED allumées.

Risque de choc électrique !

- Un appareil défectueux peut provoquer un choc électrique. Ne jamais mettre en service un appareil défectueux. Débrancher la fiche secteur ou enlever le fusible dans le boîtier à fusibles.Appeler le service après-vente.
- Tenter de réparer vous-même l'appareil est dangereux. Seul un technicien du service après-vente formé par nos soins est habilité à effectuer des réparations et à remplacer des câbles d'alimentation défectueux. Si l'appareil est défectueux, débrancher la fiche secteur ou enlever le fusible dans le boîtier à fusibles. Appeler le service après-vente.
- De l'humidité qui pénètre peut occasionner un choc électrique. Ne pas utiliser de nettoyeur haute pression ou de nettoyer à vapeur.

Causes de dommages

Attention !

Risque de détérioration par la corrosion. Toujours allumer l'appareil pendant la cuisson afin d'éviter la formation de condensation. La condensation peut provoquer de la corrosion.

Remplacer immédiatement les ampoules défectueuses, afin d'empêcher une surcharge des ampoules restantes.

Risque de détérioration par pénétration d'humidité dans l'électronique. Ne jamais nettoyer les éléments de commande avec un chiffon mouillé.

Les surfaces peuvent être endommagées par un nettoyage non conforme. Nettoyer les surfaces en inox seulement dans le sens du métal. Pour les organes de commande, ne pas utiliser de nettoyant pour inox.

Les nettoyants agressifs ou à récurer peuvent endommager la surface. Ne jamais utiliser de nettoyants agressifs ou à récurer.

Risque d'endommagement par le reflux de condensat. Installer le conduit d'air vicié légèrement incliné vers le bas à partir de l'appareil (1° de pente)

Protection de l'environnement

Déballez l'appareil et jetez l'emballage dans le respect de l'environnement.

Élimination sans nuisances pour l'environnement



Cet appareil est conforme à la Directive européenne 2012/19/CE relative aux déchets d'équipements électriques et électroniques (DEEE). Cette directive fixe un cadre pour la reprise et la valorisation des appareils usagés sur tout le territoire de l'Union européenne.

Modes

Vous pouvez utiliser cet appareil en mode Évacuation d'air ou en mode Recyclage de l'air.

Mode Évacuation de l'air



L'air aspiré est débarrassé des particules de graisse par les filtres à cet effet, transite par un conduit puis gagne l'extérieur.

Remarque : L'air sortant ne doit pénétrer ni dans une cheminée en service destinée à évacuer la fumée ou des gaz brûlés, ni dans une gaine servant à aérer les locaux où sont installés des foyers à combustion.

- Si l'air sortant circule par une cheminée non en service destinée à évacuer la fumée ou des gaz brûlés, il faudra vous procurer l'accord du ramoneur compétent dans votre quartier.
- Si l'air sortant traverse la paroi extérieure, il faudrait utiliser une ventouse télescopique.

Mode Recyclage de l'air



L'air aspiré se nettoie en traversant les filtres à graisse et un filtre au charbon actif, puis il revient dans la cuisine.

Remarques

- Pour lier les odeurs dans l'air recyclé, vous devrez incorporer un filtre au charbon actif. Pour connaître les différentes possibilités d'utiliser l'appareil en mode Recyclage d'air, consultez les prospectus ou votre revendeur spécialisé. Vous pourrez vous procurer les accessoires dans le commerce spécialisé, auprès du service après-vente ou dans la boutique en ligne.
- En cas d'appareils équipés d'un filtre supplémentaire à l'intérieur, seul le module de recyclage CleanAir (voir accessoires Mode recyclage) peut être utilisé.

Utilisation

Ces instructions valent pour plusieurs variantes d'appareil. Certains équipements ne figurant pas sur votre appareil peuvent y être décrits.

Remarque : Allumez la hotte aspirante dès le début de la cuisson ; une fois la cuisson achevée, laissez la hotte aspirante fonctionner encore quelques minutes. Ceci permet d'éliminer les buées de cuisson le plus efficacement.

Bandeau de commande



Explication	
	Eclairage allumer/éteindre
0,1	Ventilateur Arrêt/Puissance d'aspiration 1
2	Puissance d'aspiration 2
3	Puissance d'aspiration 3

Bandeau de commande



Explication	
	Eclairage allumer/éteindre
0	Ventilateur Arrêt
1	Puissance d'aspiration 1
2	Puissance d'aspiration 2
3	Puissance d'aspiration 3
P	Aspiration intensive

Régler le ventilateur

Enclencher

Appuyez sur la touche 1, 2 ou 3.

Eteindre

Appuyez sur la touche 0.

Aspiration intensive

Si des odeurs ou buées particulièrement fortes se dégagent, vous pouvez utiliser la vitesse intensive.

Appuyez sur la touche P.

La durée de marche est limitée. Le ventilateur passe ensuite automatiquement à une puissance d'aspiration inférieure. Vous pouvez à tout moment réduire manuellement à la puissance.

Éclairage

Vous pouvez allumer et éteindre l'éclairage indépendamment de la ventilation.

Appuyez sur la touche .

Nettoyage et entretien

⚠ Risque de brûlure !

L'appareil devient chaud pendant le fonctionnement, en particulier au niveau des ampoules. Laisser refroidir l'appareil avant de le nettoyer.

⚠ Risque de choc électrique !

De l'humidité qui pénètre peut occasionner un choc électrique. Nettoyer l'appareil uniquement avec un chiffon humide. Avant le nettoyage, retirer la fiche secteur ou déconnecter le fusible dans le boîtier à fusibles.

⚠ Risque de choc électrique !

De l'humidité qui pénètre peut occasionner un choc électrique. Ne pas utiliser de nettoyeur haute pression ou de nettoyer à vapeur.

⚠ Risque de blessure !

Des pièces à l'intérieur de l'appareil peuvent présenter des arêtes vives. Porter des gants de protection.

Nettoyants

Afin de ne pas endommager les différentes surfaces en utilisant des nettoyants inappropriés, veuillez respecter les indications dans le tableau. N'utilisez pas

- de produits agressifs ou récurants,
- de nettoyants fortement alcoolisés,
- de tampons en paille métallique ni d'éponges à dos récurant,
- de nettoyeurs haute pression ni de nettoyeurs à vapeur.

Avant d'utiliser des lavettes éponges neuves, rincez-les soigneusement.

Respectez les instructions et avertissements joints aux nettoyants.

Niveau	Nettoyants
Inox	Eau chaude additionnée de produit à vaisselle : Nettoyer avec une lavette et sécher avec un chiffon doux. Nettoyer les surfaces en inox seulement dans le sens du métal. Des produits d'entretien spéciaux pour inox sont en vente au service après-vente ou dans le commerce spécialisé. Appliquer avec un chiffon doux une pellicule mince de produit d'entretien.
Surfaces laquées	Eau chaude additionnée de produit à vaisselle : Nettoyer avec une lavette humide et sécher avec un chiffon doux. Ne pas utiliser de nettoyant pour inox.
Aluminium et plastique	Nettoyant pour vitres : Nettoyer avec un chiffon doux.
Verre	Nettoyant pour vitres : Nettoyer avec un chiffon doux. Ne pas utiliser de racloir à verre.
Eléments de commande	Eau chaude additionnée de produit à vaisselle : Nettoyer avec une lavette humide et sécher avec un chiffon doux. Risque de détérioration de l'électronique par pénétration d'humidité. Ne jamais nettoyer les éléments de commande avec un chiffon mouillé. Ne pas utiliser de nettoyant pour inox.

Nettoyer le filtre métallique à graisse

⚠ **Risque d'incendie !**

Les dépôts de graisse dans le filtre à graisse peuvent s'enflammer.

Nettoyer le filtre à graisse au moins tous les 2 mois.

Ne jamais faire fonctionner l'appareil sans filtre à graisse.

Remarques

- N'utilisez jamais de détergents agressifs, contenant de l'acide ou fortement alcalins.
- Pendant le nettoyage des filtres métalliques à graisse, nettoyez également leur fixation dans l'appareil au moyen d'un essuie-tout humide.
- Vous pouvez laver les filtres métalliques à graisse au lave-vaisselle ou à la main.

Au lave-vaisselle :

Remarque : Si le nettoyage a lieu au lave-vaisselle, de légères colorations peuvent se manifester. Ceci n'influe aucunement sur le fonctionnement des filtres métalliques à graisse.

- Ne nettoyez pas avec la vaisselle les filtres métalliques à graisse très sales.
- Posez les filtres métalliques à graisse dans le lave-vaisselle sans les coincer. Ne coincez pas les filtres métalliques à graisse.

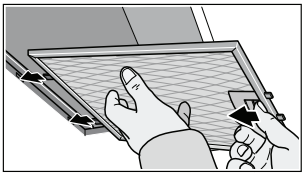
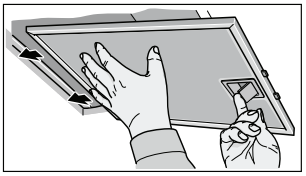
A la main :

Remarque : En présence de salissures tenaces, vous pouvez utiliser un produit dissolvant les graisses. Il est possible de le commander via la boutique en ligne.

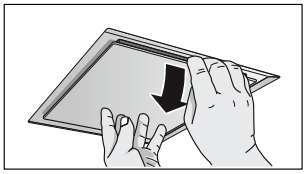
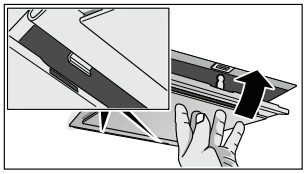
- Mettez les filtres métalliques à graisse à tremper dans de l'eau de vaisselle très chaude.
- Utilisez une brosse pour nettoyer puis rincez bien les filtres ensuite.
- Laissez les filtres métalliques à graisse s'égoutter.

Retirer le filtre métallique à graisse

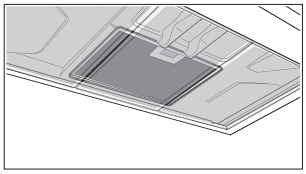
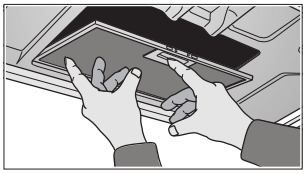
1. Ouvrez le verrouillage puis abaissez le filtre métallique à graisse. Avec l'autre main sous le filtre métallique à graisse, interceptez ce dernier.
2. Sortez le filtre métallique à graisse de sa fixation.

En cas de filtres à aspiration périphérique, tirer le filtre métallique à graisse vers le bas. Avec l'autre main sous le filtre métallique à graisse, interceptez ce dernier.

En cas de filtres supplémentaires à l'intérieur, ouvrir les verrouillages et abaisser le filtre métallique à graisse. Avec l'autre main sous le filtre métallique à graisse, interceptez ce dernier.

Remarques

- La graisse peut s'accumuler en bas dans le filtre métallique à graisse.
- Pour éviter que de la graisse ne goutte, ne tenez pas le filtre métallique à graisse en biais.

3. Nettoyer le filtre métallique à graisse.

Incorporer le filtre métallique à graisse

1. Mettre le filtre métallique à graisse en place.
   Avec l'autre main sous le filtre métallique à graisse, intercepter ce dernier.
2. Basculer le filtre métallique à graisse vers le haut puis encliqueter le verrouillage.

Anomalies – que faire ?

Dans de nombreux cas, vous pourrez remédier vous-même facilement aux anomalies. Avant de contactez le service après-vente, veuillez vérifier les points suivants :

⚠ Risque de choc électrique !

Tenter de réparer vous-même l'appareil est dangereux. Seul un technicien du service après-vente formé par nos soins est habilité à effectuer des réparations et à remplacer des câbles d'alimentation défectueux. Si l'appareil est défectueux, débrancher la fiche secteur ou enlever le fusible dans le boîtier à fusibles. Appeler le service après-vente.

Tableau de dérangements

Panne	Cause possible	Remède
L'appareil ne fonctionne pas	La fiche n'est pas connectée	Connecter l'appareil au secteur
	Panne de courant	Vérifier si d'autres appareils de cuisine fonctionnent
	Fusible défectueux	Vérifier dans le coffret à fusibles, si le fusible pour l'appareil est en bon état
L'éclairage ne fonctionne pas.	Les ampoules sont défectueuses.	Changer les ampoules, voir le chapitre “Changer les ampoules”.

Changer les ampoules

⚠ Risque de choc électrique !

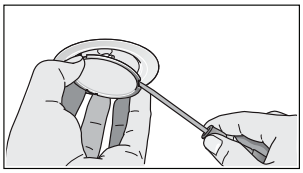
Lors du changement des ampoules, les contacts de la douille sont sous tension. Avant le changement, retirer la fiche secteur ou couper le fusible dans le boîtier à fusibles.

Important ! N’utilisez que des moyens d’éclairage du même type et de même puissance (voir le culot de l’ampoule ou la plaque signalétique à l’intérieur de l’appareil ; à cette fin, sortez le filtre métallique à graisse).

Changer les ampoules halogène

Remarque : Lorsque vous insérez les ampoules halogènes, veillez à ne pas toucher le ballon de verre. Pour insérer les ampoules halogènes, utilisez un chiffon propre.

1. Avec un outil approprié, retirez précautionneusement l’anneau de l’ampoule.
2. Extrayez l’ampoule et remplacez-la par une ampoule du même type.





3. Remettez le couvercle de l’ampoule en place.
4. Branchez la fiche mâle dans la prise de courant ou réarmez le disjoncteur.

LED

Le remplacement des LED défectueuses est exclusivement réservé au fabricant, à son service après-vente ou à un spécialiste agréé (installateur d'équipement électrique).

⚠ Risque de blessure !

La lumière des lampes LED est très éblouissante et peut causer des dommages aux yeux (groupe de risque 1). Ne pas regarder plus longtemps que 100 secondes directement les lampes LED allumées.

Service après-vente

Si votre appareil a besoin d'être réparé, notre service après-vente se tient à votre disposition. Nous trouvons toujours une solution appropriée pour éviter des visites inutiles d'un technicien.

Lors de votre appel, veuillez indiquer le numéro de produit (n° E) et le numéro de fabrication (n° FD), afin de nous permettre de mieux vous aider. Vous trouverez plaque signalétique à l'intérieur de l'appareil (après avoir déposé le filtre métallique à graisse).

Pour éviter d'avoir à les rechercher en cas de besoin, vous pouvez inscrire ici les données de votre appareil et le numéro de téléphone du service après-vente.

N° E	**N° FD**

Service après-vente☏

Tenez compte du fait que la visite d'un technicien du SAV n'est pas gratuite en cas de manipulation incorrecte, même pendant la période de garantie.

Vous trouverez les données de contact pour tous les pays dans l'annuaire ci-joint du service après-vente.

Commande de réparation et conseils en cas de dérangements

B 070 222 141
FR 01 40 10 11 00
CH 0848 840 040

Faites confiance à la compétence du fabricant. Vous garantissez ainsi que la réparation sera effectuée par des techniciens formés qui possèdent les pièces de rechange d'origine pour votre appareil.

Accessoires Mode recyclage

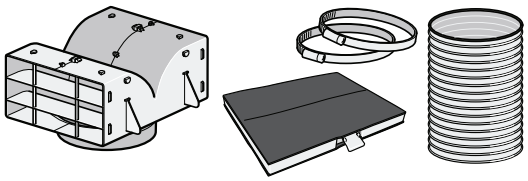
(non compris dans la fourniture)

Remarques

- Respectez les notices de montage accompagnant les accessoires.
- En cas d'appareils équipés d'un filtre supplémentaire à l'intérieur, seul le module de recyclage CleanAir peut être utilisé.

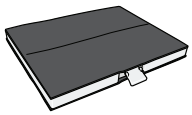
Equipement initial : Kit de démarrage pour le mode recyclage-étroit

1



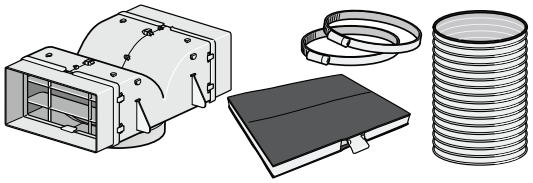
Changement du filtre

2



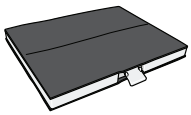
Equipement initial : Kit de démarrage pour le mode recyclage - large

3



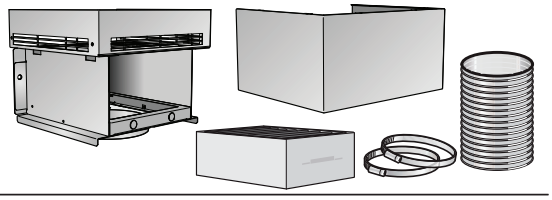
Changement du filtre

4



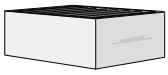
Equipement initial : Module de recyclage CleanAir - étroit

5



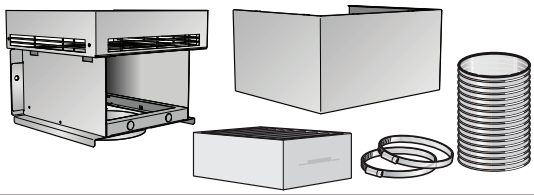
Changement du filtre

6



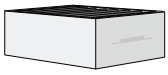
Equipement initial : Module de recyclage CleanAir - large

7



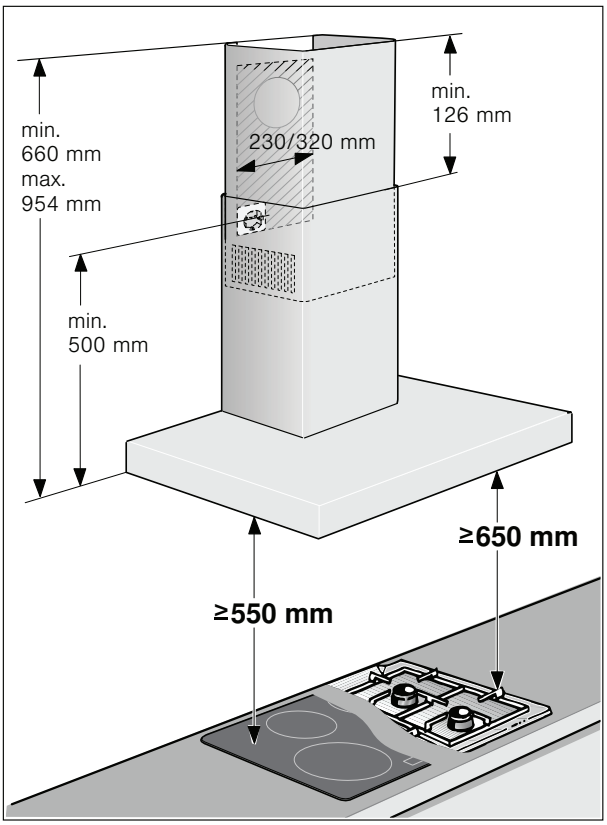
Changement du filtre

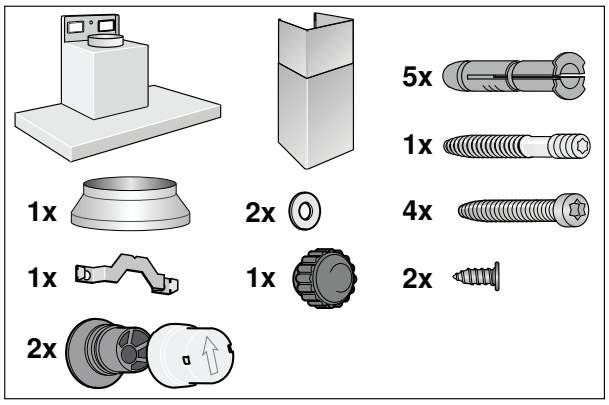
8



1	DHZ5325 Largeur de conduit 260 mm
2	DHZ5326 Largeur de conduit 260 mm
3	DHZ5345 Largeur de conduit 345 mm
4	DHZ5346 Largeur de conduit 345 mm
5	DSZ6200 Largeur de conduit 260 mm
6	DSZ5201 Largeur de conduit 260 mm
7	DSZ6240 Largeur de conduit 345 mm
8	DSZ5201 Largeur de conduit 345 mm

NOTICE DE MONTAGE





- Cet appareil s'installe contre un mur.
- Accessoires spéciaux (p.ex. pour le mode Recyclage de l'air) : tenez compte de la notice d'installation les accompagnant.
- Les surfaces de l'appareil craignent. Lors de l'installation, évitez de les endommager.

⚠ Précautions de sécurité importantes

Lire attentivement ce manuel. Ce n'est qu'alors que vous pourrez utiliser votre appareil correctement et en toute sécurité. Conserver la notice d'utilisation et de montage pour un usage ultérieur ou pour le propriétaire suivant.

La sécurité de l'appareil à l'usage est garantie s'il a été encastré conformément à la notice de montage. Le monteur est responsable du fonctionnement correct sur le lieu où l'appareil est installé.

La largeur de la hotte aspirante doit équivaloir à celle de la table de cuisson.

L'installation doit avoir lieu en respectant les prescriptions actuellement en vigueur dans le bâtiment, ainsi que les prescriptions publiées par les compagnies distributrices d'électricité et de gaz.

Le mode d'évacuation de l'air vicié devra être conforme aux arrêtés municipaux, préfectoraux, et aux prescriptions légales (par ex. aux ordonnances publiques applicables au bâtiment).

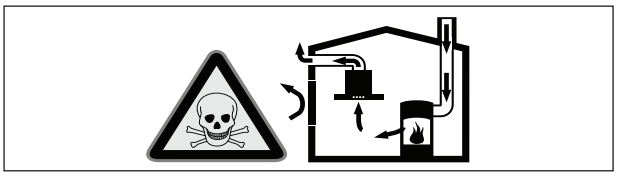
Danger de mort !

Il y a risque d'intoxication par réaspiration des gaz de combustion. L'air sortant ne doit pénétrer ni dans une cheminée en service destinée à évacuer la fumée ou des gaz brûlés, ni dans une gaine servant à aérer les locaux où sont installés des foyers à combustion. Si l'air sortant circule par une cheminée non en service destinée à évacuer la fumée ou des gaz brûlés, il faudra vous procurer l'accord du ramoneur compétent dans votre quartier.

Danger de mort !

Il y a risque d'intoxication par réaspiration des gaz de combustion.

En cas d'utilisation simultanée de l'appareil en mode évacuation de l'air et d'un foyer à combustion alimenté en air ambiant, veillez impérativement à ce que l'apport d'air soit suffisant.

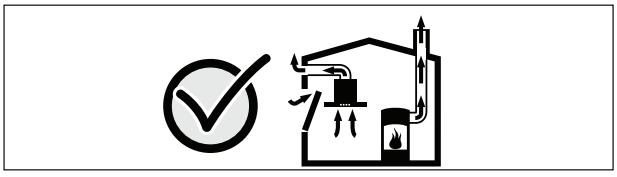


Les foyers à combustion alimentés en air ambiant (par exemple appareils de chauffage, au gaz, au bois, au fioul ou au charbon, les chauffe-eau, chauffe-eau accumulateurs) prélèvent l'air de combustion dans la pièce où ils sont installés et rejettent les gaz de fumée à l'extérieur par le biais d'un système spécifique (cheminée par exemple).

Lorsque la hotte aspirante est en marche, elle prélève de l'air dans la cuisine et dans les pièces voisines ; si l'apport d'air frais est trop faible, une dépression se forme. Des gaz toxiques provenant de la cheminée ou du conduit d'évacuation sont réaspirés dans les pièces d'habitation.

- Il faut donc toujours s'assurer que l'apport d'air frais est suffisant
- La présence d'une ventouse télescopique d'apport et d'évacuation d'air ne suffit pas à assurer le respect de la valeur limite.

Le fonctionnement sûr de l'appareil n'est possible que si la dépression dans la pièce où est installé le foyer ne dépasse pas 4 Pa (0,04 mbar). On y parvient en présence d'ouvertures non obturables ménagées par ex. dans les portes, fenêtres et en association avec des ventouses télescopiques d'admission/évacuation de l'air à travers la maçonnerie ou par d'autres mesures techniques permettant à l'air d'affluer pour assurer la combustion.



Demandez toujours conseil au maître ramoneur compétent qui pourra évaluer l'ensemble du réseau de ventilation de la maison et vous proposer le moyen le mieux adapté pour l'aération.

Si la hotte aspirante est utilisée exclusivement en mode recyclage, le fonctionnement est possible sans restrictions.

Danger de mort !

Il y a risque d'intoxication par réaspiration des gaz de combustion. Lors de l'installation d'une ventilation avec un foyer relié à une cheminée, l'alimentation électrique de la hotte doit être munie d'un circuit de sécurité approprié.

Risque d'incendie !

Les dépôts de graisse dans le filtre à graisse peuvent s'enflammer. Les distances de sécurité indiquées doivent être respectées, afin d'éviter une accumulation de chaleur. Veuillez respecter les indications relatives à votre appareil de cuisson. Si votre table de cuisson combine des foyers gaz et électrique, l'écart maximal s'applique.

Il est permis de monter l'appareil avec un seul coté directement à côté d'un meuble haut ou près d'un mur haut. La distance vers la paroi ou le meuble haut doit être d'au moins 50 mm.

Risque de blessure !

- Des pièces à l'intérieur de l'appareil peuvent présenter des arêtes vives. Porter des gants de protection.
- Si l'appareil n'est pas correctement fixé, il peut tomber. Tous les éléments de fixation doivent être montés solidement et de façon sûre.
- L'appareil est lourd. 2 personnes sont nécessaires pour déplacer l'appareil. Utiliser exclusivement des moyens appropriés.

Risque de choc électrique !

Des pièces à l'intérieur de l'appareil peuvent présenter des arêtes vives. Il y a risque d'endommagement du câble d'alimentation. Pendant l'installation, veiller à ne pas plier ni coincer le câble d'alimentation.

Risque d'électrocution !

A tout moment il doit être possible de séparer l'appareil du réseau électrique. L'appareil doit être raccordé impérativement à une prise de courant de sécurité installée de manière réglementaire. Si la prise n'est plus accessible après montage ou si un raccordement en fixe est indispensable, il faut prévoir côté secteur un dispositif de coupure omnipolaire avec un écartement des contacts d'au moins 3 mm. Le raccordement est exclusivement réservé à un électricien qualifié.

Risque d'asphyxie !

Le matériel d'emballage est dangereux pour les enfants. Ne permettez jamais aux enfants de jouer avec les matériaux d'emballage.

Consignes générales

Mode Évacuation de l'air

⚠ Danger de mort !

Il y a risque d'intoxication par réaspiration des gaz de combustion. L'air sortant ne doit pénétrer ni dans une cheminée en service destinée à évacuer la fumée ou des gaz brûlés, ni dans une gaine servant à aérer les locaux où sont installés des foyers à combustion. Si l'air sortant circule par une cheminée non en service destinée à évacuer la fumée ou des gaz brûlés, il faudra vous procurer l'accord du ramoneur compétent dans votre quartier.

Si l'air sortant traverse la paroi extérieure, il faudrait utiliser une ventouse télescopique.

Conduit d'évacuation

Remarque : Le fabricant de l'appareil décline toute garantie pour les problèmes de fonctionnement liés à la tuyauterie.

- L'appareil atteint un rendement d'autant meilleur que le tuyau d'évacuation est court et droit et que son diamètre est grand.
- Si les tuyaux d'évacuation sont longs, présentent de nombreux coudes ou ont un diamètre inférieur à 150 mm, la puissance maximale d'aspiration ne sera pas atteinte et le ventilateur fera plus de bruit.
- Les tuyaux rigides ou souples constituant le conduit d'évacuation doivent être fabriqués dans un matériau non inflammable.

Conduits de section ronde

Nous recommandons un diamètre intérieur de 150 mm, mais d'au moins 120 mm.

Conduits plats

La section intérieure doit être équivalente au diamètre des conduits ronds.

Ø 150 mm environ 177 cm²
Ø 120 mm environ 113 cm²

- Les conduits plats ne doivent pas présenter aucun coude prononcé.
- Si des tuyaux de plusieurs diamètres sont utilisés, il faut prévoir du ruban adhésif à étancher.

Vérifier le mur

- Le mur doit être plat, vertical et offrir une portance suffisante.
- La profondeur des trous percés doit être adaptée à la longueur des vis. Les chevilles doivent offrir une retenue sûre.
- Les vis et chevilles ci-jointes conviennent pour la maçonnerie massive. En présence d'autres matériaux de construction (p. ex. le Rigips, le béton cellulaire, les briques Poroton), il faut utiliser des moyens de fixation correspondants.
- La hotte aspirante pèse **40 kg** max.

Branchement électrique

⚠ Risque de choc électrique !

Des pièces à l'intérieur de l'appareil peuvent présenter des arêtes vives. Il y a risque d'endommagement du câble d'alimentation. Pendant l'installation, veiller à ne pas plier ni coincer le câble d'alimentation.

Les données de raccordement nécessaires se trouvent sur la plaque signalétique dans le compartiment intérieur de l'appareil (pour ce faire, retirez le filtre métallique à graisse).

Longueur du câble de branchement : env. 1,30 m
Cet appareil est conforme aux dispositions CE régissant l'antiparasitage.

⚠ Risque d'électrocution !

A tout moment il doit être possible de séparer l'appareil du réseau électrique. L'appareil doit être raccordé impérativement à une prise de courant de sécurité installée de manière réglementaire. Si la prise n'est plus accessible après montage ou si un raccordement en fixe est indispensable, il faut prévoir côté secteur un dispositif de coupure omnipolaire avec un écartement des contacts d'au moins 3 mm. Le raccordement est exclusivement réservé à un électricien qualifié.

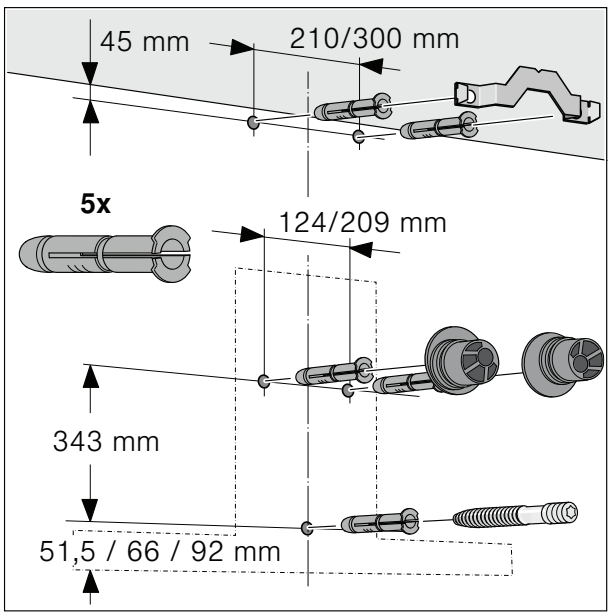
Installation

Préparer l'installation

Attention !

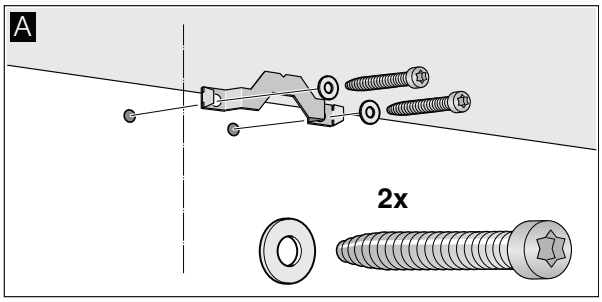
Veillez à ce qu'il n'y ait pas de conduites électriques, de tuyaux de gaz ou d'eau au niveau des perçages.

1. Du plafond au bord inférieur de la hotte aspirante, tracez une ligne médiane verticale sur le mur.
2. Marquez les emplacements des vis et le contour de la zone d'accrochage.
3. Pour les fixations, percez cinq trous de 8 mm de Ø et profonds de 80 mm, puis enfoncez les chevilles jusqu'au ras du mur.

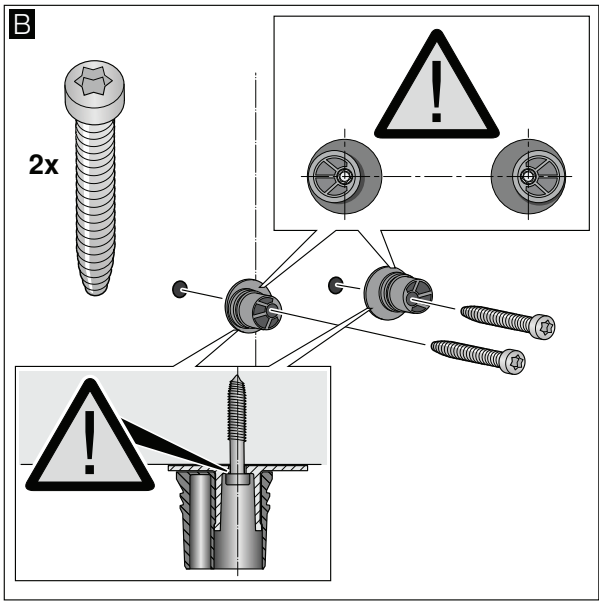


Installation

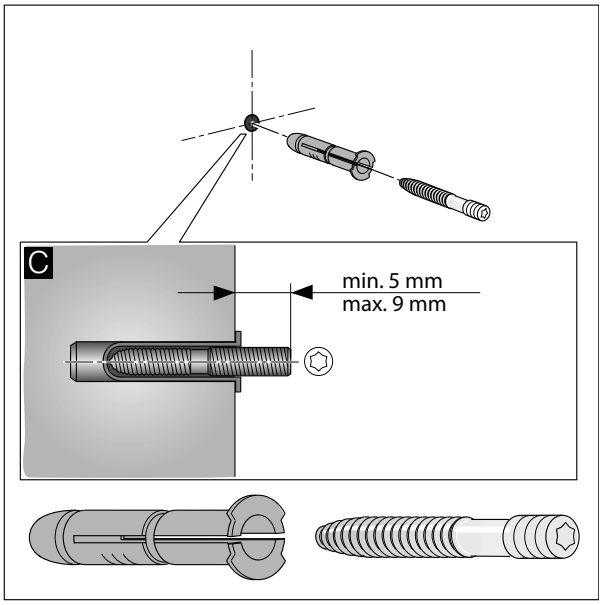
1. Vissez la cornière affectée au capot de cheminée. A



2. Vissez les moyens d'accrochage de la hotte aspirante à la main seulement, à un couple de . **3 Nm** max. B



3. Vissez le boulon fileté de sorte qu'il dépasse encore **5 - 9 mm** du mur. C

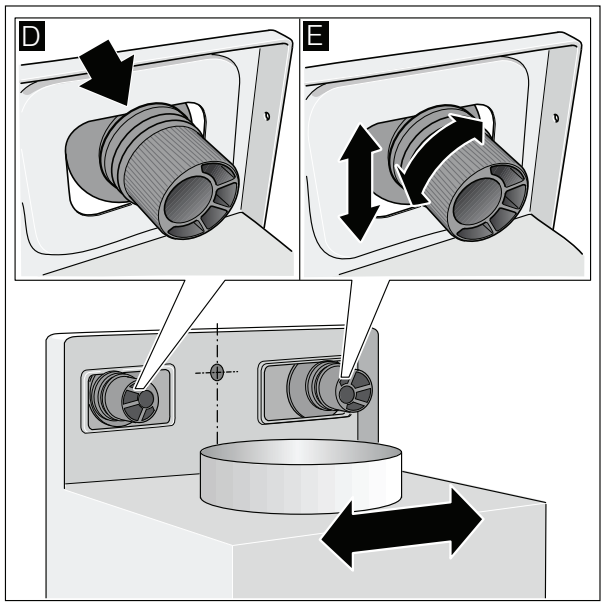


Accrocher et aligner l'appareil

1. Retirez la pellicule protectrice d'abord du dos de la hotte, puis intégralement une fois le montage achevé.

2. Accrochez l'appareil de sorte qu'il encrante fermement contre les moyens d'accrochage. D

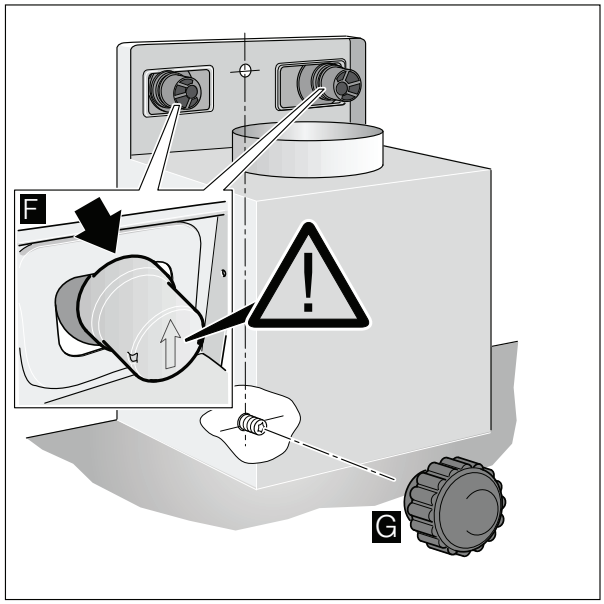
3. Tournez les moyens d'accrochage pour ajuster l'horizontalité de l'appareil. Si nécessaire, il est possible de déplacer l'appareil vers la droite ou la gauche. E



Fixer l'appareil

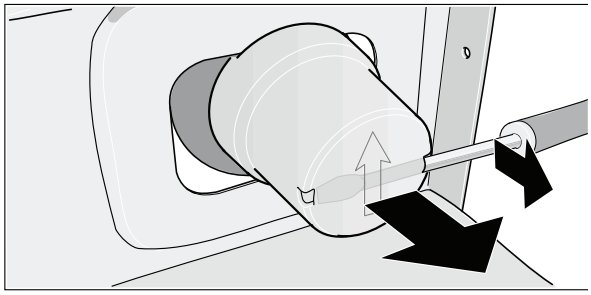
1. Sur les moyens d'accrochage, enfoncez les capuchons de sécurisation jusqu'à ce qu'ils encrantent et en veillant à ce que la flèche pointe vers le haut. F

2. Vissez la vis moletée avec rondelle intercalaire. G



Enlever les capuchons de sécurisation

S'il faut enlever les capuchons de sécurité, utilisez un tournevis à pane plate.



Fixer les jonctions des conduits

Remarque : Si vous utilisez un conduit en aluminium, lissez préalablement la zone de raccordement.

Conduit d'évacuation Ø 150 mm (diamètre recommandé)

Fixez le conduit d'évacuation directement contre le manchon puis étanchez.

Conduit d'évacuation Ø 120 mm

1. Fixez le manchon réducteur directement contre le manchon d'évacuation.
2. Fixez le conduit d'évacuation contre le manchon réducteur.
3. Étanchez les deux zones de jonction avec un moyen approprié.

Monter le capot de cheminée

⚠ **Risque de blessure !**

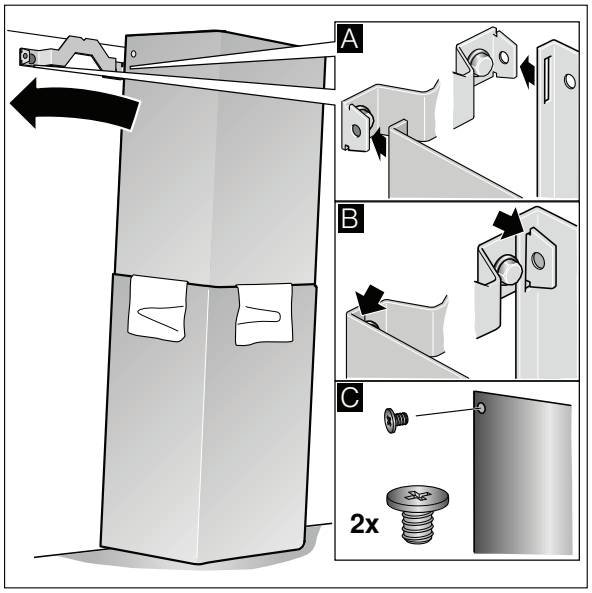
pendant l'installation à cause des arêtes vives. Pendant l'installation de l'appareil, toujours porter des gants de protection.

1. Séparez les capots de cheminée.
   Pour ce faire, retirez le ruban adhésif
2. Retirez les films protecteurs recouvrant les deux capots de cheminée.
3. Faites coulisser les capots de cheminée l'un dans l'autre.

Remarques

- Pour éviter les rayures, posez du papier, à titre de protection, sur les bords du capot extérieur.
- Les ouïes du capot intérieur de cheminée regardent vers le bas.

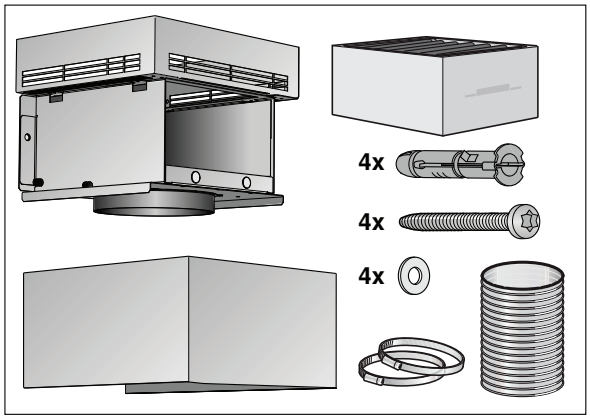
4. Posez les capots de cheminée sur l'appareil.
5. Poussez le capot de cheminée intérieur vers le haut et accrochez-le sur les côtés gauche et droit contre la cornière de retenue. A
6. Faites encranter le capot de cheminée vers le bas. B
7. A l'aide de deux vis, vissez le capot de cheminée latéralement contre la cornière de retenue. C



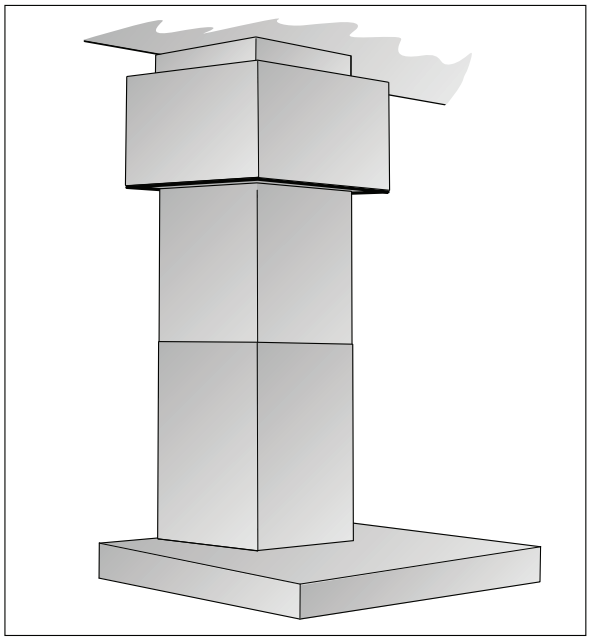
Robert Bosch Hausgeräte GmbH
Carl-Wery-Straße 34
81739 München
Germany
www.bosch-home.com

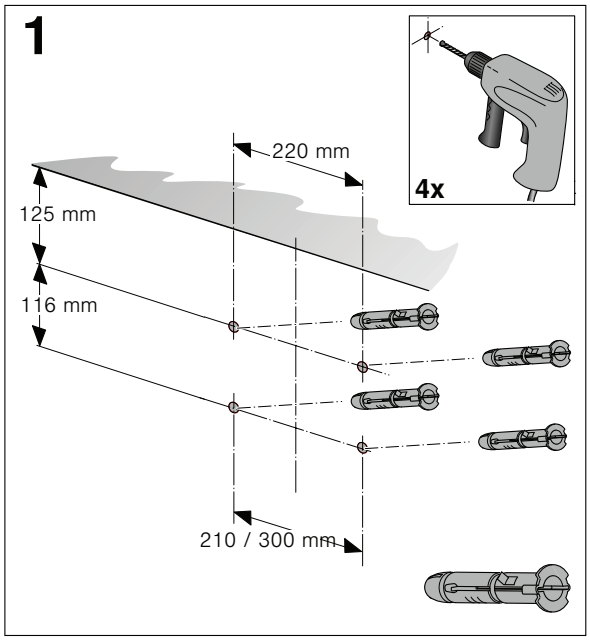
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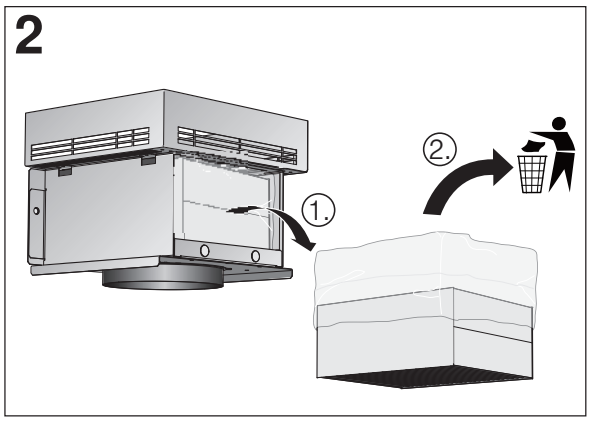
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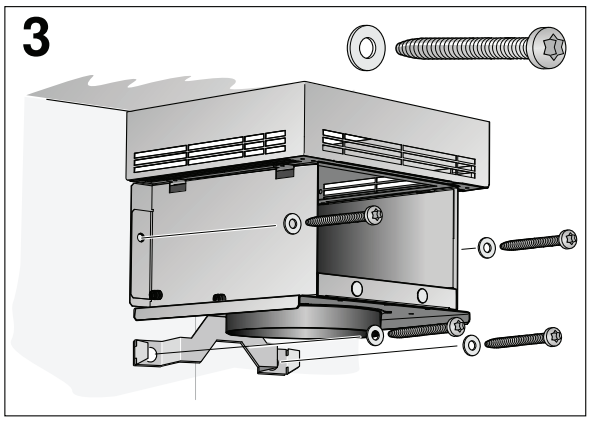


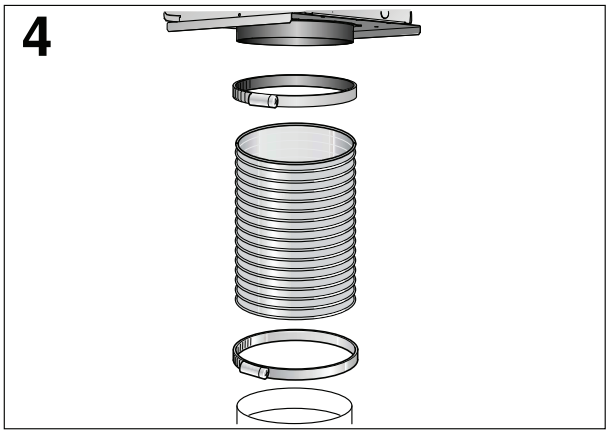
de **Montageanleitung**
en **Installation instructions**
fr **Notice de montage**
it **Istruzioni per il montaggio**
nl **Installatievoorschrift**
es **Instrucciones de montaje**
pt **Instruções de montagem**
el **Οδηγίες εγκατάστασης**
sv **Monteringsanvisning**
no **Monteringsveiledning**
fi **Asennusohje**
da **Monteringsvejledning**
ru **Инструкция по монтажу**
pl **Instrukcja montażu**
tr **Montaj kılavuzu**

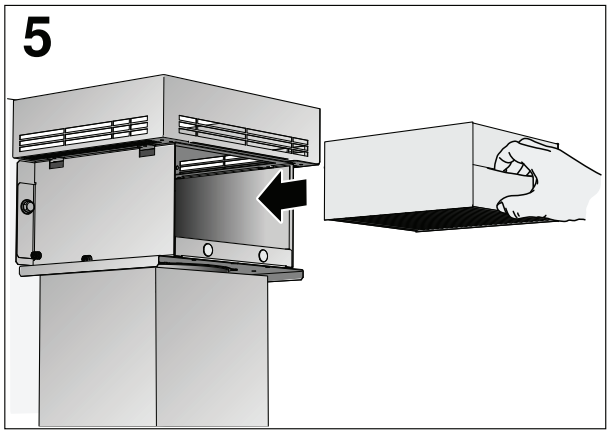


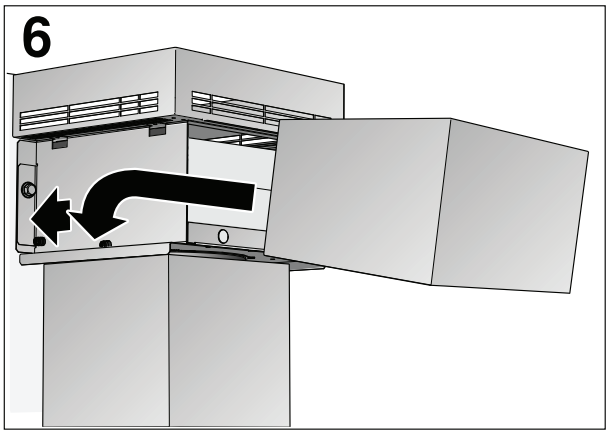












de

Diese Anleitung sorgfältig lesen. Nur dann können Sie Ihr Gerät sicher und richtig bedienen. Die Gebrauchs- und Montageanleitung für einen späteren Gebrauch oder für Nachbesitzer aufbewahren.

Nur bei fachgerechtem Einbau entsprechend der Montageanleitung ist die Sicherheit beim Gebrauch gewährleistet. Der Installateur ist für das einwandfreie Funktionieren am Aufstellungsort verantwortlich.

⚠ Verletzungsgefahr!

Ist das Gerät nicht ordnungsgemäß befestigt, kann es herabfallen. Alle Befestigungselemente müssen fest und sicher montiert werden.

⚠ Stromschlaggefahr!

Bauteile innerhalb des Gerätes können scharfkantig sein. Das Anschlusskabel kann beschädigt werden. Anschlusskabel während der Installation nicht knicken oder einklemmen.

⚠ Verletzungsgefahr!

Bauteile innerhalb des Gerätes können scharfkantig sein. Schutzhandschuhe tragen.

⚠ Erstickungsgefahr!

Verpackungsmaterial ist für Kinder gefährlich. Kinder nie mit Verpackungsmaterial spielen lassen.

Installation

Achtung!

Stellen Sie sicher, dass sich im Bereich der Bohrungen keine Stromleitungen, Gas- oder Wasserrohre befinden.

- Positionen für die Schrauben und die Kontur des Einhängebereichs anzeichnen.
  Löcher mit Ø 8 mm und Bohrtiefe 80 mm bohren und die Dübel wandbündig eindrücken - Bild 1.
- Aktivkohlefilter herausnehmen und die Folie entfernen - Bild 2.
- Das Umluftmodul und den Haltewinkel für die Kaminverblendung anschrauben - Bild 3.
- Schlauch mit den zwei Rohrschellen am Umluftmodul und am Luftstutzen der Dunstabzugshaube befestigen.
  Schlauch muss straff sein, bei Bedarf kürzen - Bild 4.
- Kaminverblendung montieren (siehe „Montageanleitung der Dunstabzugshaube“).
  Schlitze der inneren Kaminverblendung nach unten.
- Aktivkohlefilter einsetzen - Bild 5.
- Die Blende schräg ansetzen, leicht nach oben drücken und nach hinten schieben. Die Aussparungen an der Blende müssen dabei über die Sicherungsbolzen geführt werden - Bild 6.

Aktivkohlefilter für Umluftbetrieb

Aktivkohlefilter binden die Geruchsstoffe im Umluftbetrieb. Wechseln Sie den Aktivkohlefilter bei normalem Betrieb (täglich 1 bis 2 Stunden) 1x im Jahr aus.

Hinweis: Aktivkohlefilter enthalten keine Schadstoffe und können im Hausmüll entsorgt werden.

en

Important safety information

Read these instructions carefully. Only then will you be able to operate your appliance safely and correctly. Retain the instruction manual and installation instructions for future use or for subsequent owners.

The appliance can only be used safely if it is correctly installed according to the safety instructions. The installer is responsible for ensuring that the appliance works perfectly at its installation location.

⚠ Risk of injury!

The appliance may fall down if it has not been properly fastened in place. All fastening components must be fixed firmly and securely.

⚠ Risk of electric shock!

Components inside the appliance may have sharp edges. These may damage the connecting cable. Do not kink or pinch the connecting cable during installation.

⚠ Risk of injury!

Components inside the appliance may have sharp edges. Wear protective gloves.

⚠ Danger of suffocation!

Packaging material is dangerous to children. Never allow children to play with packaging material.

Installation

Caution!

Ensure that there are no electric wires, gas or water pipes in the area where holes are to be made.

- Mark positions for the screws and the contour of the attachment area.

  Drill 8 mm Ø holes to a depth of 80 mm and press the wall plugs flush with the wall – Fig. 1.
- Remove the activated carbon filter and the foil – Fig. 2.
- Screw on the recirculation module and fixing bracket for the flue duct – Fig. 3.
- Fix the hose with the two pipe brackets to the recirculation module and the air-pipe connector for the extractor hood.

  The hose must be taut, shorten it if necessary – Fig. 4.
- Fit the flue duct (see “Installation instructions for the extractor hood”).

  The slots of the inner flue duct point downwards.
- Insert the activated carbon filter – Fig. 5.
- Position the panel diagonally, gently push it upwards and backwards. The panel must be recessed using the safety bolts – Fig. 6.

Activated charcoal filter for circulating-air mode

Activated charcoal filters bind odorous substances in circulating-air mode. For normal operation (1 to 2 hours daily), change the activated charcoal filter once a year.

Note: Activated charcoal filters do not contain any toxic substances and can be discarded along with household waste.

fr

Précautions de sécurité importantes

Lire attentivement ce manuel. Ce n'est qu'alors que vous pourrez utiliser votre appareil correctement et en toute sécurité. Conserver la notice d'utilisation et de montage pour un usage ultérieur ou pour le propriétaire suivant.

La sécurité de l’appareil à l’usage est garantie s’il a été encastré conformément à la notice de montage. Le monteur est responsable du fonctionnement correct sur le lieu où l'appareil est installé.

⚠ Risque de blessure !

Si l'appareil n'est pas correctement fixé, il peut tomber. Tous les éléments de fixation doivent être montés solidement et de façon sûre.

⚠ Risque de choc électrique !

Des pièces à l'intérieur de l'appareil peuvent présenter des arêtes vives. Il y a risque d'endommagement du câble d'alimentation. Pendant l’installation, veiller à ne pas plier ni coincer le câble d’alimentation.

⚠ Risque de blessure !

Des pièces à l'intérieur de l'appareil peuvent présenter des arêtes vives. Porter des gants de protection.

⚠ Risque d'asphyxie !

Le matériel d'emballage est dangereux pour les enfants. Ne permettez jamais aux enfants de jouer avec les matériaux d’emballage.

Installation

Attention !

Veillez à ce qu'il n'y ait pas de conduites électriques, de tuyaux de gaz ou d'eau au niveau des perçages.

- Marquer les emplacements des vis et le contour de la zone d’accrochage.

  Percer des trous de Ø 8 mm et d'une profondeur de 80 mm et enfoncer les chevilles à fleur du mur - fig. 1.
- Retirer le filtre à charbon actif et enlever le film - fig. 2.
- Visser le module de recyclage et la cornière pour le capot de cheminée - fig. 3.
- Fixez le flexible avec les deux colliers au module de recyclage et au manchon d'air de la hotte.

  Le flexible doit être tendu, le raccourcir si nécessaire - fig. 4.
- Monter les capots de cheminée (voir « Notice de montage de la hotte aspirante »).

  Les ouïes du capot intérieur de cheminée regardent vers le bas.
- Mettre en place le filtre à charbon actif - fig. 5.
- Positionner le capot en l'inclinant, l'appuyer légèrement vers le haut et le pousser vers l'arrière. Ce faisant, passer les évidements du capot par-dessus les axes de sécurité - fig. 6.

Filtre à charbon actif pour le mode recyclage

Les filtres à charbon actif retiennent les substances lorsque la hotte recycle l'air. Changez le filtre à charbon actif 1 fois par an pour une hotte fonctionnant normalement (1 à 2 heures par jour).

Remarque : Les filtres à charbon actif ne contiennent aucune substance nocive et peuvent être mis à la poubelle des ordures ménagères.

it

Importanti avvertenze di sicurezza

Leggere attentamente le presenti istruzioni per l'uso. Solo così è possibile utilizzare l'apparecchio in modo sicuro e corretto. Custodire con la massima cura le presenti istruzioni per l'uso e il montaggio in caso di un utilizzo futuro o cessione a terzi.

La sicurezza di utilizzo è garantita solo in caso di installazione secondo le regole di buona tecnica riportate nelle istruzioni di montaggio. L'installatore è responsabile del corretto funzionamento nel luogo di installazione.

⚠ Pericolo di lesioni!

Se l'apparecchio non viene fissato correttamente può cadere. Tutti gli elementi di fissaggio devono essere montati in modo saldo e sicuro.

⚠ Pericolo di scossa elettrica!

Alcuni componenti all'interno dell'apparecchio possono essere affilati. Potrebbe venire danneggiato il cavo di collegamento. Durante l’installazione, fare attenzione a non piegare o serrare il cavo di collegamento.

⚠ Pericolo di lesioni!

Alcuni componenti all'interno dell'apparecchio possono essere affilati. Indossare guanti protettivi.

⚠ Pericolo di soffocamento!

Il materiale d'imballaggio è pericoloso per i bambini. Non lasciare mai che i bambini giochino con il materiale di imballaggio.

Installazione

Attenzione!

Accertarsi che nell'area dei fori non siano presenti cavi elettrici né condutture del gas o dell'acqua.

- Tracciare le posizioni delle viti e il profilo dell’area di aggancio.

  Praticare fori con Ø 8 mm e una profondità di 80 mm e inserire i tasselli a filo del muro - figura 1.
- Estrarre il filtro a carboni attivi ed eliminare la pellicola - figura 2.
- Avvitare il modulo di ventilazione e la staffa di supporto per il rivestimento del camino - figura 3.
- Fissare il tubo flessibile con i due collari serratubo al modulo di ventilazione e al manicotto dell’aria della cappa di aspirazione.

  Il tubo flessibile deve essere teso, accorciarlo se necessario - figura 4.

- Montaggio del rivestimento interno (vedere “Istruzioni di montaggio della cappa di aspirazione”).
  Le fessure del rivestimento interno del camino devono essere rivolte verso il basso.
- Inserire un filtro a carboni attivi - figura 5.
- Inserire obliquamente il pannello, premere leggermente verso l'alto e spingere verso la parte posteriore. Le fessure sul pannello devono inserirsi sui perni di sicurezza - figura 6.

Filtro a carboni attivi per modalità ricircolo

Il filtro a carboni cattura gli odori nell'esercizio a ricircolo. In presenza di funzionamento standard (da 1 a 2 ore al giorno) sostituire il filtro a carboni attivi 1 volta all'anno.

Avvertenza: I filtri a carboni attivi non contengono sostanze dannose e possono essere smaltiti con i normali rifiuti domestici.

nl

Belangrijke veiligheidsvoorschriften

Lees deze gebruiksaanwijzing zorgvuldig door. Alleen dan kunt u uw apparaat goed en veilig bedienen. Bewaar de gebruiksaanwijzing voor later gebruik of om door te geven aan een volgende eigenaar.

De veiligheid is alleen gewaarborgd bij een deskundige montage volgens de montagehandleiding. De installateur is verantwoordelijk voor een goede werking op de plaats van opstelling.

⚠ Risico van letsel!

Is het toestel niet naar behoren bevestigd, dan kan het naar beneden vallen. Alle bevestigingsschroeven moeten vast en veilig worden gemonteerd.

⚠ Gevaar van een elektrische schok!

Bepaalde onderdelen in het toestel kunnen scherpe randen hebben. Hierdoor kan de aansluitkabel beschadigd raken. Aansluitkabel niet knikken of afklemmen bij de installatie.

⚠ Risico van letsel!

Bepaalde onderdelen in het toestel kunnen scherpe randen hebben. Veiligheidshandschoenen dragen.

⚠ Verstikkingsgevaar!

Verpakkingsmateriaal is gevaarlijk voor kinderen. Kinderen nooit met verpakkingsmateriaal laten spelen.

Installatie

Attentie!

Zorg ervoor dat zich in het gebied van de openingen geen stroom-, gas- of waterleidingen bevinden.

- Posities voor de schroeven en de omtrek van het inhanggebied markeren.
  Gaten met Ø 8 mm en boordiepte 80 mm boren en de pluggen hier helemaal indrukken - Afb. 1.
- Actief koolfilter uitnemen en de folie verwijderen - Afb. 2.
- Het circulatiemodel en de bevestigingshoek voor het schoorsteenafschermstuk vastschroeven - Afb. 3.
- Slang met de twee bevestigingsringen aan het circulatiemodel en het luchtaansluitstuk van de afzuigkap vastmaken.
  Slang moet strak gespannen zijn, zo nodig inkorten - Afb. 4.
- Schoorsteenafschermstuk monteren (zie „Installatievoorschrift bij de afzuigkap“).
  Sleuven van het binnenste schoorsteenafschermstuk naar beneden.
- Actief koolfilter inbrengen - Afb. 5.
- Het afschermstuk er schuin tegenaan zetten, licht naar boven drukken en naar achteren schuiven. De uitsparingen van het afschermstuk moeten hierbij over veiligheidsbouten worden geleid - Afb. 6.

Actief koolfilter voor tijdens de circulatie

Actief koolfilters binden de reukstoffen tijdens de circulatie. Vervang de actief koolfilter bij normaal gebruik (dagelijks 1 tot 2 uur) 1x per jaar.

Aanwijzing: Actief koolfilters bevatten geen schadelijke stoffen en kunnen met het huisvuil worden afgevoerd.

es

Indicaciones de seguridad importantes

Leer con atención las siguientes instrucciones. Solo así se puede manejar el aparato de forma correcta y segura. Conservar las instrucciones de uso y montaje para utilizarlas más adelante o para posibles futuros compradores.

Solamente un montaje profesional conforme a las instrucciones de montaje puede garantizar un uso seguro del aparato. El instalador es responsable del funcionamiento perfecto en el lugar de instalación.

⚠ ¡Peligro de lesiones!

Si el aparato no está fijado correctamente, puede caerse. Todos los elementos de fijación deben montarse debidamente.

⚠ ¡Peligro de descarga eléctrica!

Las piezas internas del aparato pueden tener bordes afilados. El cable de conexión podría resultar dañado. No doblar ni aprisionar el cable de conexión durante la instalación.

⚠ ¡Peligro de lesiones!

Las piezas internas del aparato pueden tener bordes afilados. Usar guantes protectores.

⚠ ¡Peligro de asfixia!

El material de embalaje es peligroso para los niños. No dejar que los niños jueguen con el material de embalaje.

Instalación

¡Atención!

Asegurarse de que no haya cables eléctricos o tuberías de gas o agua en el área donde se va a taladrar.

- Dibujar las posiciones para los tornillos y el contorno de la zona de enganche.
  Taladrar orificios con un diámetro de 8 mm y una profundidad de 80 mm e introducir los tacos de manera que queden enrasados con la pared - Figura 1.
- Extraer el filtro de carbón activo y retirar el plástico - Figura 2.
- Atornillar el módulo de circulación de aire y la escuadra de sujeción para el revestimiento de la chimenea - Figura 3.
- Fijar el tubo con las dos abrazaderas de tubo al módulo de circulación de aire y a la salida de aire de la campana extractora.
  El tubo debe quedar estirado, acortarlo en caso necesario - Figura 4.
- Montar el revestimiento de la campana (véase "Instrucciones de montaje de la campana extractora“).
  Ranuras del revestimiento interior de la campana hacia abajo.
- Colocar el filtro de carbono activo - Figura 5.
- Colocar la moldura en posición inclinada, presionar ligeramente hacia arriba y tirar hacia abajo. Las ranuras de la moldura deben pasarse así sobre los pernos de seguridad - Figura 6.

Filtro de carbono activo para el funcionamiento con recirculación de aire

Los filtros de carbono activo absorben los olores en el funcionamiento con recirculación de aire. Cambiar el filtro de carbono activo en funcionamiento normal (entre 1 y 2 horas diarias) una vez al año.

Nota: Los filtros de carbono activo no contienen sustancias nocivas y se pueden desechar junto con los residuos del hogar.

pt

Instruções de segurança importantes

Leia atentamente o presente manual. Só assim poderá utilizar o seu aparelho de forma segura e correcta. Guarde as instruções de utilização e montagem para consultas futuras ou para futuros utilizadores.

Só com uma montagem especializada e em conformidade com as instruções de montagem, pode ser garantida a segurança durante a utilização. O instalador é responsável pelo funcionamento correto no local de montagem.

⚠ Perigo de ferimentos!

O aparelho pode cair se não estiver corretamente fixado. Todos os elementos de fixação têm de ser montados de forma fixa e segura.

⚠ Perigo de choque elétrico!
Os componentes interiores do aparelho podem ter arestas vivas. O cabo de ligação pode ficar danificado. Não dobrar nem entalar o cabo elétrico durante a instalação.

⚠ Perigo de ferimentos!
Os componentes interiores do aparelho podem ter arestas vivas. Use luvas de proteção.

⚠ Perigo de asfixia!
O material de embalagem é perigoso para as crianças. Nunca deixe as crianças brincarem com o material de embalagem.

Instalação

Atenção!
Certifique-se de que não existem cabos elétricos, tubos de gás ou de água na zona dos furos.

- Marcar as posições para os parafusos e o contorno da zona de suspensão.
  Fazer furos com Ø de 8 mm e 80 mm de profundidade, e introduzir as buchas niveladas com a parede - Figura 1.
- Retirar o filtro de carvão ativo e remover a película - Figura 2.
- Aparafusar o módulo de circulação de ar e o esquadro de fixação para o painel decorativo da chaminé - Figura 3.
- Fixar a mangueira com as duas braçadeiras no módulo de circulação de ar e na manga de ar do exaustor.
  A mangueira deve estar esticada, cortar se necessário - Figura 4.
- Montar o painel decorativo da chaminé (ver "Instruções de montagem do exaustor").
  Apontar os entalhes do painel decorativo interior para baixo.
- Montar o filtro de carvão ativo - Figura 5.
- Montar a aba inclinada, premir levemente para cima e empurrar para trás. Os rebaixos do friso decorativo devem ser alinhados por cima dos pinos de segurança - Figura 6.

Filtro de carvão ativo para funcionamento com circulação de ar

Os filtros de carvão ativo eliminam os odores no funcionamento com circulação de ar. Com utilização normal (diária de 1 a 2 horas) substitua os filtros de carvão ativo 1x por ano.

Nota: Os filtros de carvão ativo não contêm substâncias nocivas e podem ser eliminados no lixo comum.

el

Σημαντικές υποδείξεις ασφαλείας

Διαβάστε προσεκτικά αυτές τις οδηγίες. Μόνο τότε μπορείτε να χειριστείτε τη συσκευή σίγουρα και σωστά. Φυλάξτε τις οδηγίες χρήσης και συναρμολόγησης για μια αργότερη χρήση ή για τον επόμενο ιδιοκτήτη.

Μόνο με τη σωστή εγκατάσταση σύμφωνα με τις οδηγίες τοποθέτησης εξασφαλίζεται η ασφάλεια κατά τη χρήση. Ο εγκαταστάτης είναι υπεύθυνος για την άψογη λειτουργία στη θέση τοποθέτησης.

⚠ Κίνδυνος τραυματισμού!
Εάν η συσκευή δεν είναι στερεωμένη σύμφωνα με τους κανονισμούς, μπορεί να πέσει. Όλα τα στοιχεία στερέωσης πρέπει να συναρμολογηθούν καλά και σίγουρα.

⚠ Κίνδυνος ηλεκτροπληξίας!
Τα εξαρτήματα στο εσωτερικό της συσκευής μπορεί να είναι κοφτερά. Το καλώδιο σύνδεσης μπορεί να υποστεί ζημιά. Κατά την εγκατάσταση μην τσακίζετε και μην μαγκώνετε το καλώδιο σύνδεσης.

⚠ Κίνδυνος τραυματισμού!
Τα εξαρτήματα στο εσωτερικό της συσκευής μπορεί να είναι κοφτερά. Φοράτε προστατευτικά γάντια.

⚠ Κίνδυνος ασφυξίας!
Τα υλικά της συσκευασίας είναι επικίνδυνα για τα παιδιά. Μην αφήνετε τα παιδιά να παίζουν ποτέ με τα υλικά συσκευασίας.

Εγκατάσταση

Προσοχή!
Βεβαιωθείτε, ότι στην περιοχή των οπών δε βρίσκονται ηλεκτρικά καλώδια, σωλήνες παροχής αερίου ή νερού.

- Σημαδέψτε τις θέσεις για τις βίδες και το περίγραμμα της περιοχής ανάρτησης.
  Ανοίξτε τρύπες με Ø 8 mm και βάθος 80 mm και βάλτε μέσα τα βύσματα ισόπεδα με τον τοίχο - Εικ. 1.
- Βγάλτε το φίλτρο ενεργού άνθρακα και αφαιρέστε τη μεμβράνη - Εικ. 2.
- Βιδώστε τη μονάδα ανακυκλοφορίας αέρα και τη γωνία συγκράτησης για την επένδυση της καμινάδας - Εικ. 3.
- Στερεώστε τον εύκαμπτο σωλήνα με τους δύο σφιγκτήρες σωλήνων στη μονάδα ανακυκλοφορίας αέρα και στο στόμιο αέρα του απορροφητήρα.
  Ο εύκαμπτος σωλήνας πρέπει να είναι τεντωμένος, σε περίπτωση που χρειάζεται κόψτε τον - Εικ. 4.
- Συναρμολογήστε την επένδυση της καμινάδας (βλέπε "Οδηγίες συναρμολόγησης του απορροφητήρα").
  Οι σχισμές της εσωτερικής επένδυσης της καμινάδας είναι προς τα κάτω.
- Τοποθετήστε το φίλτρο ενεργού άνθρακα - Εικ. 5.
- Τοποθετήστε το κάλυμμα λοξά, πιέστε το ελαφρά προς τα επάνω και σπρώξτε το προς τα πίσω. Οι εγκοπές στο κάλυμμα πρέπει σε αυτή την περίπτωση να οδηγηθούν πάνω από τους πείρους ασφάλισης - Εικ. 6.

Φίλτρο ενεργού άνθρακα για τη λειτουργία ανακυκλοφορίας αέρα

Τα φίλτρα ενεργού άνθρακα συγκρατούν τις οσμές στη λειτουργία ανακυκλοφορίας αέρα. Αλλάξτε το φίλτρο ενεργού άνθρακα στην κανονική λειτουργία (καθημερινά 1 έως 2 ώρες) 1 φορά το χρόνο.

Υπόδειξη: Τα φίλτρα ενεργού άνθρακα δεν περιέχουν βλαβερές ουσίες και μπορούν να αποσυρθούν μαζί με τα οικιακά απορρίμματα.

sv

Viktiga säkerhetsanvisningar!

Läs bruksanvisningen noggrant. Det är viktigt för att du ska kunna använda enheten säkert och på rätt sätt. Spara bruks- och monteringsanvisningen för framtida bruk och eventuella kommande ägare.

En säker användning kan bara garanteras om spisfläkten monteras på fackmässigt sätt och i enlighet med monteringsanvisningen. Installatören ansvarar för en felfri funktion på platsen.

⚠ Skaderisk!
Om enheten inte är ordentligt fäst på väggen, så kan den falla ned. Alla fästkomponenter måste monteras stadigt och säkert.

⚠ Risk för elstötar!
Det finns komponenter inuti enheten som har vassa kanter. Anslutningskabeln kan skadas. Anslutningskabeln får inte vikas eller klämmas vid installationen.

⚠ Skaderisk!
En del komponenter inuti enheten har vassa kanter. Bär alltid skyddshandskar.

⚠ Kvävningsrisk!
Förpackningsmaterial är farligt för barn. Låt aldrig barn leka med förpackningsmaterialet.

Installation

Obs!
Se till att det inte finns några elledningar, gas- eller vattenrör i det område där du tänker borra.

- Markera borrhålen för skruvarna och området där fläkten ska hänga på väggen.
  Borra 80 mm djupa Ø 8 mm-hål och tryck i plugg så att de ligger jäms med väggen - bild 1.
- Ta ur det aktiva kolfiltret och ta bort folien - bild 2.
- Skruva fast cirkulationsluftmodulen och fästvinklarna till fläktkåpan - bild 3.
- Fäst slangen med 2 slangklämmor i cirkulationsluftmodul och fläktkåpans luftanslutning.
  Slangen ska vara sträckt, korta om det behövs - bild 4.
- Sätta på fläktkåpan (se ”Fläktens monteringsanvisning”).
  Skjut den inre delen nedåt.
- Sätta i aktivt kolfilter - bild 5.
- Sätt i delen snett och tryck uppåt och bakåt något. Urtagen i delen ska gå över låsskruvarna - bild 6.

Aktivt kolfilter för kolfilterdrift

Det aktiva kolfiltret binder oset vid kolfilterdrift. Byt aktivt kolfilter 1 ggn om året vid normal användning (dagligen 1 till 2 timmar).

Anvisning: Det aktiva kolfiltret innehåller inga skadliga ämnen, så du kan slänga det i hushållssoporna.

no

Viktige sikkerhetsanvisninger

Les denne bruksanvisningen nøye. Det er en forutsetning for at du skal kunne bruke apparatet på en sikker og riktig måte. Ta vare på bruks- og monteringsanvisningen slik at du kan bruke den igjen senere eller gi den videre til eventuelle kommende eiere av apparatet.

Sikkerheten under bruken er kun garantert dersom monteringen foretas forskriftsmessig i henhold til monteringsveiledningen. Installatøren er ansvarlig for at apparatet fungerer som det skal på oppstillingsstedet.

⚠ Fare for personskader!

Hvis apparatet ikke er forsvarlig festet, kan det falle ned. Alle festeelementer må være fast og sikkert montert.

⚠ Fare for elektrisk støt!

Komponenter inni apparatet kan ha skarpe kanter. Strømkabelen kan bli skadet. Strømkabelen må ikke knekkes eller klemmes inn under installasjonen.

⚠ Fare for personskader!

Komponenter inni apparatet kan ha skarpe kanter. Bruk vernehansker under installasjon av apparatet.

⚠ Fare for kvelning!

Emballasjematerialet er farlig for barn. Barn må aldri få leke med emballasjen.

Installering

Obs!

Se til at det ikke finnes strømledninger, gass- eller vannrør i området ved åpningene.

- Tegn opp posisjonen for skruene og konturen av opphengingsområdet.
  Bor hull med Ø 8 mm og dybde 80 mm og trykk inn pluggene – fig. 1.
- Ta ut aktivkullfilteret og fjern folien – fig. 2.
- Skru fast sirkulasjonsmodulen og holdevinkelen for avtrekksskjermen – fig. 3.
- Fest slangen med de to klemmene til sirkulasjonsmodulen og til luftstussen på avtrekkshetten.
  Slangen må være stram. Forkort den om nødvendig – fig. 4.
- Monter avtrekksskjermen (se "Monteringsanvisning for avtrekkshetten“).
  Sporene på den indre avtrekksskjermen må peke nedover.
- Sett inn aktivkullfilteret – fig 5.
- Sett panelet på skrå, trykk det litt opp og skyv det bakover. Utsparingene i panelet må føres over sikringsboltene – fig. 6.

Aktivt kullfilter til sirkulasjonsdrift

Aktive kullfiltre binder luktstoffene i sirkulasjonsdriften. Ved normal drift (en til to timer daglig) skal det aktive kullfilteret byttes ut en gang i året.

Merk: Aktive kullfiltre inneholder ingen skadelige stoffer og kan kastes i vanlig husholdningsavfall.

fi

Tärkeitä turvaohjeita

Lue tämä käyttöohje huolellisesti. Vasta sitten voit käyttää laitettasi turvallisesti ja oikein. Säilytä käyttö- ja asennusohje myöhempää käyttöä tai seuraavaa käyttäjää varten.

Turvallinen käyttö on taattu vain, kun asennus tehdään ammattitaitoisesti asennusohjeita noudattaen. Asentaja vastaa moitteettomasta toiminnasta laitteen asennuspaikassa.

⚠ Loukkaantumisvaara!

Jos laitetta ei ole kiinnitetty asianmukaisesti, se voi pudota. Kaikki kiinnityselementit pitää kiinnittää kunnolla ja varmasti.

⚠ Sähköiskun vaara!

Laitteen sisäpuolella olevat rakenneosat voivat olla teräväreunaiset. Liitäntäjohto voi vaurioitua. Varmista, että liitäntäjohto ei taivu jyrkälle mutkalle tai jää puristuksiin asennuksen aikana.

⚠ Loukkaantumisvaara!

Laitteen sisäpuolella olevat rakenneosat voivat olla teräväreunaiset. Käytä suojakäsineitä.

⚠ Tukehtumisvaara!

Pakkausmateriaali on vaarallista pikkulapsille. Älä anna lasten leikkiä pakkausmateriaalilla.

Asennus

Huomio!

Varmista, että porattavien reikien alueella ei ole sähkö-, kaasu- tai vesijohtoja.

- Merkitse ruuvien paikat ja kiinnitysalueen ääriviivat.
  Poraa reiät, Ø 8 mm ja syvyys 80 mm, ja paina tulpat reikiin niin, että ne ovat samassa tasossa seinän kanssa - kuva 1.
- Ota aktiivihiilisuodatin pois paikaltaan ja poista folio - kuva 2.
- Kiinnitä kiertoilmamoduuli ja hormisuojuksen kulmaraudat ruuveilla - kuva 3.
- Kiinnitä putki kahdella putkenkiinnittimellä kiertoilmamoduuliin ja liesituulettimen asennuskaulukseen.
  Putken pitää olla kireä, lyhennä tarvittaessa - kuva 4.
- Asenna hormisuojus (ks. "Liesituulettimen asennusohje").
  Sisemmän hormisuojuksen ilmanvaihtoaukot alas.
- Asenna aktiivihiilisuodatin - kuva 5.
- Aseta suojus viistoon asentoon, paina kevyesti ylöspäin ja työnnä taaksepäin. Ohjaa suojuksessa olevat aukot kiinnityspulttien päälle - kuva 6.

Aktiivihiilisuodatin kiertoilmakäyttöä varten

Aktiivihiilisuodattimet sitovat kiertoilman hajut itseensä. Vaihda aktiivihiilisuodatin normaalikäytössä (päivittäin 1 - 2 tuntia) kerran vuodessa.

Huomautus: Aktiivihiilisuodattimissa ei ole haitallisia aineita, joten ne voidaan hävittää kotitalousjätteen mukana.

da

Vigtige sikkerhedsanvisninger

Læs denne vejledning omhyggeligt igennem. Det er en forudsætning for, at apparatet kan betjenes sikkert og korrekt. Opbevar brugs- og montagevejledningen til senere brug eller til kommende ejere af apparatet.

Sikkerheden under brug er kun sikret, hvis emhætten er blevet monteret korrekt iht. monteringsvejledningen. Installatøren har ansvaret for, at apparatet fungerer fejlfrit på opstillingsstedet.

⚠ Fare for tilskadekomst!

Hvis apparatet ikke er korrekt fastgjort til væggen, kan den falde ned. Alle befæstigelseselementer skal være monteret fast og sikkert.

⚠ Fare for elektrisk stød!

Komponenterne indvendig i emhætten kan have skarpe kanter. Tilslutningskablet kan blive beskadiget. Sørg for, at tilslutningskablet ikke får knæk eller kommer i klemme under installationen.

⚠ Fare for tilskadekomst!

Komponenterne indvendig i emhætten kan have skarpe kanter. Brug beskyttelseshandsker.

⚠ Fare for kvælning!

Emballagemateriale er farligt for børn. Sørg for, at børn ikke leger med emballagemateriale.

Installering

Pas på!

Kontroller, at der ikke er elkabler, gas- eller vandrør i området, hvor der skal bores huller.

- Marker skruernes positioner og konturen for ophængningsområdet.
  Bor huller med en diameter på Ø 8 mm og en dybde på 80 mm til dyvlerne, og tryk dyvlerne ind, så de flugter med væggen - figur 1.
- Tag det aktive kulfilter ud, og fjern folien - figur 2.
- Skru recirkulationsmodulet og vinkelbeslagene til aftræksbeklædningen fast - figur 3.
- Fastgør slangen på recirkulationsmodulet og på emhættens luftstuds med de to spændebånd.
  Slangen skal være strakt ud. Om nødvendigt skal den afkortes - figur 4.
- Monter aftræksindklædningen (se "Monteringsvejledning til emhætte“).
  Slidserne på den indvendige aftræksbeklædning skal vende nedad.

- Sæt det aktive kulfilter på plads - figur 5.
- Sæt panelet ind på skrå, tryk det let opad, og skyd det bagud. Udsparingerne i panelet skal føres ind over låseboltene - figur 6.

Aktivt kulfilter til drift med recirkulation

Et aktivt kulfilter binder lugtpartikler ved drift med recirkulation. Ved normal drift (1 til 2 timer dagligt) skal det aktive kulfilter udskiftes 1 x om året.

Bemærk: Det aktive kulfilter indeholder ingen skadelige stoffer og kan kasseres sammen med husholdningsaffaldet.

ru

Важные правила техники безопасности

Внимательно прочитайте данное руководство. Оно поможет вам научиться правильно и безопасно пользоваться прибором. Сохраняйте руководство по эксплуатации и инструкцию по монтажу для дальнейшего использования или для передачи новому владельцу.

Безопасность эксплуатации гарантируется только при квалифицированной сборке с соблюдением инструкции по монтажу. За безупречность функционирования ответственность несёт монтёр.

⚠ Опасность травмирования!

Если прибор не зафиксирован надлежащим образом, он может упасть. Все элементы крепления должны быть надёжно установлены.

⚠ Опасность удара током!

Некоторые детали внутри прибора имеют острые кромки, что может повредить соединительный провод. Проследите, чтобы соединительный провод не зажимался и не перегибался.

⚠ Опасность травмирования!

Некоторые детали внутри прибора имеют острые кромки. Используйте защитные перчатки.

⚠ Опасность удушья!!

Упаковочный материал представляет опасность для детей. Никогда не позволяйте детям играть с упаковочным материалом.

Установка

Внимание!

Убедитесь, что в зоне сверления отверстий нет электропроводки, газопроводов или водных труб.

- Разметьте точки расположения винтов и контур зоны крепления.
  Просверлите отверстия (Ø 8 мм, глубина 80 мм) и вставьте дюбели заподлицо со стенкой - рис. 1.
- Выньте угольный фильтр и удалите пленку - рис. 2.
- Привинтите вытяжной модуль и кронштейн для вытяжной трубы - рис. 3
- Закрепите шланг двумя хомутами на вытяжном модуле и воздуховоде.
  Шланг должен быть натянут, при необходимости укоротите его - рис. 4.
- Установите вытяжную трубу (см. «Руководство по эксплуатации вытяжки»).
  Прорези на внутренней части вытяжной трубы должны смотреть вниз.
- Установите фильтр с активированным углём - рис. 5.
- Вставьте лицевую панель под углом, слегка приподнимите и задвиньте назад. Пазы на лицевой панели должны защелкнуться на стопорах - рис. 6.

Фильтр с активированным углём для режима рециркуляции воздуха

Фильтр с активированным углём задерживает неприятные запахи в режиме рециркуляции воздуха. При нормальной эксплуатации (ежедневно от 1 до 2 часов) фильтр с активированным углём заменяется 1 раз в год.

Указание: Фильтры с активированным углём не содержат вредных веществ и могут утилизироваться с бытовым мусором.

pl

Ważne wskazówki dotyczące bezpieczeństwa

Należy dokładnie przeczytać niniejszą instrukcję. Zapoznanie się z nią pozwoli na bezpieczne i właściwe użytkowanie urządzenia. Instrukcję obsługi i montażu należy zachować do późniejszego wglądu lub dla kolejnego użytkownika.

Bezpieczeństwo podczas użytkowania zapewnione jest tylko po prawidłowym zamontowaniu zgodnie z instrukcją montażu. Monter jest odpowiedzialny za prawidłowe działanie w miejscu instalacji urządzenia.

⚠ Niebezpieczeństwo obrażeń!

Jeśli urządzenie nie jest prawidłowo przymocowane, może spaść. Wszystkie elementy mocujące muszą być zamontowane starannie i dokładnie.

⚠ Niebezpieczeństwo porażenia prądem elektrycznym!

Elementy urządzenia mogą mieć ostre krawędzie. Może to doprowadzić do uszkodzenia przewodu przyłączeniowego. Nie zaginać ani nie zaciskać kabla przyłączeniowego podczas instalowania.

⚠ Niebezpieczeństwo obrażeń!

Elementy urządzenia mogą mieć ostre krawędzie. Zaleca się zakładanie rękawic ochronnych.

⚠ Niebezpieczeństwo uduszenia!

Opakowanie jest niebezpieczne dla dzieci. Nie pozwalać dzieciom na zabawę opakowaniem.

Instalacja

Uwaga!

Upewnić się, że w obszarze nawierceń nie ma przewodów elektrycznych, rur gazowych ani przewodów doprowadzających wodę.

- Zaznaczyć pozycje śrub i kontur obszaru zawieszenia.
  Wywiercić otwory o Ø 8 mm i głębokości 80 mm i wcisnąć kołki rozporowe tak, aby ich brzeg znajdował się w jednej płaszczyźnie ze ścianą - rys. 1.
- Wyjąć filtr z węglem aktywnym i usunąć folię - rys. 2.
- Przykręcić moduł obiegu zamkniętego oraz kątownik mocujący do montażu obudowy kominowej - rys. 3.
- Za pomocą dwóch obejm przymocować rurę do modułu obiegu zamkniętego i do króćca powietrza na okapie.
  Rura musi być naprężona, w razie potrzeby skrócić - rys. 4.
- Zamontować obudowę kominową (patrz „Instrukcja montażu okapu“).
  Szczeliny wewnętrznej obudowy kominowej skierować do dołu.
- Włożyć filtr z węglem aktywnym - rys. 5.
- Nasadzić ukośnie przesłonę, lekko nacisnąć do góry i przesunąć do tyłu. Wgłębienia na przesłonie muszą nachodzić na bolce zabezpieczające - rys. 6.

Filtr z węglem aktywnym w obiegu zamkniętym

W obiegu zamkniętym filtry z węglem aktywnym wiążą zapachy. W przypadku normalnej eksploatacji (1-2 godziny dziennie) filtry z węglem aktywnym należy wymieniać raz na rok.

Wskazówka: Filtry z węglem aktywnym nie zawierają substancji trujących i można je wyrzucać z odpadami komunalnymi.

tr

Önemli güvenlik uyarıları

Bu kılavuzu dikkatlice okuyunuz. Ancak bu şekilde cihazı güvenli ve doğru bir biçimde kullanmanız mümkün olacaktır. Daha sonra kullanılmak üzere veya başka birisinin kullanımı için kullanım ve montaj kılavuzunu muhafaza ediniz.

Sadece montaj kılavuzuna göre yapılmış uzmanca bir kurma sayesinde, kullanım güvenliği garanti edilmiş olur. Yerleşim yerinde sorunsuz çalışmadan tesisatçı sorumludur.

⚠ Yaralanma tehlikesi!

Cihaz, gerektiği gibi sabitlenmemişse düşebilir. Tüm sabitleme elemanları sıkılmış ve güvenli bir şekilde monte edilmiş olmalıdır.

⚠ Elektrik çarpma tehlikesi!

Cihaz içindeki parçalar keskin kenarlı olabilir. Bağlantı kablosu hasar görebilir. Bağlantı kablosunu kurma işlemi esnasında katlamayınız veya sıkıştırmayınız.

⚠ Yaralanma tehlikesi!
Cihaz içindeki parçalar keskin kenarlı olabilir. Koruyucu eldivenler kullanınız.

⚠ Boğulma tehlikesi!
Ambalaj malzemeleri çocuklar için tehlikelidir. Çocukların ambalaj malzemeleri ile oynamalarına kesinlikle izin vermeyiniz.

Kurulum

Dikkat!
Deliklerin etrafında elektrik hatlarının, gaz veya su borularının olmadığından emin olunuz.

- Cıvataların pozisyonlarını ve cihazı asma alanının kenarlarını çiziniz.
  8 mm çapında ve 80 mm derinliğinde delikler açınız ve dübelleri duvarla hizalayarak bastırınız - Resim 1.
- Aktif kömür filtresi çıkarılmalı ve folyo kaldırılmalıdır - Resim 2.
- Havalandırma modülü ve baca kaplaması tutturma köşebendini vidalayınız - Resim 3.
- Hortum, iki boru braketi ile havalandırma modülü üzerinde ve davlumbaz fan kademeleri üzerine sabitlenmelidir.
  Hortum gergin olmalıdır, gerekirse kısaltılmalıdır - Resim 4.
- Baca kaplamasının monte edilmesi (bkz. "Davlumbaz montaj kılavuzu").
  İç baca kaplamasının delikleri aşağı doğru olmalıdır.
- Aktif kömür filtresi takılmalıdır - Resim 5.
- Kaplama enine oturmalı, hafifçe yukarı bastırılmalı ve aşağı itilmelidir. Kaplama üzerindeki boşluklar üzerinden de emniyet pimi ile geçilmelidir - Resim 6.

Havalandırma çalışması için aktif karbon filtre

Aktif karbon filtre, kokulu maddeleri havalandırma çalışmasında bağlar. Aktif karbon filtreyi normal çalışmada (günlük 1 - 2 saat) yılda 1 kere değiştiriniz.

Bilgi: Aktif karbon filtre hiçbir zararlı madde içermez ve evsel atıklarla birlikte atılabilir.



Built-in oven HBG36B6.0

BOSCH

[en] Instruction manual

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Additional information on products, accessories, replacement parts and services can be found at **www.bosch-home.com** and in the online shop **www.bosch-eshop.com**

⚠ Safety precautions

Please read this instruction manual carefully. Please keep the instruction and installation manuals in a safe place. Please pass on these manuals to the new owner if you sell the appliance.

Before installation

Damage during transport

Check the appliance for damage after unpacking it. Do not connect the appliance if it has been damaged in transit.

Electrical connection

Only a licensed expert may connect the appliance. You will lose your warranty entitlement in the event of any damage caused by incorrect connection.

Safety notes

This appliance is intended for domestic use only. This appliance must only be used for food preparation.

Adults and children must not operate the appliance without supervision,

- if they are physically or mentally incapable of doing so or
- if they have insufficient knowledge or experience.

Never let children play with the appliance.

Hot cooking compartment

Risk of burns!

- Never touch the interior surfaces of the cooking compartment or the heating elements. Open the appliance door carefully. Hot steam may escape. Small children must be kept at a safe distance from the appliance.
- Never prepare food containing large quantities of drinks with a high alcohol content. Alcoholic vapours can catch fire in the cooking compartment. Only use small quantities of drinks with a high alcohol content and open the appliance door carefully.

Risk of fire!

- Never store combustible items in the cooking compartment. Never open the appliance door if there is smoke inside. Switch off the appliance. Pull out the mains plug or switch off the circuit breaker in the fuse box.
- Do not place greaseproof paper loosely over accessories during preheating. A draught is created when the appliance door is opened. The greaseproof paper may come into contact with the heating element and catch fire. Always weight down the greaseproof paper with a dish or a baking tin. Only cover the surface required with greaseproof paper. The greaseproof paper must not protrude over the accessories.

Risk of short circuit!

Never trap connecting cables of electrical appliances in the hot appliance door. The cable insulation could melt.

Risk of scalding!

Never pour water into the hot cooking compartment. This will produce hot steam.

Hot accessories and ovenware

Risk of burns!

Never remove ovenware or accessories from the cooking compartment without an oven cloth or oven gloves.

Improper repairs

Risk of electric shock!

Improper repairs are dangerous. Repairs may only be carried out by one of our trained after-sales engineers. If the appliance is defective, pull out the mains plug or switch off the appliance at the circuit breaker in the fuse box. Call the after-sales service.

Causes of damage

Caution!

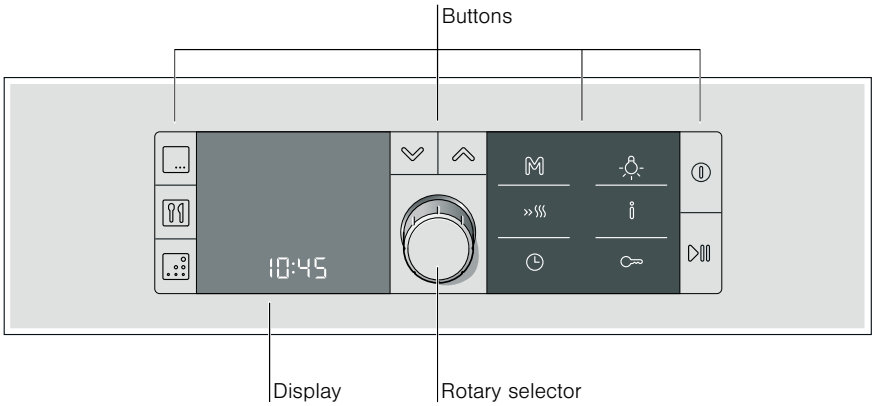
- Accessories, foil, greaseproof paper or ovenware on the cooking compartment floor: do not place accessories on the cooking compartment floor. Do not cover the cooking compartment floor with any sort of foil or greaseproof paper. Do not place ovenware on the cooking compartment floor if a temperature of over 50 °C has been set. This will cause heat to accumulate. The baking and roasting times will no longer be correct and the enamel will be damaged.
- Water in a hot cooking compartment: do not pour water into the cooking compartment when it is hot. This will cause steam. The temperature change can cause damage to the enamel.
- Moist food: do not store moist food in the cooking compartment when it is closed for prolonged periods This will damage the enamel.
- Fruit juice: when baking particularly juicy fruit pies, do not pack the baking tray too generously. Fruit juice dripping from the baking tray leaves stains that cannot be removed. If possible, use the deeper universal pan.
- Cooling with the appliance door open: only allow the cooking compartment to cool when it is closed. Even if the appliance door is only open a little, front panels of adjacent units could be damaged over time.
- Heavily soiled oven seal: if the oven seal is heavily soiled, the oven door will no longer close properly when the oven is in operation. The fronts of adjacent units could be damaged. Always keep the oven seal clean.
- Oven door as a bearing surface: do not stand or place objects on the oven door when it is open. Do not place ovenware or accessories on the oven door.
- Carrying the appliance: do not carry or hold the appliance by the door handle. The door handle cannot support the weight of the appliance and could break.

Your new oven

Here you will learn about your new oven. The control panel and the individual operating controls are explained. You will find information on the cooking compartment and the accessories.

Control panel

Here, you will see an overview of the control panel. Depending on the appliance model, individual details may differ.



Buttons

The sensors are located under the individual buttons. They must not be pressed too firmly. Just touch the corresponding symbol.

Symbol	Button function
	Selects the type of heating and temperature
	Selects automatic programmes
	Selects the cleaning system. This button is not assigned. The cleaning system can only be selected when the self-cleaning ceiling and side parts have been retrofitted and connected, and the cleaning system has been activated in the basic settings.
	Moves one row down
	Moves one row up
	Press and hold = selects the memory Press briefly = starts the memory
	Setting rapid heating
	Opens and closes the time-setting options
	Switches the oven light on and off
	Press briefly = calls up the temperature Press and hold = opens and closes the Basic settings menu
	Activates/deactivates the childproof lock
	Switches the oven on and off
	Press briefly = starts/pauses operation Press and hold = cancels operation

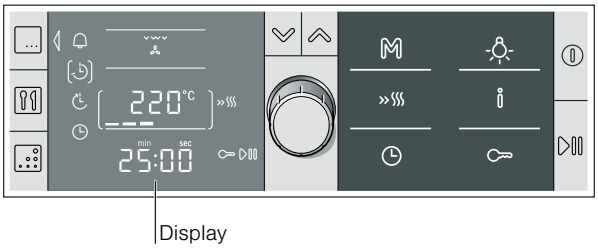
Rotary selector

The rotary selector is used to alter the default values and set values. The brackets in the control panel show which value you can adjust.

The rotary selector is retractable. Press on the rotary selector to pop it in or out.

Display

The display is divided into different areas.



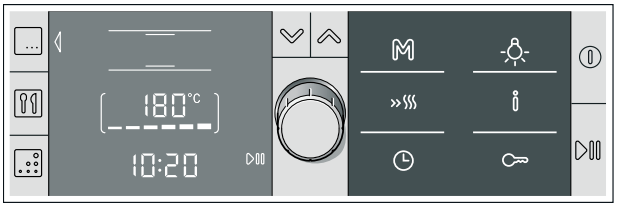
- Left area = time-setting options
  When you open the Time-setting options menu, the symbols for the time-setting options are displayed here. An outside arrow on the left points to the operating mode which has been selected.
- Centre area = settings area
  1st row = type of heating display
  2nd row = temperature display
  3rd row = clock display
  You can use the and navigation buttons to switch from one row to the other. Brackets are displayed around the row you are currently in. You can use the rotary selector to change the value in brackets.
- Right area = display
  Symbols for the various functions are displayed here, e.g. for the childproof lock or rapid heating, etc. if they have been set.

Temperature indicator

The temperature indicator bars show the heating phases or residual heat in the cooking compartment.

Heating indicator

The heating indicator displays the rising temperature in the cooking compartment. If all bars are filled, the optimum time for placing the dish in the oven has been reached.



The bars do not appear when settings are made for grilling and cleaning.

You can use the ⓘ button to check the current heating temperature while the oven is heating up. Due to thermal inertia, the temperature displayed may differ slightly from the actual temperature in the cooking compartment.

Residual heat

The temperature indicator shows the residual heat in the cooking compartment when the appliance is switched off. If all the bars are filled, the temperature in the cooking compartment is approximately 300 °C. Once the temperature has dropped to approximately 60 °C, the display goes out.

Cooking compartment

The oven light is located in the cooking compartment. A cooling fan protects the oven from overheating.

Oven light

During operation, the oven light in the cooking compartment is on. When temperatures up to 60 °C are selected, the light remains switched off. This enables precise temperature regulation.

The oven light switches on when you open the oven door.

You can use the ☼ button to switch the light on and off.

Cooling fan

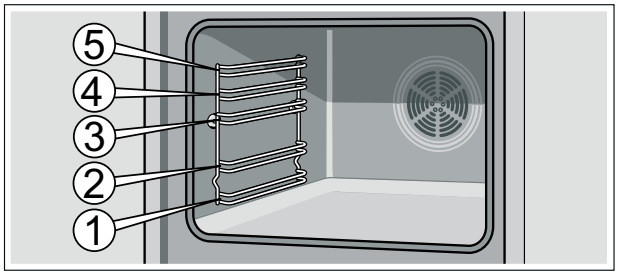
The cooling fan switches on and off as required. The hot air escapes above the door. Caution: do not cover the ventilation slots. Otherwise the oven will overheat.

So that the cooking compartment cools down more quickly after operation, the cooling fan continues to run for a certain period afterwards.

Accessories

The accessories can be inserted into the oven at 5 different levels.

You can pull out the accessories two thirds of the way without them tipping. This allows dishes to be removed easily.



The accessories can become deformed when they get hot. As soon as they have cooled down, the deformation disappears with no effect on the function.

You can buy accessories from the after-sales service, from specialist retailers or online. Please specify the HEZ number.



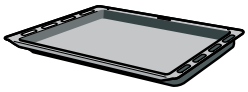
Wire rack
For ovenware, cake tins, joints, grilled items and frozen meals.

Insert the wire rack with the curvature pointing downward ⌣.



Enamel baking tray
For cakes and biscuits.

Push the baking tray into the oven with the sloping edge facing towards the oven door.



Universal pan
For moist cakes, pastries, frozen meals and large joints. It can also be used to catch dripping fat when grilling directly on the wire rack.

Slide the universal pan into the oven with the sloping edge facing the oven door.

Special accessories

You can purchase special accessories from the after-sales service or specialist retailers. You will find a comprehensive range of products for your oven in our brochures and on the Internet. The availability of special accessories and whether it is possible to order them online may vary depending on your country. Please see the sales brochures for more details.

Not all optional accessories are suitable for every appliance. When purchasing, please always quote the exact designation (E-no.) of your appliance.

Special accessories	HEZ number	Use
Wire rack	HEZ334000	For ovenware, cake tins, joints, grilled items and frozen meals.
Enamel baking tray	HEZ331000	For cakes and biscuits. Slide the baking tray into the oven with the sloping edge facing towards the oven door.
Universal pan	HEZ332000	For moist cakes, pastries, frozen meals and large joints. It can also be used to catch dripping fat when you are grilling directly on the wire rack. Slide the universal pan into the oven with the sloping edge facing the oven door.
Wire insert	HEZ324000	For roasting. Always place the wire rack in the universal pan. This ensures that dripping fat and meat juices are collected.

Special accessories	HEZ number	Use
Grill tray	HEZ325000	Use for grilling instead of the wire rack or as a splatter guard, so that the oven does not become very dirty. Only use the grill tray in the universal pan. Grilling on the grill tray: only use at shelf height 1, 2 and 3. Using the grill tray as a splatter guard: insert the universal pan with the grill tray under the wire rack.
Glass pan	HEZ336000	A deep baking tray made of glass. Can also be used as a serving dish.
Pizza tray	HEZ317000	Ideal for pizza, frozen products or large round cakes. You can use the pizza tray instead of the universal pan. Place the baking tray on the wire rack and proceed according to the details in the tables.
Bakestone	HEZ327000	The bakestone is perfect for preparing home-made bread, bread rolls and pizzas which require a crispy base. The bakestone must always be preheated to the recommended temperature.
Enamel baking tray with non-stick coating	HEZ331010	Cakes and biscuits can be removed more easily from the baking tray. Slide the baking tray into the oven with the sloping edge facing towards the oven door.
Universal pan with non-stick coating	HEZ332010	Moist cakes, pastries, frozen meals and large joints can be removed more easily from the universal pan. Slide the universal pan into the oven with the sloping edge facing the oven door.
Profi extra-deep pan with wire insert	HEZ333000	Ideally suited for preparing large amounts.
Lid for the Profi extra-deep pan	HEZ333001	The lid converts the Profi extra-deep pan into the Profi roasting dish.
Glass roasting dish	HEZ915001	The glass roasting dish is suitable for stews and bakes that are cooked in the oven. It is ideally suited to automatic programmes or automatic roasting.
Telescopic shelves		
2-level	HEZ338250	The pull-out rails at levels 2 and 3 allow you to pull accessories out further without them tipping.
3-level	HEZ338352	The pull-out rails at levels 1, 2 and 3 allow you to pull accessories out further without them tipping. The 3-level pull-out is not suitable for appliances that have a rotary spit.
3-level complete pull-out	HEZ338356	The pull-out rails at levels 1, 2 and 3 allow you to pull accessories out fully without them tipping. The 3-level complete pull-out is not suitable for appliances that have a rotary spit.
3-level complete pull-out with stop function	HEZ338357	The pull-out rails at levels 1, 2 and 3 allow you to pull accessories out fully without them tipping. The pull-out rails lock in position allowing accessories to be easily placed on top. The 3-level complete pull-out with stop function is not suitable for appliances that have a rotary spit.
Self-cleaning side walls		
Appliance with one oven light	HEZ339020	You can retrofit side walls so that the cooking compartment automatically cleans itself during operation.
Appliances with one oven light and automatic roasting	HEZ339020	You can retrofit side walls so that the cooking compartment automatically cleans itself during operation.
Self-cleaning oven ceiling and side walls		
Appliances with one oven light and a folding grill element	HEZ329020	You can retrofit the ceiling and side walls so that the cooking compartment automatically cleans itself during operation.
Appliances with two oven lights and a folding grill element	HEZ329022	You can retrofit the ceiling and side walls so that the cooking compartment automatically cleans itself during operation.
Appliances with one oven light, a folding grill element and a meat thermometer	HEZ329027	You can retrofit the ceiling and side walls so that the cooking compartment automatically cleans itself during operation.
Steam filter	HEZ329000	You can retrofit this in your oven. The steam filter filters out grease particles from the exhaust air, thereby reducing odours. Only for appliances with a 6, 7 or 8 as the second digit in the E-no. (e.g. HBA38B750).
System steamer	HEZ24D300	For easy preparation of vegetables and fish.

After-sales service products

You can obtain suitable care and cleaning agents and other accessories for your domestic appliances from the after-sales service, specialist retailers or (in some countries) online via the e-Shop. Please specify the relevant product number.

Cleaning cloths for stainless-steel surfaces	Product no. 311134	Reduces the build-up of dirt. Impregnated with a special oil for perfect maintenance of your appliance's stainless-steel surfaces.
Oven and grill cleaning gel	Product no. 463582	For cleaning the cooking compartment. The gel is odourless.
Microfibre cloth with honeycomb structure	Product no. 460770	Especially suitable for cleaning delicate surfaces, such as glass, glass ceramic, stainless steel or aluminium. The microfibre cloth removes liquid and grease deposits in one go.
Door lock	Product no. 612594	To prevent children from opening the oven door. The locks on different types of appliance door are screwed in differently. See the information sheet supplied with the door lock.

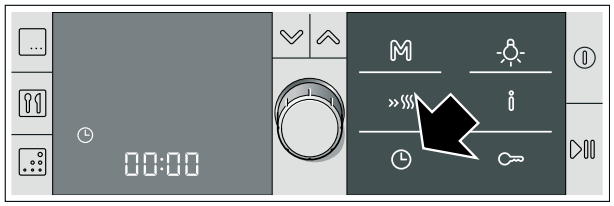
Before using the appliance for the first time

This section tells you everything you need to do before using the appliance for the first time.

- Set the clock
- Heat up the cooking compartment
- Clean the accessories
- Read the safety information at the start of the instructions for use. This is very important.

Setting the clock

Once your new appliance has been connected, the ◷ symbol and 00:00 appear in the display. Set the clock and then the oven is ready to use.



1. Press the ◷ button.
   The [◷] symbol for the clock is shown in brackets and [12:00] appears.
2. Turn the rotary selector to set the current time.
3. Press the ◷ button.

The current time is saved.

Note: You can read how to change the time in the *Time-setting options* section.

Heating up the cooking compartment

To get rid of the new cooker smell, heat up the cooking compartment when it is empty and the oven door closed. Set ⊟ Top/bottom heating and 240 °C.

Make sure that the cooking compartment contains no leftover packaging, e.g. polystyrene pellets.

1. Press the ⏻ button.
   The 3D hot air heating type and a temperature of 160 °C are suggested. Brackets are shown around the type of heating.
2. Turn the rotary selector to change the type of heating to ⊟ Top/bottom heating.
3. Press the ⌄ button to switch to the temperature.
   Brackets are shown around the temperature.
4. Using the rotary selector, change the temperature to 240 °C.
5. Press the ▷II button.
   Appliance operation begins. The ▷II symbol lights up in the display.
6. Switch the oven off after 60 minutes using the ⏻ button.

The temperature indicator bars show the residual heat in the cooking compartment.

Cleaning the accessories

Before you use the accessories for the first time, clean them thoroughly with hot soapy water and a soft dish cloth.

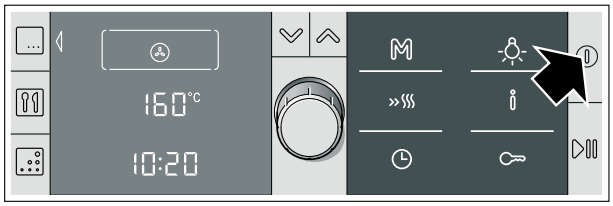
Switching the oven on and off

You can switch the oven on and off with the ⏻ button.

Switching on

Press the ⏻ button.

The 3D hot air symbol for the 3D hot air heating type and 160 °C are suggested in the display.



You can start the oven immediately with this setting or

- set a different type of heating or temperature
- select a programme with the button
- select the cleaning system with the button

- start a saved memory setting with the M button

You can read how to make these settings in the various sections.

Switching off

Press the ⏻ button. The oven switches off.

Setting the oven

In this section, you will find information about

- which types of heating are available in your oven
- how you set a type of heating and a temperature
- and how you set rapid heating

Types of heating

A large number of types of heating are available in your oven. This allows you to select the ideal way of preparing every dish.

Type of heating and temperature range	Application
3D hot air 30-275 °C	For cakes and pastries on one to three levels. The fan distributes the heat from the ring heating element in the back wall evenly throughout the cooking compartment.
Hot air eco* 30-275 °C	For cakes and pastries, bakes, frozen and convenience products, meat and fish, on one level without preheating. The fan distributes the energy-optimised heat from the ring heating element evenly in the cooking compartment.
Top/bottom heating 30-300 °C	For cakes, bakes and lean joints of meat (e. g. beef or game) on one level. Heat is emitted evenly from the top and bottom.
HydroBaking 30-300 °C	For yeast-risen pastry, e. g. bread/bread rolls or plaited loaves, and for choux pastry, e. g. cream puffs, or sponge. Heat is emitted evenly from the top and bottom. The moisture from the food remains in the cooking compartment as steam.
Pizza setting 30-275 °C	For the quick preparation of frozen products without preheating, e. g. pizza, chips or strudel. Heat is emitted from below and by the ring heating element in the back wall.
Bottom heating 30-300 °C	For preserving and final baking or rebrowning. The heat is emitted from below.
Hot air grilling 30-300 °C	For roasting meat, poultry and whole fish. The grill element and the fan switch on and off alternately. The fan causes the hot air to circulate around the dish.
Grill, large area Grill settings 1, 2 or 3	For grilling steaks, sausages, toast and pieces of fish. The whole area below the grill element becomes hot.
Grill, small area Grill settings 1, 2 or 3	For grilling small quantities of steaks, sausages, toast and pieces of fish. The centre part of the grill element becomes hot.
Defrost 30-60 °C	For defrosting, e.g.meat, poultry, bread and cakes. The fan causes the warm air to circulate around the dish.
Keep warm 60-100 °C	For keeping cooked dishes warm.

* Type of heating used to determine the energy efficiency class in accordance with EN50304.

Setting the type of heating and temperature

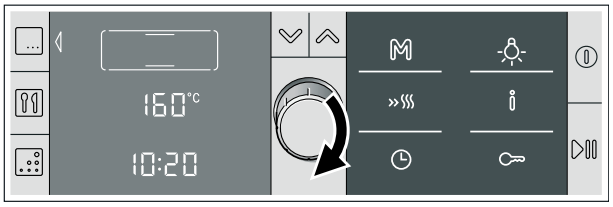
Example in the picture: Setting for Top/bottom heating at 180 °C.

Switch on the oven with the ⏻ button or press the button. The 3D hot air symbol and 160 °C are suggested in the display.

You can apply this setting immediately with the ▷II button.

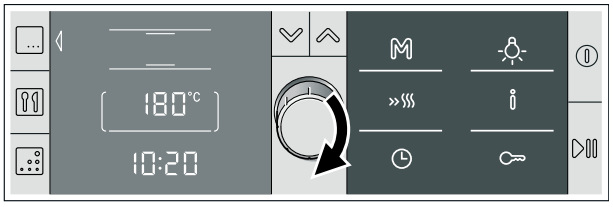
If you wish to specify another type of heating and temperature, proceed as follows.

1. Turn the rotary selector to set the desired type of heating.

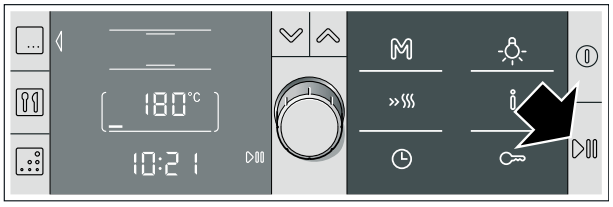


2. Press the ⌄ button to switch to the temperature. Brackets are shown around the temperature or grill setting.

3. Modify the suggested temperature using the rotary selector.



4. Press the ▷II button. Appliance operation begins. The ▷II symbol lights up in the display.



5. Once the dish is ready, switch the oven off with the ⏻ button or select and apply a new operating mode.

Changing the temperature or grill setting

This can be done at any time. Turn the rotary selector to change the temperature or grill setting.

Calling up the heating temperature

Press the ⓘ button briefly. The current heating temperature in the cooking compartment is displayed for several seconds.

Opening the oven door during cooking

Operation is suspended. The symbol ▷II flashes. When the door is closed again, operation resumes.

Pausing operation

Press the ▷II button briefly. The oven is paused. The ▷II symbol flashes. Press the ▷II button again, operation continues.

Cancelling operation

Press and hold the ▷II button until 3D hot air and 160 °C appear. You can now change the settings.

Setting the cooking time

See section *Time-setting options*, setting the cooking time.

Setting a later end time

See the section entitled *Time-setting options*, Setting a later end time.

Setting rapid heating

Rapid heating is not suitable for all types of heating.

Suitable types of heating

- 3D hot air
- Top/bottom heating
- HydroBaking
- Pizza setting

A short signal sounds to indicate that the selected type of heating is not suitable for rapid heating.

Suitable temperatures

Rapid heating will not work if the temperature is set to less than 100 °C. If the temperature in the cooking compartment is only slightly less than the temperature you have set, rapid heating is not necessary. It will not switch on.

Setting rapid heating

Press the »ʃʃʃ button to activate rapid heating. The »ʃʃʃ symbol appears next to the temperature you have set. The temperature indicator bars start filling in.

Once all the bars are filled, rapid heating is complete. You will hear a short signal. The »ʃʃʃ symbol goes out. Place your dish in the cooking compartment.

Notes

- Rapid heating is cancelled if you change the type of heating.
- If a cooking time has been set, this runs independently of rapid heating and counts down immediately when operation is started.
- You can use the ⓘ button to check the current cooking compartment temperature during rapid heating.
- To ensure an even cooking result, do not place your dish in the cooking compartment until rapid heating is complete.

Cancelling rapid heating

Press the »ʃʃʃ button. The symbol goes out.

Time-setting options

You can call up the time-setting options menu by pressing the ◷ button. The following functions are available:

If the oven is switched off:

- 🔔 = Set timer
- ◷ = Set clock

If the oven is switched on:

- 🔔 = Set timer
- = Set cooking time
- = Set a later end time

The brackets around the symbol indicate that this function is selected. Once you have started the oven, the brackets show which time function is currently counting down in the display.

Setting the time-setting options - in brief

1. Press the ◷ button to open the menu.
2. Select the desired function with the ⌄ button.
3. Set the desired value with the rotary selector.
4. Press the ◷ button to close the menu.

A detailed description of how to adjust each individual function is provided below.

Short audible signal

If you cannot change or set a value, you will hear a short audible signal.

Setting the timer

The timer runs independently of the oven. You can use it as a kitchen timer and set it at any time, regardless of whether oven is switched on or off.

1. Press the ◷ button.
   The time-setting options menu appears. The [🔔] symbol in brackets shows that the timer function is selected.
2. Set the running time for the timer using the rotary selector.
3. Press the ◷ button to close the menu.

The time counts down in the clock display.

When the time has elapsed

A signal sounds. The time has elapsed. The display shows 00:00. Press the ◷ button. The display goes out.

Cancelling the timer time

Press the ◷ button to open the time-setting options menu. Using the rotary selector, turn the time back to 00:00. Press the ◷ button to close the menu.

Changing the timer time

Press the ◷ button to open the time-setting options menu. Use the rotary selector to change the time within the next few seconds. Press the ◷ button to close the menu.

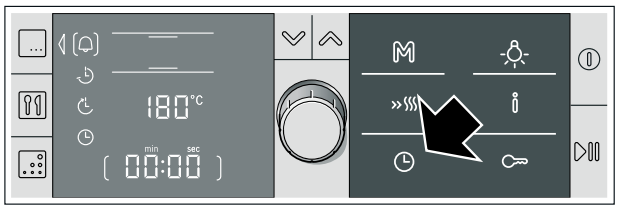
Setting the cooking time

If you set the cooking time for your dish, operation stops automatically once this time has elapsed. The oven stops heating.

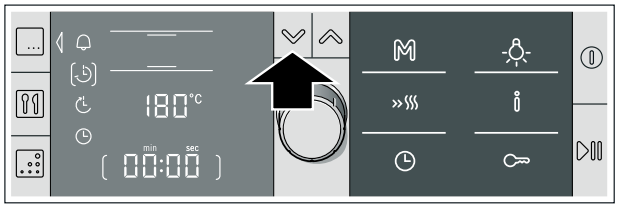
Prerequisite: The type of heating and temperature must be set.

Example in the picture: setting for ⊟ top/bottom heating, 180 °C, cooking time of 45 minutes

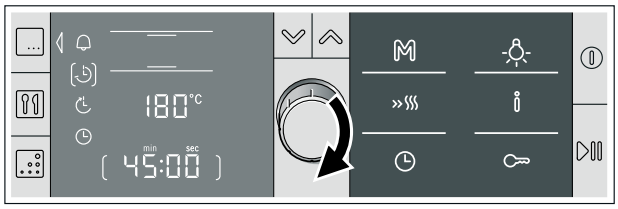
1. Press the ◷ button.
The time-setting options menu appears. The time-setting options are displayed in the left-hand side of the display. The [🔔] timer function is selected.



2. Using the ⌄ button, move to the [⏲] end time.



3. Turn the rotary selector to set the cooking time.



4. Press the ◷ button.
The time-setting options menu closes.

5. If the operation has not yet started, press the ▷II button.
The time starts counting down.

The cooking time has elapsed

A signal sounds. The oven stops heating. The cooking time is at 00:00. You can cancel the signal earlier by pressing the ◷ button.

Cancelling the cooking time

Press the ◷ button to open the menu. Using the ⌄ button, switch to the [⏲] cooking time and use the rotary selector to set the cooking time to 00:00. Press the ◷ button to close the menu.

Changing the cooking time

Press the ◷ button to open the menu. Using the ⌄ button, move to the [⏲] cooking time and set the cooking time using the rotary selector. Press the ◷ button to close the menu.

Setting a later end time

A later end time can be set for

- all types of heating
- a variety of programmes
- and the cleaning system

Example: you put the dish in the cooking compartment at 9.30. It takes 45 minutes to cook and will be ready at 10.15, but you would like it to be ready at 12.45 instead.

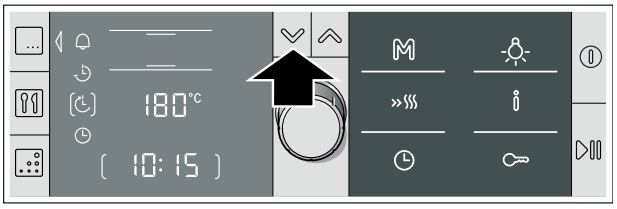
Change the end time from 10.15 to 12.45. Cooking starts at 12.00 and finishes at 12.45.

Please remember that easily spoiled foods must not be allowed to remain in the cooking compartment for too long.

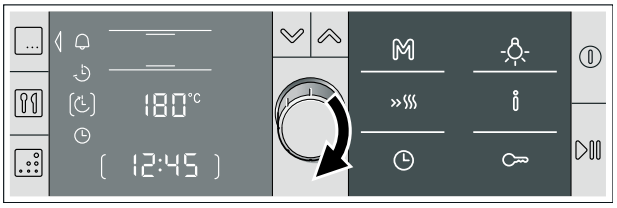
Setting a later end time

Prerequisite: a cooking time has already been set. Operation has not yet begun. The time-setting options menu ◷ is opened.

1. Using the ⌄ button, move to the [⏲] end time .



2. Using the rotary selector, set a later end time.



3. Press the ◷ button to close the time-setting options menu.

4. Confirm by pressing the ▷II button.

The oven is in [⏲] standby. The end time is shown in the clock display. As soon as operation starts, you will see the cooking time counting down.

The cooking time has elapsed

A signal sounds. The oven stops heating. 00:00 is shown on the clock display. You can stop the audible signal by pressing the ◷ button.

Correcting the end time

This is only possible as long as the oven is in [⏲] standby. Press the ◷ button to open the menu. Move to the end time using the ⌄ button. Adjust the end time using the rotary selector. Press the ◷ button to close the menu.

Cancelling the end time

This is possible, providing the oven is on standby. Select the menu with the ◷ button and move to the end time using the ⌄ button. Turn the rotary selector anti-clockwise until the current end time is reached. The cooking time immediately starts to count down.

Setting the clock

The oven must be switched off before you can set or change the clock.

Following a power cut

After a power cut [◷] and 00:00 appears in the display. Set the current time.

1. Press the ◷ button.
The selected function [◷] and [12:00] appear in the display.

2. Turn the rotary selector to set the current time.

3. Confirm by pressing the ◷ button.

The time appears in the display.

Changing the clock

If you wish to change the clock from summer to winter time, for example:

1. Press the ◷ button.
   The time-setting options menu appears.
2. Move to the clock [◷] using the ⌄ button.
3. Turn the rotary selector to set the current time.
4. Press the ◷ button.

The time appears in the display.

Hiding the clock

You can hide the clock. Then it will only appear when the oven is switched on. For more information, refer to the *Basic settings* section.

Memory

You can save the settings for a dish in the memory and call it up again at any time.

The memory is useful if you frequently prepare a specific dish.

Saving settings in the memory

The cleaning system cannot be saved.

1. Specify the type of heating, temperature and, if required, a cooking time for the dish you wish to cook. Do not start. If you want to save a programme: Select the programme and enter the weight. Do not start.
2. Press and hold the M button until the M symbol lights up on the display. This will take a few seconds.

The setting is saved and can be started at any time.

Saving another setting

Enter and save the new setting. The old settings are overwritten.

Starting the memory

You can start cooking at any time using the settings saved for your dish.

1. Press the M button briefly.
   The saved settings are displayed.
2. Press the ▷II button.

The memory setting starts.

Changing the settings

This can be done at any time. The setting you originally saved appears the next time you start the memory.

Sabbath mode

When this setting is used, the temperature of the oven remains at between 85 °C and 140 °C with Top/bottom heating. You can set a time between 24 and 73 hours.

You can keep dishes in the cooking compartment hot for this time without having to switch the oven on or off.

Starting Sabbath mode

Prerequisite: "Sabbath mode, yes" is activated in the basic settings. See the *Basic settings* section.

1. Press the ⌴ button.
   3D hot air and 160 °C are suggested in the display.
2. Turn the rotary selector anti-clockwise to Sabbath mode.
3. Use the ⌄ button to switch to the temperature and set the desired temperature using the rotary selector.
4. Use the ◷ button to open the Time-setting options menu and switch to [] Cooking time with the ⌄ button.
   27:00 hours are suggested.
5. Turn the rotary selector to set the required cooking time.
6. Press the ◷ button.
   The time-setting options menu closes.
7. Press the ▷II button.
   The Sabbath mode starts. You can see the cooking time counting down in the status bar.

The cooking time has elapsed

The oven stops heating.

Setting a later end time

It is not possible to set a later end time.

Cancelling Sabbath mode

Press and hold the ▷II button until 3D hot air, 160 °C appears. You can make new settings.

Childproof lock

The oven has a childproof lock to prevent children from switching it on or changing a setting by accident.

Activating the childproof lock

Press and hold the ⊂ key button until the ⊂ symbol appears. This takes about 4 seconds.

The control panel is locked.

Releasing the lock

Press and hold the ⊂ button until the symbol disappears. You can make settings again.

Note: You can still switch the oven off, set the timer and switch the audible signal off when the childproof lock is active by pressing ⏻ or by pressing and holding the ▷II button.



Basic settings

Your appliance has various basic settings, which you can adjust to suit your needs at any time.

Note: In the table, you will find all the basic settings and the associated options for changing them. Only the basic settings that correspond to the features of your specific appliance are displayed.

	Function	Basic setting	Options
c 1	Audible signal after a time has elapsed	2 = 2 minutes	1 = 10 seconds 2 = 2 minutes 3 = 5 minutes
c2	Confirmation tone when a button is pressed.	0 = off	0 = off* 1 = on *Exception: A tone always sounds when switching the appliance on and off.
c3	Brightness of the display lighting	3 = day	1 = night 2 = medium 3 = day
c4	Clock display when the oven is switched off	1 = on	0 = off* * The clock is shown while the residual heat is displayed. 1 = on
c5	Oven light during operation	1 = on	0 = off 1 = on
c6	Continue operation when the oven door is closed	1 = operation continues automatically	0 = continue operation with ▷II 1 = operation continues automatically
c 7	Additional door lock for childproof lock	0 = no	0 = no 1 = yes
c8	Length of cooling fan run-on time	2 = medium	1 = short 2 = medium 3 = long 4 = very long
c9	Self-cleaning ceiling and side panels are retrofitted	0 = no	0 = no 1 = yes
c 10	Telescopic shelves are retrofitted	0 = no	0 = no 1 = yes
c 11	Undo all changes and restore basic settings.	0 = no	0 = no 1 = yes
c 12	Sabbath mode	0 = no	0 = no 1 = yes

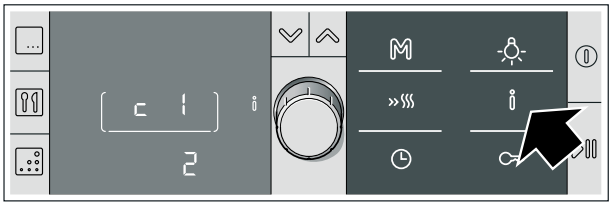
Changing the basic settings

Prerequisite: The oven must be switched off.

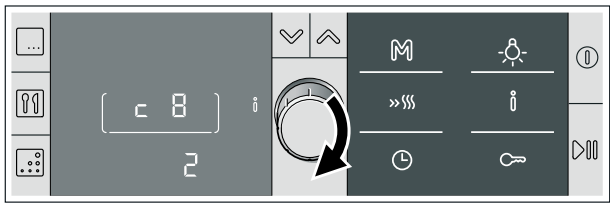
Have a look at the table containing the basic settings so that you know what the numbers mean.

Example in the picture: changing the cooling fan run-on time basic setting from medium to short.

1. Press and hold the i button for approximately 4 seconds until the first basic setting appears in the display.

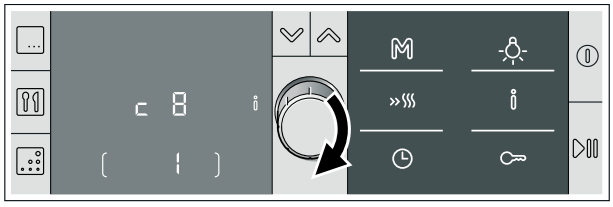


2. Turn the rotary selector to select the required basic setting



3. Press the ⌄ button.

4. Change the basic setting by turning the rotary selector.



5. You can now change other basic settings, as described in points 2 to 4.

6. Press and hold the i button until the clock appears. This takes about four seconds. All changes are saved.

Cancelling

Press the ⏻ button. The changes are not applied.

Automatic switch-off

Your oven has an automatic switch-off function. It is activated if no cooking time is set and the settings have not been changed for a long time. The point at which this occurs depends on the temperature or grill setting that has been set.

Switch-off activated

F8 appears in the display. Operation is interrupted.

Press any button to make the display message go out. You can make new settings.

Note: If a cooking time is set, the oven stops heating once the cooking time has elapsed. The automatic switch-off function is not necessary.

Cleaning system

The cleaning system regenerates the self-cleaning surfaces in the cooking compartment.

The self-cleaning surfaces are coated with a highly porous ceramic layer. This coating absorbs and disintegrates splashes from baking and roasting while the oven is in operation. If the surfaces no longer clean sufficiently and dark stains appear, they can be regenerated with the cleaning system.

Retrofitting the self-cleaning ceiling and side walls

The back wall in the cooking compartment is coated with ceramic. In order for you to be able to use the cleaning system, the ceiling and side walls must also be coated. You can obtain the self-cleaning ceiling and side walls as a special accessory from the after-sales service.

Changing the basic settings

When you have retrofitted the self-cleaning ceiling and side walls, you must activate the cleaning system in the basic settings. To find out how to do this, refer to the *Basic settings* section.

Cleaning levels

You can choose from three cleaning levels.

Level	Degree of cleaning	Duration
1	gentle	approx. 45 minutes
2	moderate	approx. 1 hour
3	intensive	approx. 1 hour, 15 minutes

Before cleaning

Remove accessories and cookware from the cooking compartment.

Cleaning the cooking compartment floor

Before you set the cleaning system, clean the surfaces in the cooking compartment that are not self-cleaning. Otherwise, stains will develop that it is not possible to remove.

Use a dish cloth and hot soapy water or a vinegar solution. If there are heavy deposits of dirt, use a stainless steel scouring pad or oven cleaner. Only use when the cooking compartment is cold. Never treat the self-cleaning surfaces with a scouring pad or oven cleaner.

Setting the cleaning level

1. Press the button.

Cleaning level 3 is suggested. You can start the cleaning process immediately with the ▷II button.

If you wish to change the cleaning level:

2. Select the desired cleaning level using the rotary selector.

3. Press the ▷II button to start the cleaning operation.

The time counts down.

Once cleaning has finished

The oven stops heating. 00:00 appears in the display.

Cancelling the setting

Press and hold the ▷II button until 3D hot air, 160 °C appears. You can make new settings.

Adjusting the cleaning level

Once cleaning starts, the cleaning level can no longer be changed.

Setting cleaning to run overnight

So that you can use your oven throughout the day, delay the end of the cleaning process to during the night. See the *Time-setting options* section, setting a later end time.

After cleaning

When the cooking compartment has cooled down completely, wipe the salt residues off the self-cleaning surfaces with a damp cloth.

Care and cleaning

With good care and cleaning, your oven will remain clean and fully-functioning for a long time to come. Here we will explain how to maintain and clean your oven correctly.

Notes

- Slight differences in the colours on the front of the oven are caused by the use of different materials, such as glass, plastic and metal.
- Shadows on the door panel which look like streaks, are caused by reflections made by the oven light.
- Enamel is baked on at very high temperatures. This can cause some slight colour variations. This is normal and does not affect their function. The edges of thin trays cannot be completely enamelled. As a result, these edges can be rough. This will not impair the anti-corrosion protection.

Cleaning agents

To ensure that the different surfaces are not damaged by using the wrong cleaning agent, observe the information in the table. Do not use

- sharp or abrasive cleaning agents,
- cleaning agents with a high concentration of alcohol,
- hard scouring pads or sponges,
- high-pressure cleaners or steam cleaners.

Wash new sponge cloths thoroughly before use.

Area	Cleaning agents
Oven front	Hot soapy water: Clean with a dish cloth and dry with a soft cloth. Do not use glass cleaners or glass scrapers.
Stainless steel	Hot soapy water: Clean with a dish cloth and dry with a soft cloth. Remove flecks of limescale, grease, starch and albumin (e.g. egg white) immediately. Corrosion can form under such residues. Special stainless steel cleaning products suitable for warm surfaces are available from our after-sales service or from specialist retailers. Apply a thin layer of the cleaning product with a soft cloth.
Door panels	Glass cleaner: Clean with a soft cloth. Do not use a glass scraper.
Glass cover for the oven light	Hot soapy water: Clean with a dish cloth.
Seal Do not remove.	Hot soapy water: Clean with a dish cloth. Do not scour.
Shelves	Hot soapy water: Soak and clean with a dish cloth or brush.
Telescopic shelves	Hot soapy water: Clean with a dish cloth or a brush. Do not soak or clean in the dishwasher.
Accessories	Hot soapy water: Soak and clean with a dish cloth or brush.

Cleaning the self-cleaning surfaces in the cooking compartment

The back wall in the cooking compartment is coated with a highly porous ceramic layer. This coating absorbs and disintegrates splashes from baking and roasting while the oven is in operation. The higher the temperature and the longer the oven is in operation, the better the result will be.

If splashes are still visible even after repeated use, proceed as follows:

1. Clean the floor, ceiling and side panels of the cooking compartment thoroughly.
2. Set 3D hot air.
3. With the door closed, heat up the empty oven for approximately 2 hours at maximum temperature.

The ceramic coating is regenerated. When the cooking compartment has cooled down, remove the brown or white residue with water and a soft sponge.

Light discolouration of the coating does not affect automatic self-cleaning.

If you buy the "self-cleaning ceiling and side panels" optional accessory at a later stage, you can regenerate the self-cleaning surfaces with the cleaning system. For this, please see the *Cleaning system* section.

Caution!

- Never use abrasive cleaning agents. You will scratch or destroy the highly porous coating.
- Never treat the ceramic coating with oven cleaner. If oven cleaner accidentally gets onto it, remove it immediately with a sponge and plenty of water.

Cleaning the cooking compartment floor, ceiling and side walls

Use a dish cloth and hot soapy water or a vinegar solution.

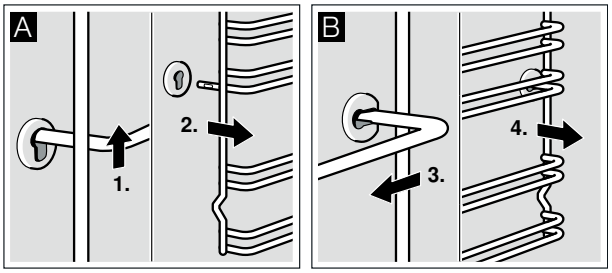
If there are heavy deposits of dirt, use a stainless steel scouring pad or oven cleaner. Only use when the cooking compartment is cold. Never treat the self-cleaning surfaces with a scouring pad or oven cleaner.

Detaching and refitting the rails

The rails can be removed for cleaning. The oven must have cooled down.

Detaching the rails

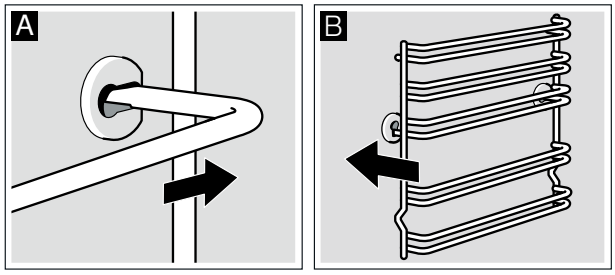
1. Lift up the front of the rail
2. and unhook it (figure A).
3. Then pull the whole rail forward
4. and remove it (Fig. B).



Clean the rails with cleaning agent and a sponge. For stubborn deposits of dirt, use a brush.

Refitting the rails

1. First insert the rail into the rear socket, press it to the back slightly (figure A),
2. and then hook it into the front socket (figure B).



The rails fit both the left and right sides. Ensure that, as shown in figure B, levels 1 and 2 are below and levels 3, 4 and 5 are above.

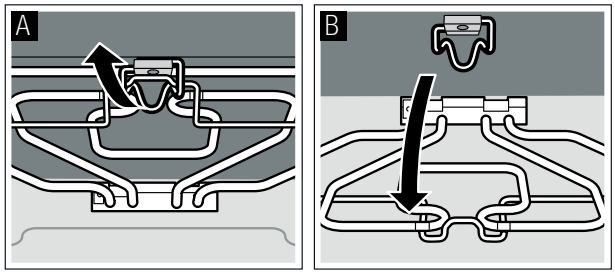
Folding down the grill element

You can fold down the grill element to clean the ceiling.

⚠ Risk of burns!

The oven must be cold.

1. Hold the grill element and pull the handle forwards until it clicks audibly in place (figure A).
2. Fold the grill element downwards (figure B).

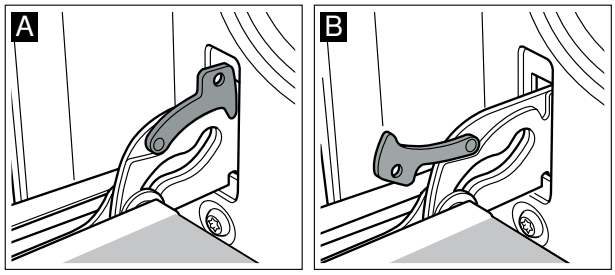


3. After cleaning, fold the grill element back up and hold it.
4. Pull the handle downwards until it clicks audibly into place.

Detaching and attaching the oven door

For cleaning purposes and to remove the door panels, you can detach the oven door.

The oven door hinges each have a locking lever. When the locking levers are closed (figure A), the oven door is secured in place. It cannot be detached. When the locking levers are open in order to detach the oven door (Fig. B), the hinges are locked. They cannot snap shut.

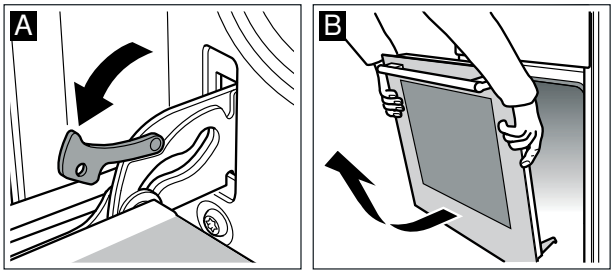


⚠ Risk of injury!

Whenever the hinges are not locked, they snap shut with great force. Ensure that the locking levers are always fully closed or, when detaching the oven door, fully open.

Detaching the door

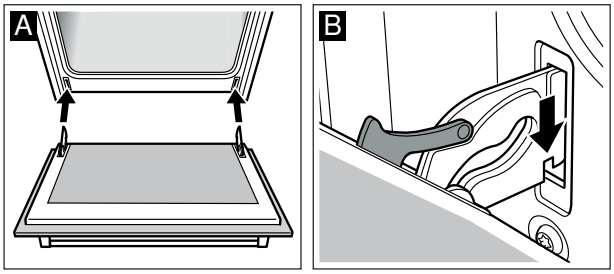
1. Open the oven door fully.
2. Fold up the two locking levers on the left and right (figure A).
3. Close the oven door as far as the limit stop. With both hands, grip the door on the left and right-hand sides. Close the door a little further and pull it out (figure B).



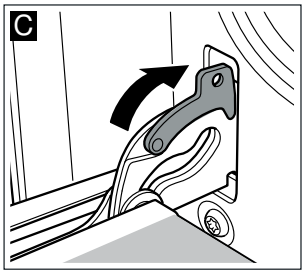
Attaching the door

Reattach the oven door in the reverse sequence to removal.

1. When attaching the oven door, ensure that both hinges are inserted straight into the opening (figure A).
2. The notch on the hinge must engage on both sides (figure B).



3. Fold back both locking levers (figure C). Close the oven door.



⚠ Risk of injury!

If the oven door falls out accidentally or a hinge snaps shut, do not reach into the hinge. Call the after-sales service.

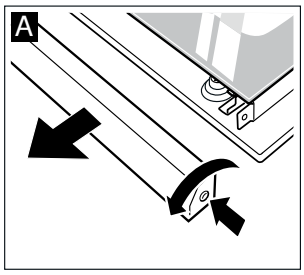
Removing and installing the door panels

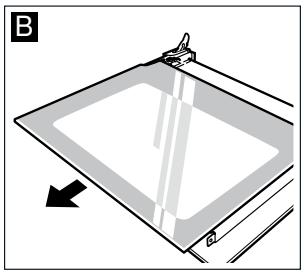
To facilitate cleaning, you can remove the glass panels from the oven door.

When removing the inner panels, pay attention to the order in which the panels are removed. In order to reassemble the panels in the correct sequence, follow the number which appears on each panel.

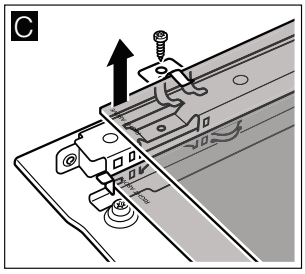
Removal

1. Detach the oven door and lay on a cloth with the handle facing down.
2. Unscrew the cover at the top of the oven door. To do this, undo the left and right screws (fig. A).
3. Lift the top panel up and out (fig. B).





4. Unscrew the retaining clips on the right and left and remove them (fig. C). Remove the middle panel.



5. Pull the lower panel diagonally upwards and out.

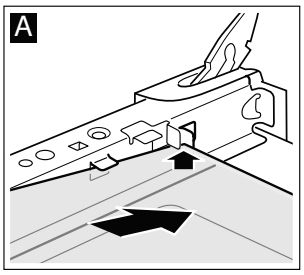
Clean the panels with glass cleaner and a soft cloth.

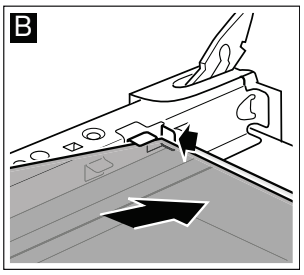
Do not use sharp or abrasive materials or a glass scraper. This may damage the glass.

Fitting

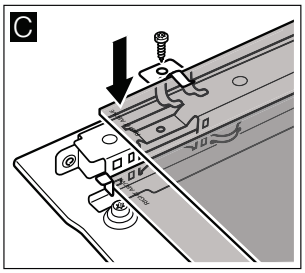
When fitting, make sure that the lettering "right above" is upside down at the bottom left on both panels.

1. Insert the lower panel diagonally towards the back (fig. A).
2. Insert the centre panel (fig. B).





3. Stick the retaining clips onto the right and left-hand side of the panel, aligning them so that the carriers are over the screw holes, and then screw in place (fig. C).



4. Insert the uppermost panel diagonally towards the back. The smooth surface must face outwards.
5. Put the cover back in place and screw it on.
6. Attach the oven door.

Do not use the oven again until the panels have been correctly fitted.

Troubleshooting

Malfunctions often have simple explanations. Refer to the table before calling the after-sales service as you may be able to remedy the fault yourself.

Malfunction table

If a dish does not turn out exactly as you wanted, refer to the *Tested for you in our cooking studio* section, where you will find plenty of cooking tips and tricks.

⚠ Risk of electric shock!

Incorrect repairs are dangerous. Repairs may only be carried out by one of our trained after-sales engineers.

Problem	Possible cause	Note/remedy
The appliance does not work.	Defective fuse	Look in the fuse box and check that the circuit breaker is in working order.
00:00 appears in the display.	Power cut	Reset the clock.
The oven does not heat up or the type of heating selected cannot be set.	Type of heating not recognised	Make the settings again.
The oven does not heat up. A small square lights up in the temperature display.	The oven is in demo mode.	Switch off the circuit breaker in the fuse box, then switch it back on after at least 20 seconds. Within the next 2 minutes, press and hold the ⊂⊃ button for 4 seconds until the square disappears from the display.

Problem	Possible cause	Note/remedy
When you press the ⊡ button, no appears in the display.	The ceiling and side parts in the cooking compartment are not self-cleaning. The cleaning system cannot be run.	You can only set the cleaning system if you have retrofitted the self-cleaning ceiling and side parts and activated the cleaning system in the basic settings. See the *Cleaning system* section and the *Basic settings* section.
"F8" appears on the display.	Automatic switch-off has been activated. The oven stops heating.	Press any button.

Error messages with E

If an error message with E is shown in the display, press the ◷ button. This cancels the error message. You may then have to reset the time. If the error is shown again, call the after-sales service.

You can take remedial action yourself if the following error message is displayed.

Error message	Possible cause	Note/remedy
E011	A button has been pressed for too long.	Press all buttons individually. Check that the buttons are clean. If the error message remains, please contact the after-sales service.

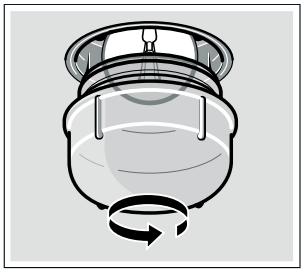
Replacing the bulb in the oven ceiling light

If the bulb in the oven light fails, it must be replaced. Heat-resistant, 40 watt spare bulbs can be obtained from our after-sales service or a specialist retailer. Only use these bulbs.

⚠ **Risk of electric shock!**

Switch off the circuit breaker in the fuse box.

1. Place a tea towel in the oven when it is cold to prevent damage.
2. Unscrew the glass cover by turning it anti-clockwise.



3. Replace the bulb with one of the same type.
4. Screw the glass cover back in.
5. Remove the tea towel and switch on the circuit breaker.

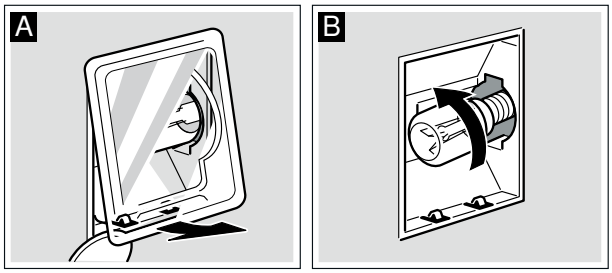
Replacing the bulb in the left-hand oven light

If the bulb in the oven light fails, it must be replaced. Heat-resistant, 25 watt spare bulbs can be obtained from our after-sales service or a specialist retailer. Only use these bulbs.

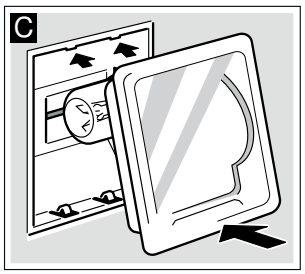
⚠ **Risk of electric shock!**

Switch off the circuit breaker in the fuse box.

1. Place a tea towel in the oven when it is cold to prevent damage.
2. Remove the glass cover. To do this, open the glass cover from the bottom with your hand (Fig. A). If the glass cover is difficult to remove, use a spoon as an aid.



3. Unscrew the bulb and replace it with one of the same type (Fig. B). When fitting the new bulb, make sure that it is screwed in straight.
4. Refit the glass cover. Make sure that the curvature in the glass is on the right. Insert the glass at the top and push it in firmly at the bottom (Fig. C). The glass cover will click into place.



5. Remove the tea towel and switch on the circuit breaker.

Glass cover

You must replace a damaged glass cover. Suitable glass covers may be obtained from the after-sales service. Please specify the E number and FD number of your appliance.

After-sales service

Our after-sales service is there for you if your appliance needs to be repaired. We will always find the right solution in order to avoid unnecessary visits from a service technician.

E number and FD number

When calling us, please give the product number (E no.) and the production number (FD no.) so that we can provide you with the correct advice. The rating plate containing these numbers can be found on the right-hand side of the oven door. You can

make a note of the numbers of your appliance and the telephone number of the after-sales service in the space below to save time should it be required.

E no. **FD no.**

After-sales service ☎

Please note that there will be a fee for a visit by a service technician in the event of a malfunction, even during the warranty period.

Please find the contact data of all countries in the enclosed customer service list.

To book an engineer visit and product advice

GB 0844 8928979
Calls from a BT landline will be charged at up to 3 pence per minute. A call set-up fee of up to 6 pence may apply.

IE 01450 2655

Trust the expertise of the manufacturer, and rest assured that the repair will be carried out by trained service technicians using original spare parts for your domestic appliance.

Energy and the environment

Your new appliance is particularly energy-efficient. You will find information here about the energy-optimised "Hot air eco" heating type. You will also find tips on how to save even more energy with your appliance and how to dispose of it in an environmentally friendly way.

Hot air eco heating type

With the energy-efficient "Hot air eco" heating type, you can prepare many dishes on one level. The fan distributes the energy-optimised heat from the ring heating element in the back wall evenly around the cooking compartment. You can achieve successful baking, roasting and cooking without having to preheat the oven.

Notes

- Place the items in the empty cooking compartment before it has heated up. Otherwise, energy optimisation will not have any effect.
- Only open the oven door during cooking when required.

Table

The table contains a selection of dishes best suited to Hot air eco. It provides details on suitable temperatures and cooking times. You can see which accessories and shelf positions are suitable.

The temperature and cooking time depend on the amount, composition and quality of the food. This is why temperature ranges are given in the table. You should try the lower temperature first, since a lower temperature results in more even browning. You can increase the temperature next time if necessary.

Place the baking tins and cookware in the centre of the wire rack. If you are grilling food directly on the wire rack, the universal pan should also be inserted at level 1. Fat and juices are caught in the universal pan, which keeps the oven cleaner.

Dishes using Hot air eco	Accessories	Level	Temperature in °C	Cooking time in minutes
Cakes and pastries				
Sponge on the baking tray with dry topping	Baking tray	3	170-190	25-35
Dough in tins	Loaf tin	2	160-180	50-60
Flan cake, sponge mixture	Flan-based cake tin	2	160-180	20-30
Delicate fruit flan, sponge	Springform/ring tin	2	160-180	50-60
Yeast dough on the baking tray with dry topping	Baking tray	3	170-190	25-35
Shortcrust pastry on the baking tray with dry topping	Baking tray	3	180-200	20-30
Swiss roll	Baking tray	3	170-190	15-25
Sponge base, 2 eggs	Flan-based cake tin	2	150-170	20-30
Sponge flan, 6 eggs	Springform cake tin	2	150-170	40-50
Puff pastry	Baking tray	3	180-200	20-30
Biscuits	Baking tray	3	130-150	15-25
Whirls	Baking tray	3	140-150	30-45
Choux pastry	Baking tray	3	210-230	35-45
Bread rolls, rye flour	Baking tray	3	200-220	20-30
Bakes				
Potato gratin	Ovenproof dish	2	160-180	60-80
Lasagne	Ovenproof dish	2	180-200	40-50
Frozen products				
Pizza, thin base	Universal pan	3	190-210	15-25
Pizza, deep-pan	Universal pan	2	180-200	20-30

Dishes using Hot air eco	Accessories	Level	Temperature in °C	Cooking time in minutes
Chips	Universal pan	3	200-220	20-30
Chicken wings	Universal pan	3	220-240	20-30
Fish fingers	Universal pan	3	220-240	10-20
Crispy bread rolls	Universal pan	3	180-200	10-15
Meat				
Pot-roasted beef, 1.5 kg	Ovenware, covered	2	190-210	130-150
Joint of pork, neck, 1 kg	Ovenware, uncovered	2	190-210	110-130
Joint of veal, topside, 1.5 kg	Ovenware, uncovered	2	190-210	110-130
Fish				
Sea bream, x 2, 750 g each	Universal pan	2	170-190	50-60
Sea bream with salted, crisped skin, 900 g	Universal pan	2	170-190	60-70
Pike, 1000 g	Universal pan	2	170-190	60-70
Trout, x2, 500 g each	Universal pan	2	170-190	45-55
Fish fillets, 100 g each	Ovenware, covered	2+1	190-210	30-40

Saving energy

- Only preheat the oven if this is specified in the recipe or in the operating instruction tables.
- Use dark, black lacquered or enamelled baking tins. They absorb the heat particularly well.
- Open the oven door as infrequently as possible while you are cooking, baking or roasting.
- It is best to bake several cakes one after the other. The oven is still warm. This reduces the baking time for the second cake. You can also place two loaf tins next to each other.
- For longer cooking times, you can switch the oven off 10 minutes before the end of the cooking time and use the residual heat to finish cooking.

Environmentally-friendly disposal

Dispose of packaging in an environmentally-friendly manner.

This appliance complies with European Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE). The directive gives a framework for the collection and recycling of old appliances, which is valid across the EU.

Automatic programmes

The automatic programmes help you to achieve elaborate pot roasts, juicy roasts and delicious stews very easily. You do not have to worry about turning and basting and the cooking compartment remains clean.

The cooking result depends on the quality of the meat and the size and type of ovenware. Use an oven cloth or oven gloves when you take the finished dish out of the cooking compartment. The ovenware will be very hot. Take care when opening the ovenware, as hot steam will escape.

Ovenware

Automatic programmes are only suitable for roasting meat in ovenware with lid, with the exception of browning a ham joint. Only use ovenware with a tightly fitting lid. Also observe the information from the ovenware manufacturer.

Suitable cookware

We recommend heat-resistant cookware (up to 300 °C) made from glass or glass ceramic. Roasting dishes made from stainless steel are not ideal. Their shiny surface reflects a high proportion of the thermal radiation. The food will not brown as much and the meat will be less well cooked. If you use a stainless-steel roasting dish, remove the lid once the programme has finished. Grill the meat at grill setting 3 for 8 to 10 minutes more. The dish browns more quickly if you use a roasting dish made of enamelled steel, cast iron or diecast aluminium. Add a little more liquid.

Unsuitable cookware

Cookware made of bright, shiny aluminium, unglazed clay or plastic, and cookware with plastic handles, is not suitable.

Size of the ovenware

The meat should cover about two thirds of the ovenware base. This will ensure that you get good meat juices.

The distance between the meat and the lid must be at least 3 cm. The meat may expand during the roasting process.

Preparing the dish

You can use fresh or frozen meat. We recommend fresh chilled meat.

Select a suitable roasting dish.

Weigh the fresh or frozen meat, poultry or fish. You will find detailed information in the corresponding tables. You need the weight in order to make the setting.

Season the meat. Season frozen meat in the same way as fresh meat.

Many dishes require the addition of liquid. Pour enough liquid into the ovenware so that the base is covered to a depth of approx. ½ cm. If the table specifies “a little” liquid, 2-3 tablespoons are usually sufficient. If the table says “Yes”, feel free to add more. Observe the instructions given before and in the tables.

Cover the ovenware with a lid. Place it on the wire rack at level 2.

For some dishes, it is not possible to set a later end time. These dishes are marked with an asterisk *.

Always place the ovenware into the cooking compartment without preheating it.

Programmes

Poultry

Place poultry in the roasting dish, breast side up. The programme is not suitable for stuffed poultry.

When cooking several drumsticks, set the weight of the heaviest drumstick. The drumsticks must be approximately the same weight.

Example: For 3 chicken drumsticks of 300 g, 320 g and 400 g, set 400 g.

Just as with drumsticks, if you want to prepare two chickens of similar size in one roasting dish, make settings according to the weight of the heavier chicken.

Programmes	Programme number	Weight range in kg	Add liquid	Weight setting
Poultry				
Chicken, fresh	P1*	0.7-2.0	No	Weight of meat
Poulard, fresh	P2*	1.4-2.3	No	Weight of meat
Duck, fresh	P3*	1.6-2.7	No	Weight of meat
Goose, fresh	P4*	2.5-3.5	No	Weight of meat
Small turkey, fresh	P5*	2.5-3.5	No	Weight of meat
Drumsticks, fresh, e. g. chicken, duck, goose, turkey drumsticks	P6*	0.3-1.5	No	Weight of heaviest drumstick

Meat

Pour the specified amount of liquid into the ovenware.

Beef

When cooking pot roasts, ensure that sufficient liquid is added. You can also use the marinade. Cook sirloin fatty-side up.

Programmes	Programme number	Weight range in kg	Add liquid	Weight setting
Beef				
Pot roast, fresh e g. prime rib, boned shoulder, shoulder, marinated beef	P7	0.5-3.0	Yes	Weight of meat
Pot roast, frozen e g. prime rib, boned shoulder, shoulder	P8*	0.5-2.0	Yes	Weight of meat
Sirloin, fresh, rare e. g. loin	P9	0.5-2.5	No	Weight of meat
Veal				
Joint, fresh, lean e. g. topside, flank	P10	0.5-3.0	Yes	Weight of meat
Joint, fresh, marbled e. g. neck, scrag end	P11	0.5-3.0	A little	Weight of meat
Knuckle on the bone, fresh	P12	0.5-2.5	Yes	Weight of meat
Lamb				
Leg, fresh, boned, well done	P13	0.5-2.5	A little	Weight of meat
Leg, fresh, boned, medium	P14	0.5-2.5	No	Weight of meat
Leg, fresh, on the bone, well done	P15	0.5-2.5	A little	Weight of meat
Leg, frozen, boned, well-done	P16*	0.5-2.0	A little	Weight of meat
Leg, frozen, on the bone, well done	P17*	0.5-2.0	A little	Weight of meat

Game

Game can be covered with bacon, which keeps the meat more succulent, but means that it will not brown as much. To create a more delicate taste, you can marinate the game overnight in the fridge in buttermilk, wine or vinegar, before cooking.

When cooking more than one haunch of hare, set the weight of the heaviest haunch.

Rabbit can also be cooked pre-cut into portions. Set the total weight.

Game	Programme number	Weight range in kg	Add liquid	Weight setting
Joint of venison, fresh e. g. shoulder, breast	P18	0.5-3.0	Yes	Weight of meat
Boned leg of roe venison, fresh	P19	0.5-3.0	Yes	Weight of meat
Hare haunch on the bone, fresh	P20	0.3-0.6	Yes	Weight of meat

Game	Programme number	Weight range in kg	Add liquid	Weight setting
Rabbit, fresh	P21	0.5-3.0	Yes	Weight of meat

Fish

Prepare the fish, then add vinegar, lemon juice or white wine and salt as usual.

For braised fish: Pour some liquid (e. g. wine or lemon juice) into the cookware, ½ cm deep.

For baked fish: Turn the fish in flour and brush with melted butter.

Whole fish turns out particularly well if it is placed in the dish in a swimming position In other words, the dorsal fin is pointing upwards. To ensure that the fish remains in position, place half a potato or a small, ovenproof container into the stomach cavity.

When cooking more than one fish, set the total weight. However, the fish must be roughly the same size or the same weight. Example: For two trout of 0.6 kg and 0.5 kg, set 1.1 kg.

Programmes	Programme number	Weight range in kg	Add liquid	Weight setting
Fish				
Trout, fresh, braise	P22*	0.3-1.5	Yes	Total weight
Trout, fresh, bake	P23*	0.3-1.5	No	Total weight
Cod, fresh, braise	P24*	0.5-2.0	Yes	Total weight
Cod, fresh, bake	P25*	0.5-2.0	No	Total weight

Stew

You can combine various types of meat and fresh vegetables.

Cut the meat into bite-sized pieces. Use whole chicken portions.

Add between the same and double the quantity of vegetables to the meat. Example: For 0.5 kg of meat, add 0.5 kg to 1 kg of fresh vegetables.

If you wish the meat to brown, add it as the last ingredient to the roasting dish on top of the vegetables. If you do not want it to brown so much, mix the meat in among the vegetables.

When cooking a stew with meat, set the weight of the meat. If you want the vegetables to be softer, set the total weight.

Firm types of vegetables are suitable for making vegetable stew, such as carrots, green beans, white cabbage, celery and potatoes. The smaller you cut the vegetables, the softer they will become. So that the vegetables are not browned too much, cover them with liquid.

Programmes	Programme number	Weight range in kg	Add liquid	Weight setting
Stew				
With meat e. g. beef stew	P26	0.3-3.0	Yes	Weight of meat
With vegetables e. g. vegetable stew	P27	0.3-3.0	Yes	Total weight
Goulash	P28	0.3-3.0	Yes	Weight of meat
Roulades	P29	0.3-3.0	Yes	Weight of meat

Meat loaf

Use fresh minced meat.

Set the total weight of the meat loaf.

The recipe can be improved by adding diced vegetables or cheese.

Programmes	Programme number	Weight range in kg	Add liquid	Weight setting
Meat loaf				
Made from fresh beef	P30	0.3-3.0	No	Total weight
Made from fresh lamb	P31*	0.3-3.0	No	Total weight
Made from fresh, mixed meat	P32*	0.3-3.0	No	Total weight
Made from fresh pork	P33*	0.3-3.0	No	Total weight



Pork

Joints with a crust should be placed in the dish with the crust side up. Score the rind to make a grid-like pattern, without cutting into the meat.

Place ham joints in the dish with the layer of fat facing upwards. Cook in an uncovered dish until a brown crust forms.

When roasting joints of meat, set the weight of the meat. For rolled roasting joints, set the total weight.

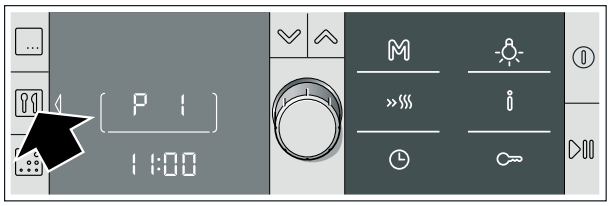
Programmes	Programme number	Weight range in kg	Add liquid	Weight setting
Pork				
Neck joint, fresh, boned	P34	0.5-3.0	Yes	Weight of meat
Neck joint, frozen, boned	P35*	0.5-2.0	Yes	Weight of meat
Roast loin, fresh	P36	0.5-2.5	Yes	Weight of meat
Rolled roasting joint, fresh	P37	0.5-3.0	Yes	Total weight
Joint with crust, fresh, belly	P38	0.5-3.0	No	Weight of meat
Ham joint, fresh, cured, cook	P39	1.0-4.0	A little	Weight of meat
Ham joint, fresh, cured, brown	P40*	1.0-4.0	No	Weight of meat

Selecting and setting a programme

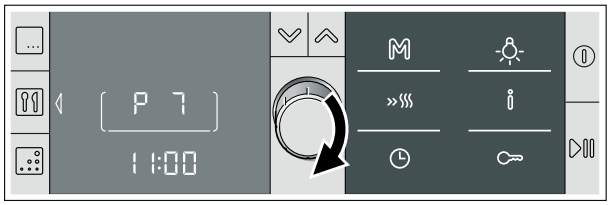
First choose a suitable programme from the programme table.

Example in the diagram: setting for pot-roasted beef, fresh, programme 7, weight of meat 1.3 kg.

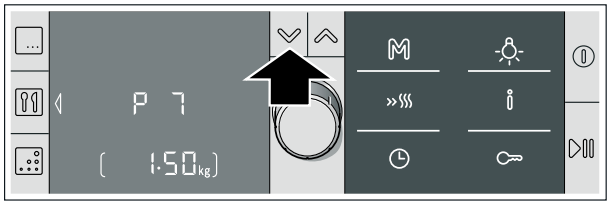
1. Press the button.
The first programme number appears in the temperature display.



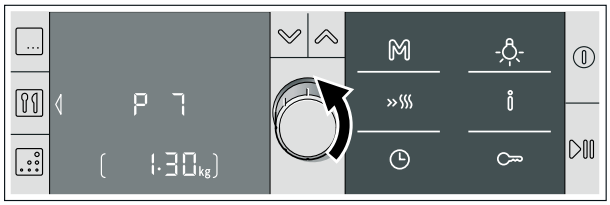
2. Select the desired programme number using the rotary selector.



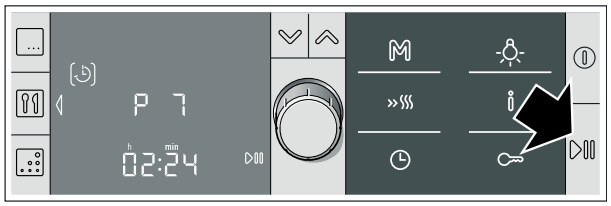
3. Press the button.
A weight is suggested in the clock display.



4. Use the rotary selector to specify the weight of the dish.



5. Press the button.
The programme length is shown.



The programme starts. You will see the cooking time [] counting down on the clock display.

The programme has ended

A signal sounds. The oven stops heating. You can cancel the signal earlier by pressing the button.

Changing the programme duration

The duration of the programme cannot be changed.

Changing the programme

Once a programme has been started, it can no longer be changed.

Opening the oven door during cooking

Operation is suspended. When the door is closed again, operation resumes.

Pausing operation

Press the button briefly. The oven is paused. Press the button again to continue operation.

Cancelling the programme

Press and hold button until the symbol for 3D hot air and 160 °C appear. You can now change the settings.

Setting a later end time

See the section entitled *Time-setting options - Setting a later end time*.

Tips for the automatic programmes

The weight of the joint or poultry is greater than the weight ranges available.	The weight range is deliberately limited. For very large joints, it is often impossible to obtain a sufficiently large roasting dish. Prepare large pieces with Top/bottom heating or Hot air grilling.
The joint has cooked well, but the juices are too dark.	Select a smaller dish or use more liquid.
The joint has cooked well, but the juices are too clear and watery.	Select a larger dish or use less liquid.
The joint is too dry on the top.	Use a dish with a tightly fitting lid. Very lean meat will remain more succulent if it is covered with rashers of bacon.
The joint looks good, but there was a burning smell during roasting.	The lid of the roasting dish is not closed properly, or the meat has expanded and has pushed up the lid. Always use the right lid for your ovenware. Make sure that there is at least 3 cm between the meat and the lid.
You wish to prepare frozen meat.	Season frozen meat in the same way as fresh meat. Caution: For frozen meat it is not possible to delay the end time. The meat would defrost during the waiting time and would be inedible.

Tested for you in our cooking studio

Here you will find a selection of dishes and the ideal settings for them. We will show you which type of heating and which temperature are best suited for your dish. You can find information about suitable accessories and the height at which they should be inserted. There are also tips about cookware and preparation methods.

Notes

- The values in the table always apply to dishes placed into the cooking compartment when it is cold and empty.

  Only preheat the appliance if the table specifies that you should do so. Do not line the accessories with greaseproof paper until after they have been preheated.
- The times specified in the tables are guidelines only. They will depend on the quality and composition of the food.
- Use the accessories supplied. Additional accessories may be obtained as special accessories from specialist retailers or from the after-sales service.

  Before using the oven, remove any unnecessary accessories and ovenware from the cooking compartment.
- Always use oven gloves when taking hot accessories or ovenware out of the cooking compartment.

Cakes and pastries

Baking on one level

When baking cakes, the best results can be achieved using Top/bottom heating.

When baking with 3D hot air, use the following shelf heights for the accessory:

- Cakes in tins: level 2
- Cakes on trays: level 3

Baking on two or more levels

Use 3D hot air.

Shelf heights for baking on 2 levels:

- Universal pan: level 3
- Baking tray: level 1

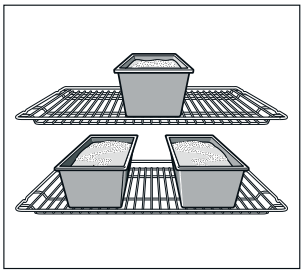
Shelf heights for baking on 3 levels:

- Baking tray: level 5
- Universal pan: level 3
- Baking tray: level 1

Baking trays that are placed in the oven at the same time will not necessarily be ready at the same time.

The tables show numerous suggestions for your dishes.

If you are baking with 3 cake/loaf tins at the same time, place these on the wire racks as indicated in the picture.



Baking tins

It is best to use dark-coloured metal baking tins.

Baking times are increased when light-coloured baking tins made of thin metal or glass dishes are used, and cakes do not brown so evenly.

If you wish to use silicone baking tins, use the information and recipes provided by the manufacturer as a guide. Silicone baking tins are often smaller than normal tins. The amount of mixture and recipe instructions may differ.

Tables

The tables show the ideal type of heating for the various cakes and pastries. The temperature and baking time depend on the amount and composition of the mixture. This is why temperature ranges are given in the tables. You should try the lower temperature first, since a lower temperature results in more even browning. You can increase the temperature next time if necessary.

If you preheat the oven, the baking time is shortened by 5 to 10 minutes.

Additional information can be found in the *Baking tips* section following the tables.

Note: Due to the high level of moisture when baking with HydroBake, condensation can form on the inside window of the oven. Open the oven door carefully, as hot steam will escape.

Cakes in tins	Tin	Level	Type of heating	Temperature in °C	Cooking time in minutes
Sponge cake, simple	ring tin/round tin	2		160-180	50-60
	3 loaf tins	3+1		140-160	60-80
Sponge cake, delicate	ring tin/round tin	2		150-170	60-70
Flan base, sponge	flan tin	3		160-180	20-30
Delicate fruit flan, sponge	springform/ring tin	2		160-180	50-60
Sponge base, 2 eggs (preheat)	flan tin	2		160-180	20-30
Sponge flan, 6 eggs (preheat)	springform cake tin	2		160-180	40-50
Shortcrust pastry base with crust	springform cake tin	1		180-200	25-35
Fruit tart/cheesecake, pastry base*	springform cake tin	1		160-180	70-90
Swiss flan	pizza tray	1		220-240	35-45
Ring cake	ring cake tin	2		150-170	60-70
Pizza, thin base with light topping (preheat)	pizza tray	1		280-300	10-15
Savoury cakes*	springform cake tin	1		170-190	45-55

* Turn off the oven and allow cakes to cool for an additional 20 minutes with the oven door closed.

Cakes on trays	Accessories	Level	Type of heating	Temperature in °C	Cooking time in minutes
Sponge with dry topping	baking tray	2		170-190	20-30
	universal pan + baking tray	3+1		150-170	35-45
Sponge with moist topping (fruit)	universal pan	2		170-190	25-35
	universal pan + baking tray	3+1		140-160	40-50
Yeast dough with dry topping	baking tray	3		170-190	25-35
	universal pan + baking tray	3+1		150-170	35-45
Yeast dough with moist topping (fruit)	universal pan	3		160-180	40-50
	universal pan + baking tray	3+1		150-160	50-60
Shortcrust pastry with dry topping	baking tray	1		180-200	20-30
Shortcrust pastry with moist topping (fruit)	universal pan	2		160-180	60-70
Swiss flan	universal pan	1		210-230	40-50
Swiss roll (preheat)	baking tray	2		170-190	15-20
Plaited loaf with 500 g flour	baking tray	2		180-200	25-35
Stollen with 500 g flour	baking tray	3		160-180	60-70
Stollen with 1 kg flour	baking tray	3		140-160	90-100
Strudel, sweet	universal pan	2		190-210	55-65
Pizza	baking tray	2		220-240	25-35
	universal pan + baking tray	3+1		180-200	40-50
Tarte flambée (preheat)	universal pan	2		280-300	10-12
Börek	Universal pan	2		180-200	40-50

Small baked items	Accessories	Level	Type of heating	Temperature in °C	Cooking time in minutes
Biscuits	baking tray	3		140-160	15-25
	universal pan + baking tray	3+1		130-150	25-35
	2 baking trays + universal pan	5+3+1		130-150	30-40

Small baked items	Accessories	Level	Type of heating	Temperature in °C	Cooking time in minutes
Viennese whirls (preheat)	baking tray	3		140-150	30-40
	baking tray	3		140-150	25-35
	universal pan + baking tray	3+1		140-150	30-45
	2 baking trays + universal pan	5+3+1		130-140	35-50
Macaroons	baking tray	2		100-120	30-40
	universal pan + baking tray	3+1		100-120	35-45
	2 baking trays + universal pan	5+3+1		100-120	40-50
Meringue	baking tray	3		80-100	100-150
Muffins	wire rack with muffin tray	3		180-200	20-25
	2 wire racks with muffin trays	3+1		160-180	25-30
Choux pastry	baking tray	2		210-230	30-40
Puff pastry	baking tray	3		180-200	20-30
	universal pan + baking tray	3+1		180-200	25-35
	2 baking trays + universal pan	5+3+1		170-190	35-45
Leavened cake	baking tray	3		190-210	20-30
	universal pan + baking tray	3+1		160-180	25-35

Bread and rolls
When baking bread, preheat the oven, unless instructions state otherwise.

Never pour water into the hot oven.

Bread and rolls	Accessories	Level	Type of heating	Temperature in °C	Cooking time in minutes
Yeast bread with 1.2 kg flour	universal pan	2		300	5
				200	30-40
Sourdough bread with 1.2 kg flour	universal pan	2		300	8
				200	35-45
Flatbread	universal pan	2		300	10-15
Bread rolls (do not preheat)	baking tray	3		200-220	20-30
Rolls made with sweet yeast dough	baking tray	3		180-200	15-20
	universal pan + baking tray	3+1		150-170	20-30

Baking tips

You wish to bake according to your own recipe.	Use similar items in the baking tables as a guide.
How to establish whether sponge cake is baked through.	Approximately 10 minutes before the end of the baking time specified in the recipe, stick a cocktail stick into the cake at the highest point. If the cocktail stick comes out clean, the cake is ready.
The cake collapses.	Use less fluid next time or set the oven temperature 10 degrees lower. Observe the specified mixing times in the recipe.
The cake has risen in the middle but is lower around the edge.	Do not grease the sides of the springform cake tin. After baking, loosen the cake carefully with a knife.
The cake goes too dark on top.	Place it lower in the oven, select a lower temperature and bake the cake for a little longer.
The cake is too dry.	When it is done, make small holes in the cake using a cocktail stick. Then drizzle fruit juice or an alcoholic beverage over it. Next time, select a temperature 10 degrees higher and reduce the baking time.
The bread or cake (e.g. cheesecake) looks good, but is soggy on the inside (sticky, streaked with water).	Use slightly less fluid next time and bake for slightly longer at a lower temperature. For cakes with a moist topping, bake the base first. Sprinkle it with almonds or bread crumbs and then place the topping on top. Please follow the recipe and baking times.
The cake is unevenly browned.	Select a slightly lower temperature to ensure that the cake is baked more evenly. Bake delicate pastries on one level using Top/bottom heating. Protruding greaseproof paper can affect the air circulation. For this reason, always cut greaseproof paper to fit the baking tray.
The bottom of a fruit cake is too light.	Place the cake one level lower the next time.

The fruit juice overflows.	Next time, use the deeper universal pan, if you have one.
Small baked items made out of yeast dough stick to one another when baking.	There should be a gap of approx. 2 cm around each item. This gives enough space for the baked items to expand well and turn brown on all sides.
You were baking on several levels. The items on the top baking tray are darker than that on the bottom baking tray.	Always use 3D hot air to bake on more than one level. Baking trays that are placed in the oven at the same time will not necessarily be ready at the same time.
Condensation forms when you bake moist cakes.	Baking may result in the formation of water vapour, which escapes above the door. The steam may settle and form water droplets on the control panel or on the fronts of adjacent units. This is a natural process.

Meat, poultry, fish

Ovenware

You may use any heat-resistant ovenware. The universal pan is suitable for large roasts.

Glass ovenware is the most suitable. Ensure that the lid of the roasting dish fits well and closes properly.

Add a little more liquid when using enamelled roasting dishes.

With roasting dishes made of stainless steel, browning is not so intense and the meat may be somewhat less well cooked. Increase the cooking times.

Information in the tables:
Ovenware without a lid = open
Ovenware with a lid = closed

Always place the ovenware in the centre of the wire rack.

Place hot glass ovenware on a dry mat after cooking. The glass could crack if placed on a cold or wet surface.

Roasting

Add in a little liquid if the meat is lean. Cover the base of the ovenware with approx. ½ cm of liquid.

Add liquid generously for pot roasts. Cover the base of the ovenware with approx. 1 - 2 cm of liquid.

The amount of liquid depends on the type of meat and the material the ovenware is made of. If preparing meat in an enamelled roasting dish, it will need a little more liquid than if cooked in glass ovenware.

Roasting dishes made from stainless steel are not ideal. The meat cooks more slowly and browns less fully. Use a higher temperature and/or a longer cooking time.

Grilling

When grilling, preheat the oven for approx. 3 minutes, before placing the food into the cooking compartment.

Always grill with the oven door closed.

As far as possible, the pieces of food you are grilling should be of equal thickness. This will allow them to brown evenly and remain succulent and juicy.

Turn the food you are grilling after ⅔ of the time.

Do not add salt to steaks until they have been grilled.

Place the food to be grilled directly on the wire rack. If you are grilling a single piece, the best results are achieved by placing it in the centre of the wire rack.

The universal pan should also be inserted at level 1. The meat juices are collected in the pan and the oven is kept cleaner.

When grilling, do not insert the baking tray or universal pan at level 4 or 5. The high heat distorts it and the cooking compartment can be damaged when removing it.

The grill element switches on and off continually. This is normal. The grill setting determines how frequently this will happen.

Meat

Turn pieces of meat halfway through the cooking time.

When the roast is ready, turn off the oven and allow it to rest for an additional 10 minutes. This allows better distribution of the meat juices.

After cooking, wrap sirloin in aluminium foil and leave it to rest for 10 minutes in the oven.

For roast pork with a rind, score the rind in a crossways pattern, then lay the roast in the dish with the rind at the bottom.

Meat	Weight	Accessories and ovenware	Level	Type of heating	Temperature in °C, grill setting	Cooking time in minutes
Beef						
Pot-roasted beef	1.0 kg	covered	2		200-220	100
	1.5 kg		2		190-210	120
	2.0 kg		2		180-200	140
Fillet of beef, medium	1.0 kg	uncovered	2		210-230	60
	1.5 kg		2		200-220	80
Sirloin, medium	1.0 kg	uncovered	1		220-240	60
Steaks, 3 cm thick, medium		wire rack + universal pan	5+1		3	15
Veal						
Joint of veal	1.0 kg	uncovered	2		190-210	110
	1.5 kg		2		180-200	130
	2.0 kg		2		170-190	150
Knuckle of veal	1.5 kg	uncovered	2		210-230	140

Meat	Weight	Accessories and ovenware	Level	Type of heating	Temperature in °C, grill setting	Cooking time in minutes
Pork						
Joint without rind (e.g. neck)	1.0 kg	uncovered	1		190-210	120
	1.5 kg		1		180-200	150
	2.0 kg		1		170-190	170
Joint with rind (e.g. shoulder)	1.0 kg	uncovered	1		190-210	130
	1.5 kg		1		180-200	160
	2.0 kg		1		170-190	190
Fillet of pork	500 g	wire rack + universal pan	3+1		230-240	30
Pork joint, lean	1.0 kg	uncovered	2		200-220	120
	1.5 kg		2		190-210	140
	2.0 kg		2		180-200	160
Smoked pork on the bone	1.0 kg	covered	2		210-230	70
Steaks, 2 cm thick		wire rack + universal pan	5+1		3	15
Pork medallions, 3 cm thick		wire rack + universal pan	5+1		3	10
Lamb						
Saddle of lamb on the bone	1.5 kg	uncovered	2		190-210	60
Leg of lamb, boned, medium	1.5 kg	uncovered	1		160-180	120
Game						
Saddle of venison on the bone	1.5 kg	uncovered	2		200-220	50
Leg of roe venison, boned	1.5 kg	covered	2		210-230	100
Wild boar joint	1.5 kg	covered	2		180-200	140
Joint of venison	1.5 kg	covered	2		180-200	130
Rabbit	2.0 kg	covered	2		220-240	60
Minced meat						
Meat loaf	Made from 500 g meat	uncovered	1		180-200	80
Sausages						
Sausages		wire rack + universal pan	4+1		3	15

Poultry

The weights indicated in the table refer to oven-ready poultry (without stuffing).

Place whole poultry on the lower wire rack breast-side down. Turn after ⅔ of the specified time.

Turn roasts, such as rolled turkey joint or turkey breast, halfway through the cooking time. Turn poultry portions after ⅔ of the time.

For duck or goose, pierce the skin on the underside of the wings. This allows the fat to run out.

Poultry will turn out particularly crispy and brown if you baste it towards the end of the roasting time with butter, salted water or orange juice.

Poultry	Weight	Accessories and ovenware	Level	Type of heating	Temperature in °C, grill setting	Cooking time in minutes
Chicken, whole	1.2 kg	wire rack	2		220-240	60-70
Poulard, whole	1.6 kg	wire rack	2		210-230	80-90
Chicken, halved	500 g each	wire rack	2		220-240	40-50
Chicken portions	150 g each	wire rack	3		210-230	30-40
Chicken portions	300 g each	wire rack	3		210-230	35-45
Chicken breast	200 g each	wire rack	3		3	30-40
Duck, whole	2.0 kg	wire rack	2		190-210	100-110

Poultry	Weight	Accessories and ovenware	Level	Type of heating	Temperature in °C, grill setting	Cooking time in minutes
Duck breast	300 g each	wire rack	3		240-260	30-40
Goose, whole	3.5-4.0 kg	wire rack	2		170-190	120-140
Goose legs	400 g each	wire rack	3		220-240	40-50
Small turkey, whole	3.0 kg	wire rack	2		180-200	80-100
Rolled turkey joint	1.5 kg	uncovered	1		200-220	110-130
Turkey breast	1.0 kg	covered	2		180-200	80-90
Turkey thigh	1.0 kg	wire rack	2		180-200	90-100

Fish

Turn the pieces of fish after ⅔ of the time.

Whole fish does not have to be turned. Place the whole fish in the oven in its swimming position with its dorsal fin facing upwards. Placing half a potato or a small ovenproof container in the stomach cavity of the fish will make it more stable.

For fish fillet, add a few tablespoons of liquid to provide steam.

Fish	Weight	Accessories and ovenware	Level	Type of heating	Temperature in °C, grill setting	Cooking time in minutes
Fish, whole	300 g each (approx.)	wire rack	2		2	20-25
	1.0 kg	wire rack	2		200-220	45-55
	1.5 kg	wire rack	2		190-210	60-70
	2.0 kg	covered	2		190-210	70-80
Fish steak, 3 cm thick		wire rack	3		2	20-25
Fish fillet		covered	2		210-230	25-30

Tips for roasting and grilling

The table does not contain information for the weight of the joint.	Select the next lowest weight from the instructions and extend the time.
How to tell when the roast is ready.	Use a meat thermometer (available from specialist shops) or carry out a “spoon test”. Press down on the roast with a spoon. If it feels firm, it is ready. If the spoon can be pressed in, it needs to be cooked for a little longer.
The roast is too dark and the crackling is partly burnt.	Check the shelf height and temperature.
The roast looks good but the juices are burnt.	Next time, use a smaller roasting dish or add more liquid.
The roast looks good but the juices are too clear and watery.	Next time, use a larger roasting dish and use less liquid.
Steam rises from the roast when basted.	This is normal and due to the laws of physics. The majority of the steam escapes through the steam outlet. It may settle and form condensation on the cooler switch panel or on the fronts of adjacent units.

Slow cooking

Slow cooking, also known as low-temperature cooking, is the ideal cooking method for tender pieces of meat that are to be cooked medium rare or à point. Meat remains very succulent and tender.

The benefit of this cooking method is that it allows lots of scope for menu planning because slow-cooked meat is easy to keep warm.

Notes

- Only use fresh, good-quality meat. Carefully remove sinews and fat from around the edge. Fat develops a strong, distinct taste during slow cooking.
- Larger pieces of meat do not need to be turned.
- Meat can be carved immediately following slow cooking. No standing time is required.
- Due to the special cooking method, the meat looks pink, i.e. medium rare. This does not mean, however, that it is raw or not well done enough.
- If you want to make gravy, cook the meat in ovenware with a lid. Please note that the cooking times will be reduced.
- In order to check whether the meat is cooked, use a meat thermometer. A core temperature of 60 °C should be maintained for at least 30 minutes.

Suitable ovenware

Use shallow ovenware, e.g. a porcelain serving plate or an glass roasting dish without the lid.

Always place the uncovered ovenware on the wire rack at level 2.

Making settings

1. Select Top/bottom heating and set a temperature between 70 and 90 °C.

   Preheat the oven, placing the ovenware inside it to warm.

2. Rapidly heat a little fat in a pan. Sear the meat on all sides, even on the ends, and place immediately on the preheated ovenware.
3. Put the ovenware containing the meat back in the oven and slow cook. A slow-cook temperature of 80 °C is ideal for most pieces of meat.

Table

All tender joints of poultry, beef, veal, pork and lamb are suitable for slow cooking. The slow cooking times depend on the thickness and the core temperature of the meat.

Dish	Weight	Level	Type of heating	Temperature in °C	Searing time in minutes	Slow cooking time in hours
Poultry						
Turkey breast	1000 g	2		80	6-7	4-5
Duck breast*	300-400 g	2		80	3-5	2-2½
Beef						
Joint of beef (e.g. rump) 6-7 cm thick	approx. 1.5 kg	2		80	6-7	4½-5½
Tenderloin, whole	approx. 1.5 kg	2		80	6-7	5-6
Sirloin, 5-6 cm thick	approx. 1.5 kg	2		80	6-7	4-5
Steak-cut rump, 3 cm thick		2		80	5-7	80-110 Min.
Veal						
Joint of veal (e.g. topside), 6-7 cm thick	approx. 1.5 kg	2		80	6-7	5-6
Fillet of veal	approx. 800 g	2		80	6-7	3-3½
Pork						
Pork joint, lean (e.g. loin), 5-6 cm thick	approx. 1.5 kg	2		80	6-7	5-6
Fillet of pork, whole	approx. 500 g	2		80	6-7	2½-3
Lamb						
Lamb saddle fillet, whole	approx. 200 g	2		80	5-6	1½-2

* For crispy skin, briefly fry the duck breast in a frying pan after slow cooking.

Tips for slow cooking

Slow-cooked meat is not as hot as conventionally roasted meat.	So that the roasted meat does not cool so quickly, warm the plates and serve the gravy very hot.
If you wish to keep slow-cooked meat warm.	After slow cooking, turn the temperature down to 70 °C. Small pieces of meat can be kept warm for up to 45 minutes, larger pieces for up to 2 hours.

Bakes, gratins, toast with toppings

Always place ovenware on the wire rack.

If you are grilling directly on the wire rack without ovenware, you should also insert the universal pan at level 1. This keeps the oven cleaner.

How well cooked the bake is will depend on the size of the ovenware and the height of the bake. The figures in the table are only average values.

Dish	Accessories and ovenware	Level	Type of heating	Temperature in °C, grill setting	Cooking time in minutes
Bakes					
Bake, sweet	ovenproof dish	2		180-200	50-60
Soufflé	ovenproof dish	2		180-200	35-45
	Ramekins	2		200-220	20-25
Pasta bake	ovenproof dish	2		200-220	40-50
Lasagne	ovenproof dish	2		180-200	40-50
Gratin					
Potato gratin, raw ingredients, max. 4 cm deep	1 ovenproof dish	2		160-180	60-80
	2 ovenproof dishes	3+1		150-170	60-80



Dish	Accessories and ovenware	Level	Type of heating	Temperature in °C, grill setting	Cooking time in minutes
Toast					
4 slices, with topping	wire rack + universal pan	3+1		160-170	10-15
12 slices, with topping	wire rack + universal pan	3+1		160-170	15-20

Convenience products

Observe the instructions on the packaging.

If you line the accessories with greaseproof paper, make sure that the paper is suitable for these temperatures. Make sure the paper is a suitable size for the dish to be cooked.

The cooking result greatly depends on the quality of the food. Pre-browning and irregularities can sometimes even be found on the raw product.

Dish	Accessories	Level	Type of heating	Temperature in °C	Cooking time in minutes
Pizza, frozen					
Pizza with thin base	universal pan	2	/	200-220	15-25
	universal pan + wire rack	3+1		180-200	20-30
Pizza with deep-pan base	universal pan	2	/	170-190	20-30
	universal pan + wire rack	3+1		170-190	25-35
Pizza baguette	universal pan	3	/	170-190	20-30
Mini pizza	universal pan	3	/	190-210	10-20
Pizza, chilled					
Pizza (preheat)	universal pan	1	/	180-200	10-15
Potato products, frozen					
Chips	universal pan	3	/	190-210	20-30
	universal pan + baking tray	3+1		180-200	30-40
Croquettes	universal pan	3	/	190-210	20-25
Rösti, stuffed potato pockets	universal pan	3	/	200-220	15-25
Baked items, frozen					
Bread rolls, baguette	universal pan	3	/	180-200	10-20
Pretzels (dough)	universal pan	3	/	200-220	10-20
Baked items, prebaked					
Part-cooked rolls, part-cooked baguette	universal pan	2		190-210	10-20
	universal pan + wire rack	3+1		160-180	20-25
Processed portions, frozen					
Fish fingers	universal pan	2	/	220-240	10-20
Chicken goujons, chicken nuggets	universal pan	3	/	200-220	15-25
Strudel, frozen					
Strudel	universal pan	3	/	190-210	30-35

Special dishes

At low temperatures, 3D hot air is equally useful for producing creamy yoghurt as it is for proving light yeast dough.

First, remove accessories, hook-in racks or telescopic shelves from the cooking compartment.

Preparing yoghurt

1. Bring 1 litre of milk (3.5 % fat) to the boil and cool down to 40 °C.
2. Stir in 150 g of yoghurt (at refrigerator temperature).
3. Pour into cups or small screw-top jars and cover with cling film.
4. Preheat the cooking compartment as indicated.
5. Place the cups or jars on the cooking compartment floor and incubate as indicated.

Proving dough

1. Prepare the dough as usual, place it in a heat-resistant ceramic dish and cover.
2. Preheat the cooking compartment as indicated.
3. Switch off the oven and place the dough in the cooking compartment and leave it to prove.

Dish	Ovenware		Type of heating	Temperature	Cooking time
Yoghurt	Cups or screw-top jars	on the cooking compartment floor	3D	50 °C Preheat 50 °C	5 mins 8 hrs
Proving dough	Heat-resistant dish	on the cooking compartment floor	3D	50 °C Preheat Switch off the appliance and place the yeast dough in the cooking compartment	5-10 mins 20-30 mins

Defrost

This Defrost setting is most ideal for frozen goods.

The defrosting time will depend on the type and quantity of the food.

Observe the instructions on the packaging.

Take frozen food out of its packaging and place in suitable ovenware on the wire rack.

Place poultry on a plate with the breast side facing down.

Note: The oven light does not come on at temperatures of less than 60 °C. This enables precise temperature regulation.

Dish	Accessories	Level	Type of heating	Temperature
Delicate frozen foods e.g. cream gateaux, buttercream cakes, gateaux with chocolate or sugar-based icing, fruit, etc.	wire rack	1	Defrost	30 °C
Other frozen products Chicken, sausage and meat, bread and bread rolls, cake and other baked goods	wire rack	1	Defrost	50 °C

Drying

With 3D hot air, you can dry foods brilliantly.

Use unblemished fruit and vegetables only and wash them thoroughly.

Drain off the excess water, then dry them.

Line the universal pan and the wire rack with greaseproof or parchment paper.

Turn very juicy fruit or vegetables several times.

Remove fruit and vegetables from the paper as soon as they have dried.

Fruit and herbs	Accessories	Level	Type of heating	Temperature	Cooking time
600 g apple rings	Universal pan + rack	3+1	3D	80 °C	5 hrs (approx.)
800 g pear slices	Universal pan + rack	3+1	3D	80 °C	8 hrs (approx.)
1.5 kg damsons or plums	Universal pan + rack	3+1	3D	80 °C	8-10 hrs (approx.)
200 g herbs, washed	Universal pan + rack	3+1	3D	80 °C	1½ hrs (approx.)

Preserving

For preserving, the jars and rubber seals must be clean and intact. If possible, use jars of the same size. The information in the table is for round, one-litre jars.

Caution!

Do not use jars that are larger or taller than this. The lids could crack.

Only use fruit and vegetables in good condition. Wash them thoroughly.

The times given in the tables are a guide only. The time will depend on the room temperature, number of jars, and the quantity and temperature of the contents. Before you switch off the appliance or change the cooking mode, check whether the contents of the jars are bubbling as they should.

Preparation

1. Fill the jars, but not to the top.
2. Wipe the rims of the jars, as they must be clean.
3. Place a damp rubber seal and a lid on each jar.
4. Seal the jars with the clips.

Place no more than six jars in the cooking compartment.

Making settings

1. Insert the universal pan at level 2. Arrange the jars on it so that they do not touch each other.
2. Pour ½ litre of hot water (approx. 80 °C) into the universal pan.
3. Close the oven door.

4. Set ⊟ Bottom heating.
5. Set the temperature to between 170 and 180 °C.
6. Start operation.

Preserving

Fruit

After approx. 40 to 50 minutes, small bubbles begin to form at short intervals. Switch off the oven.

After 25 to 35 minutes of residual heat, remove the preserving jars from the cooking compartment. If they are allowed to cool for longer in the cooking compartment, germs could multiply, promoting acidification of the preserved fruit.

Fruit in one-litre jars	When it starts to bubble	Residual heat
Apples, redcurrants, strawberries	Switch off	approx. 25 minutes
Cherries, apricots, peaches, gooseberries	Switch off	approx. 30 minutes
Apple purée, pears, plums	Switch off	approx. 35 minutes

Vegetables

As soon as bubbles begin to form in the jars, set the temperature back to between 120 and 140 °C. Depending on the type of vegetable, heat for approx. 35 to 70 minutes. Switch off the oven after this time and use the residual heat.

Vegetables with cold cooking water in one-litre jars	When it starts to bubble	Residual heat
Gherkins	-	approx. 35 minutes
Beetroot	approx. 35 minutes	approx. 30 minutes
Brussels sprouts	approx. 45 minutes	approx. 30 minutes
Beans, kohlrabi, red cabbage	approx. 60 minutes	approx. 30 minutes
Peas	approx. 70 minutes	approx. 30 minutes

Taking out the jars

After preserving, remove the jars from the cooking compartment.

Caution!

Do not place the hot jars on a cold or wet surface. They could suddenly burst.

Acrylamide in foodstuffs

Acrylamide is mainly produced in grain and potato products prepared at high temperatures, such as potato crisps, chips, toast, bread rolls, bread or fine baked goods (biscuits, gingerbread, cookies).

Tips for keeping acrylamide to a minimum when preparing food	
General	■ Keep cooking times to a minimum. ■ Cook meals until they are golden brown, but not too dark. ■ Large, thick pieces of food contain less acrylamide.
Baking	With top/bottom heating max. 200 °C. With 3D hot air or hot air max.180 °C.
Biscuits	With top/bottom heating max. 190 °C. With 3D hot air or hot air max. 170 °C. Egg or egg yolk reduces the production of acrylamide.
Oven chips	Spread evenly over the baking tray, in a single layer. Bake at least 400 g per baking tray so that the chips do not dry out

Test dishes

These tables have been produced for test institutes to facilitate the inspection and testing of the various appliances.

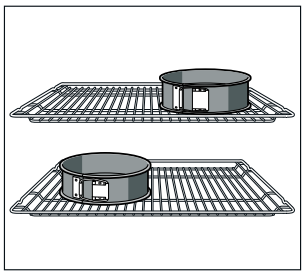
In accordance with EN 50304/EN 60350 (2009) and IEC 60350.

Baking

Baking on 2 levels:
Always insert the universal pan above the baking tray.
Baking on 3 levels:
Insert the universal pan in the middle.

Piped biscuits:
Baking trays that are placed in the oven at the same time will not necessarily be ready at the same time.

Double crust apple pie on 1 level:
place dark springform cake tins next to each other diagonally on the same level.
Double crust apple pie on 2 levels:
Place dark springform cake tins next to each other (see illustration).



Cakes in tinplate springform cake tins:
Bake on 1 level with Top/bottom heating. Place the springform cake tin on the universal pan instead of on the wire rack.

Note: For baking, use the lower of the temperatures indicated first.

Dish	Accessories and tins	Level	Type of heating	Temperature in °C	Cooking time in minutes
Whirls (preheat*)	Baking tray	3		140-150	30-40
	Universal pan + baking tray	3+1		140-150	30-45
	2 baking trays + universal pan	5+3+1		130-140	35-50
Whirls	Baking tray	3	/	140-150	30-45
Small cakes (preheat*)	Baking tray	3		150-170	20-30
	Baking tray	3		150-160	20-30
	Universal pan + baking tray	3+1		140-160	25-40
	2 baking trays + universal pan	5+3+1		130-150	25-40
Hot water sponge cake (preheat*)	Springform cake tin on the wire rack	2		160-170	30-40
Hot water sponge cake	Springform cake tin on the wire rack	2	/	160-180	30-40
German apple pie	Wire rack+ 2 springform cake tins, dia. 20 cm	1		180-200	70-90
	2 wire racks + 2 spring-form cake tins, dia. 20 cm	3+1		170-190	70-80

* Do not use rapid heating to preheat the appliance.

Grilling

If you are grilling food directly on the wire rack, the universal pan should also be inserted at level 1. The liquid is then collected, keeping the oven cleaner.

Dish	Accessories	Level	Type of heating	Grill setting	Cooking time in minutes
Toast Preheat for 10 minutes	Wire rack	5		3	½-2
Beefburgers, 12 pieces* do not preheat	Wire rack + universal pan	4+1		3	25-30

* turn over after ⅔ of the cooking time.

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Samsung TV LED 28" UE28H4000AWXXN

TV LED 28"

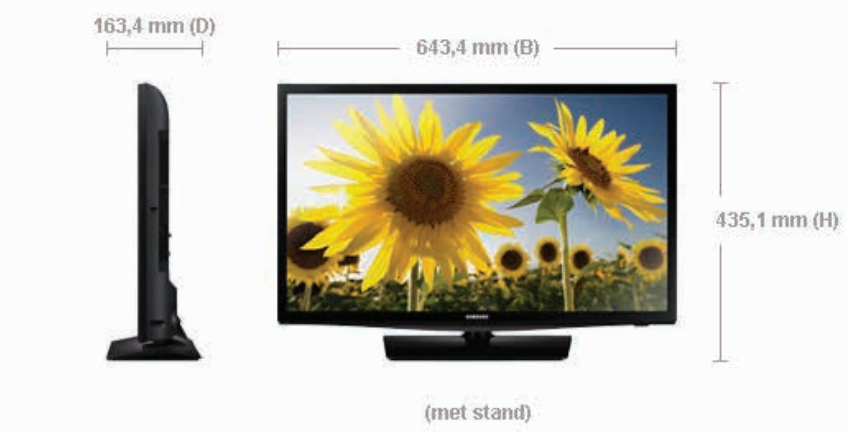
- Printervriendelijke versie

UE28H4000AW

Waar te koop

- OVERZICHT
- Kenmerken
- Specificaties
- Product Foto's
- Service & Downloads

R01 R0101 nl 02011200 UE28H4000AWXXN
Y
Y



Tabel

Product

LED

spec view Product data

Series

4

spec view Series data

Display

spec view Display data

Afmeting Inch	28"
Afmeting cm	68 cm
Resolutie	1 366 x 768

Video

spec view Video data

Picture Engine	HyperReal Engine
Clear Motion Rate	100
Wide Color Enhancer (Plus)	Ja
Film modus	Ja

Audio

spec view Audio data

Dolby MS10 / MS110	Dolby Digital Plus / Dolby Pulse
DTS Studio Sound / DNSe+	DTS Studio Sound
DTS Premium Audio / DTS Premium Audio 5.1	DTS Premium Sound 5.1
Automatische volume-afvlakking	Ja
Sound Output (RMS)	5 W x 2
Speaker Type	Down Firing + Full Range
HD Audio	Nee

Smart Convergence

spec view Smart Convergence data

Easy Pin pairing	Nee

Tuner/Broadcasting

spec view Tuner/Broadcasting data

CI / CI+ / 2CI+	CI+ (1,3)
DTV Tuner	DVB-TC
Analoge tuner	Ja
MHP / MHEG / HbbTV / ACAP / GINGA / OHTV	Nee

Connectivity

spec view Connectivity data

HDMI	2
USB	1
Componentingang (Y / Pb / Pr)	1
Composietingang (AV)	1 (Common Use for Component Y)
Hoofdtelefoonuitgang	Ja
Digitale audio-uitgang (optisch)	1
RF In (Territoriaal / kabelingang)	1
Ex-Link (RS-232C)	Nee
CI Sleuf	1
Scart	1

Design

spec view Design data

Design	Wavy Line
Lijst Type	NNB
Kleur voorzijde lijst	BLACK
Type voet	SQUARE

Additional Feature

spec view Additional Feature data

Auto Power Off	Ja
Clock & On / Off Timer	Ja
Sleeptimer	Ja
Captions (ondertiteling)	Ja
Kanaalvolgorde via USB kopiëren	Ja
ConnectShare™ (USB 2.0)	Movie
Voetbal Modus	Basic
Embeded POP	Ja
EPG	Ja
Game-modus	Ja
OSD-taal	27 European Languages
Picture-In-Picture	Ja
Teletext (TTXT)	Ja

Eco Feature

spec view Eco Feature data	
Energiezuinigheidsklasse	A+
Hoeveelheid Kwik	0,0 mg
Aanwezigheid lood	Ja

Power

spec view Power data	
Voeding	220 ~ 240 V
Stroomverbruik (Max)	44 W
Stroomverbruik (Stand-by)	0,3 W
Stroomverbruik (Energiebesparings Modus)	21 W
Stroomverbruik (IEC 62087 Edition 2)	21 W
Peak Luminance Ratio	74%
Jaarlijks Stroomverbruik (EU-Norm, kWh)	31 kWh

Dimension

spec view Dimension data	
Afmetingen doos (B x H x D)	815 x 463 x 108 mm
TV met Voet (B x H x D)	643,4 x 435,1 x 163,4 mm
TV zonder Voet (B x H x D)	643,4 x 396,5 x 62,9 mm

Gewicht

spec view Gewicht data	
Gewicht Doos	5,6 kg
TV met voet	4,1 kg
TV zonder voet	3,7 kg

Accessory

spec view Accessory data	
Afstandsbediening	TM1240A
Batterijen voor Afstandsbediening	Ja
Vesa muurbevestiging	Ja
Gebruikershandleiding (bijgeleverd)	Ja
E-Gebruikershandleiding	Ja
Stroomkabel	Ja

- Een vriend of vriendin e-mailen
- Printervriendelijke versie

Functies en specificaties kunnen zonder voorafgaande kennisgeving worden gewijzigd.



Meer informatie over milieutechnische aangelegenheden met betrekking tot dit product, kunt u terug vinden in de milieu sectie door te kiezen voor ‘More Downloadable File’ bij het onderdeel service

deze pagina afdrukken

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❑ Using the INFO button (Now & Next guide)

The display identifies the current channel and the status of certain audio-video settings.

The Now & Next guide shows daily TV programme information for each channel according to the broadcasting time.

When you press the **INFO** button, a channel information banner will appear on the top of the screen. And then press the **ENTER** button, you can see the details of the programme.

- Scroll ◄, ► to view information for a desired programme while watching the current channel.
- Scroll ▲, ▼ to view information for other channels.

❑ Memorizing channels

■ Aerial

MENU → Broadcasting → Aerial → **ENTER**

Before your television can begin memorising the available channels, you must specify the type of signal source that is connected to the TV.

■ Auto Tuning

(depending on the country)

MENU → Broadcasting → Auto Tuning → **ENTER**

Automatically allocated programme numbers may not correspond to actual or desired programme numbers. If a channel is locked, the PIN input window appears.

- Auto Tuning

  Aerial (Air/Cable): Select the aerial source to memorise.

  When selecting Air, scans for a channel automatically and stores in the TV.

  Channel Type (Digital & Analogue / Digital / Analogue): Select the channel source to memorise.

  Channel Ordering (depending on the country): Select the channel order type.

When selecting Cable → Digital & Analogue, Digital or Analogue

– Operator Selection (depending on the country): Selects a provider of cable services.

– Search Mode: Scans for all channels with active broadcast stations and stores them in the TV.

If you select Quick, you can set up the Network, Network ID, Frequency, Modulation and Symbol Rate manually by pressing the button on the remote control.

– Network: Selects the Network ID setting mode among Auto or Manual.

- Network ID: When Network is Manual, you can set up Network ID using the numeric buttons.

- Frequency: Displays the frequency for the channel (differs in each country).
- Modulation: Displays available modulation values.
- Symbol Rate: Displays available symbol rates.

- Cable Search Option

(depending on the country & cable channels only)

Sets additional search options such as the frequency and symbol rate for a cable network search.

Start Frequency / Stop Frequency: Set the start or stop frequency (differs in each country).

Symbol Rate: Displays available symbol rates.

Modulation: Displays available modulation values.

❑ Using the Channel menu

MENU → Broadcasting → Channel List → ENTER

■ Channel List

The Channel List contains the channels your TV displays when you press the channel button. You can view channel information, All, TV, Radio, Data/Other, Analogue or Favourites 1-5.

Press ► (Mode) button to change the channel mode, or press ◄ (Sorting) button to change the channel order according to channel number or name on the list.

When you press the CH LIST button on the remote control, Channel List screen will be displayed at once.

Channel Sorting

- Number / Name: Arranges the channel order according to channel number or name on the list.

Channel Mode

- Aerial: Switches to Air or Cable.
- Edit Favourites: Set channels you watch frequently as favourites.
  For detailed information about using Edit Favourites, refer to "Edit Favourites".
- Favourites 1-5: Shows all favourite channels, arranged in up to five groups. Each group has a separate screen.
  The TV displays Favourites 1-5 only if you have added favourites using Edit Favourites.

- All: Shows all currently available channels.
- TV: Shows all currently available TV channels.
- Radio: Shows all currently radio channels.
- Data/Other: Shows all currently available MHP or other channels.
- Analogue: Shows all currently available analogue channels.

■ Guide

MENU → Broadcasting → Guide → ENTER

The EPG (Electronic Programme Guide) information is provided by broadcasters. Using programme schedules provided by broadcasters, you can specify programmes you want to watch in advance so that the channel automatically changes to the selected programme channel at the specified time. Programme entries may appear blank or out of date depending on a channel status.

- A Red (Quick Nav): Viewing the TV programmes on the list quickly using ▲/▼/◄/► buttons.
- B Green (Channel Category): Select the type of channels you want to display.
- C Yellow (Schedule Manager): Moves to the reserved programmes in Schedule Manager.

■ Schedule Manager

MENU → Broadcasting → Schedule Manager → ENTER

You can set a desired channel to be displayed automatically at the intended time. In addition, you can view, modify or delete a channel you have reserved to watch.

You must set the current time first using the Time → Clock function in the System menu to use this function.

1. Press the Schedule on the Schedule Manager screen. The Schedule Viewing menu appears.
2. Press the ▲/▼/◄/► buttons to set each option menu.
   - Aerial: Select the desired broadcasting signal.
   - Channel: Select the desired channel.

   - Repeat: Select Once, Manual, Sat~Sun, Mon~Fri or Everyday to set at your convenience. If you select Manual, you can set the day you want.
     The (✓) mark indicates the day you've selected.
   - Date: You can set the desired date.
     It is available when you select Once in Repeat.
   - Start Time: You can set the start time you want.

If you want to edit or cancel a reserved schedule, select the reserved schedule on Schedule Manager. Then press the ENTER button and select the Edit or Delete.

■ Edit Channel

MENU → Broadcasting → Edit Channel → ENTER

You can edit or delete channels.

1. Go to Edit Channel screen.
2. Press the ▲/▼ buttons to select the desired channel, then press the ENTER button. The (✓) mark indicates the channel you've selected.
   You can select more than one channel.
   Press the ENTER again to deselect the channel.

Using the coloured and function buttons with the **Edit Channel**.

- A Red (**Change Number**): Changes channel order on the channel list.
  - (**Done**): Completes changing the channel order.

    Digital channel does not support this function when the **Edit Channel Number** (depending on the country) is set to **Disable**.
- B Green (**Delete**): Deletes a channel from the channel list.
- C Yellow (**Lock / Unlock**): Lock a channel so that the channel cannot be selected and viewed. / Unlock the channel that you locked.

  This function is available only when the **Channel Lock** is set to **On**.

  The PIN input screen appears. Enter your 4-digit PIN. Change the PIN using the **Change PIN** option.

- D Blue (**Select All / Deselect All**): Selects or deselects all channels at once.
- 0~9 (**Go To**): Goes to channel directly by pressing numbers (0~9).
- (**Page**): Move to previous or next page.
- (**Tools**): Displays the option menu. The option menu items that appear may differ depending on the channel status and type.
  - **Sorting** (digital channels only): Changes the list ordered by channel number or channel name.
  - **Aerial**: Select the desired broadcasting signal.

  - **Category**: Change the channel mode to **All**, **TV**, **Radio**, **Data/Other**, **Analogue**, **Recently Viewed**, **Most Viewed**. The selected channel mode is displayed.
  - **Edit Favourites**: Go to **Edit Favourites** screen directly.
  - **Rename channel** (analogue channels only): Assign a name of up to five characters to a channel. For example, Food, Golf, etc. This makes it easier to find and select the channel.
  - **Channel Info**: Display details of the selected channel.
  - **Information**: Display details of the selected programme.

■ Edit Favourites TOOLS

MENU → Broadcasting → Edit Favourites → ENTER

You can add, edit or delete favourite channels.

1. Go to Edit Favourites screen.
2. Press the ▲/▼ buttons to select the desired channel, and then press ENTER button.
3. Choose a specific favourite list among Favourites 1-5 using B (Change Fav.) button, and then press the D (Add) button. The selected channel has been added in Favourites 1-5.

   One favourite channel can be added in several of favourites among Favourites 1-5.

Using the coloured and function buttons with the Edit Favourites.

- A Red (Category / Change order)
  - Category: Changes the channel mode to All, TV, Radio, Analogue, Data/Other, Recently Viewed, Most Viewed. The selected channel mode is displayed.
  - Change order: Changes the favourite channel order.
  - (Done): Completes changing the channel order.

- B Green (Change Fav.): Changes favourite list among Favourites 1-5.
- C Yellow (Select All / Deselect All): Selects or deselects all channels at once.
- D Blue (Add / Delete)
  - Add: Adds selected channels to Favourites 1-5.
  - Delete: Deletes the favourite channel from Favourites 1-5.

- 0~9 (Go To): Goes to channel directly by pressing numbers (0~9).
- ⇕ (Page): Move to previous or next page.
- (Tools): Displays the option menu. The option menu items that appear may differ depending on the channel status and type.
  - Copy to Favourites: Edit the selected favourite channel in Favourites 1-5.
  - Rename Favourites: Assign your own favourite channel name.
  - Aerial: Select the desired broadcasting signal.
  - Edit Channel: Go to Edit Channel screen directly.
  - Information: Display details of the selected programme.

❑ Locking Programme

■ Programme Rating Lock

(depending on the country)

MENU → Broadcasting → Programme Rating Lock → ENTER

Prevent unauthorised users, such as children, from watching unsuitable programme with a user-defined 4-digit PIN code. If the selected channel is locked, the "🔒" symbol will be displayed.

The items of Programme Rating Lock differs depending on the country.

■ Channel Lock

MENU → Broadcasting → Channel Lock → ENTER

Lock channels in Channel menu to prevent unauthorised users, such as children, from watching unsuitable programme.

Available only when the Source is set to TV.

❑ Other Features

■ Channel Settings

MENU → Broadcasting → Channel Settings → ENTER

- Country (Area)
  (depending on the country)
  The PIN input screen appears. Enter your 4 digit PIN number.
  Digital Channel: Change the country for digital channels.
  Analogue Channel: Change the country for analogue channels.

- Manual Tuning
  Scans for a channel manually and stores in the TV.
  - If a channel is locked, the PIN input window appears.
  - According to the channel source, Manual Tuning may be supported.
  - Digital Channel Tuning: Scans for a digital channel manually and stores in the TV. Press the New button to search the digital channels. When scanning has finished, a channel is updated in the channel list.
    - When selecting Aerial → Air: Channel, Frequency, Bandwidth
    - When selecting Aerial → Cable: Frequency, Modulation, Symbol Rate

- Analogue Channel Tuning: Scans for an analogue channel. Press the New button to search the channels by adjusting the Programme, Colour System, Sound System, Channel, Search.
  - Channel mode
    - P (programme mode): When tuning is complete, the broadcasting stations in your area have been assigned to the position numbers from P0 to P99. You can select a channel by entering the position number in this mode.
    - C (aerial channel mode) / S (cable channel mode): These two modes allow you to select a channel by entering the assigned number for each aerial broadcasting station or cable channel.

- **Fine Tune**
  (analogue channels only)
  If the signal is weak or distorted, fine tune the channel manually.
  Fine tuned channels are marked with an asterisk "*".
  To reset the fine-tuning, select **Reset**.
- **Transfer Channel List**
  (depending on the country)
  Imports or exports the channel map. You should connect a USB storage to use this function.
  The PIN number input screen appears. Enter your 4 digit PIN number.
  Supported file systems are FAT and exFAT.
- **Delete CAM Operator Profile**: Selects the CAM operator to delete.

■ Subtitle TOOLS

MENU → Broadcasting → Subtitle → ENTER

Use this menu to set the **Subtitle** mode.

- **Subtitle**: Switches subtitles on or off.
- **Subtitle Mode**: Sets the subtitle mode.
- **Subtitle Language**: Sets the subtitle language.
  If the programme you are watching does not support the **Hearing Impaired** function, **Normal** automatically activates even if the **Hearing Impaired** mode is selected.

  English is the default in cases where the selected language is unavailable in the broadcast.
- **Primary Subtitle**: Sets the primary subtitle.
- **Secondary Subtitle**: Sets the secondary subtitle.

■ Edit Channel Number (depending on the country)

MENU → Broadcasting → Edit Channel Number → ENTER

Use this change channel number. When channel number is changed, channel information is not updated automatically.

■ Audio Options

(digital channels only)

MENU → Broadcasting → Audio Options → ENTER

- **Audio Language** TOOLS

  Change the default value for audio languages.

  Primary Audio / Secondary Audio: You can set the primary or secondary audio.

  The available language may differ depending on the broadcast.

- **Audio Format**

  When sound is emitted from both the main speaker and the audio receiver, a sound echo may occur due to the decoding speed difference between the main speaker and the audio receiver. In this case, use the TV Speaker function.

  Audio Format option may differ depending on the broadcast. 5.1ch Dolby digital sound is only available when connecting an external speaker through an optical cable.

- **Audio Description** (not available in all locations)

  This function handles the Audio Stream for the AD (Audio Description) which is sent along with the Main audio from the broadcaster.

  Audio Description: Turn the audio description function on or off.

  Volume: Adjust the audio description volume.

■ Teletext Language

(depending on the country)

MENU → Broadcasting → Teletext Language → ENTER

- **Teletext Language**

  English is the default in cases where the selected language is unavailable in the broadcast.

- **Primary teletext / Secondary teletext**

  Primary teletext and **Secondary teletext** may not be supported in some locations.

■ Digital Text

(UK only)

MENU → Broadcasting → Digital Text → ENTER

If the programme broadcasts with digital text, this feature is enabled.

MHEG (Multimedia and Hypermedia Information Coding Experts Group)
An International standard for data encoding systems used in multimedia and hypermedia. This is at a higher level than the MPEG system which includes data-linking hypermedia such as still images, character service, animation, graphic and video files as well as multimedia data. MHEG is user runtime interaction technology and is being applied to various fields including VOD (Video-On-Demand), ITV (Interactive TV), EC (Electronic Commerce), tele education, teleconferencing, digital libraries and network games.

■ Common Interface

MENU → Broadcasting → Common Interface → ENTER

- CI Menu: This enables the user to select from the CAM-provided menu. Select the CI Menu based on the menu CI CARD.
- CAM video transcoding: You can configure the setting to transcode the video codec from the CAM automatically. Turn it Off if you do not want to use it.

  You must use a CAM that supports transcoding the video codec.

- Application Info: View information on the CAM inserted into the CI slot and on the “CI or CI+ CARD” which is inserted into the CAM. You can install the CAM anytime whether the TV is on or off.
  1. Purchase a CI CAM module at your nearest dealer or by phone.
  2. Firmly insert the “CI or CI+ CARD” into the CAM in the direction of the arrow.
  3. Insert the CAM with the “CI or CI+ CARD” into the common interface slot, in the direction of the arrow so that it aligns parallel with the slot.
  4. Check if you can see a picture on a scrambled signal channel.

❑ Changing the Preset Picture Mode

■ Picture Mode TOOLS

MENU → Picture → Picture Mode → ENTER

Select your preferred picture type.

When connecting a PC, you can only make changes to the Entertain and Standard.

- Dynamic: Suitable for a bright room.
- Standard: Suitable for a normal environment.
- Natural for LED 5 series 32" and above: Suitable for reducing eye strain.
- Movie: Suitable for watching movies in a dark room.
- Entertain: Suitable for watching movies and games.

  It is only available when connecting a PC.

❑ Adjusting Picture Settings

■ Samsung MagicAngle for LED 19", 22" models

MENU → Picture → Samsung MagicAngle → ENTER

Adjust screen viewing Angle to optimise screen quality according to your viewing position.

- Samsung MagicAngle: When viewing the screen at an angle from below or above by setting the appropriate mode for each position, you can obtain a similar picture quality as viewing the screen directly from the front.

Off: Select when viewing from the front position.

Lean Back Mode: Select when viewing from a slightly lower position.

Standing Mode: Select when viewing from the upper position.

- Mode: Adjust screen viewing angle.

When Samsung MagicAngle is set to Lean Back Mode or Standing Mode, Gamma is not available.

■ Backlight for LED TV / Cell Light for PDP TV / Contrast / Brightness / Sharpness / Colour / Tint (G/R)

Your television has several setting options for picture quality control.

NOTE

- In analogue TV, Ext., AV modes of the PAL system, the Tint (G/R) function is not available.
- When connecting a PC, you can only make changes to Backlight for LED TV / Cell Light for PDP TV, Contrast, Brightness and Sharpness.
- Settings can be adjusted and stored for each external device connected to the TV.
- Lowering picture brightness reduces power consumption.

■ Picture Size

MENU → Picture → Picture Size → ENTER

Set the various picture options such as picture size and aspect ratio.

The available items may differ depending on the selected mode.

Depending on the input source, the picture size options may vary.

- Picture Size TOOLS: Your cable box/satellite receiver may have its own set of screen sizes as well. However, we highly recommend you use 16:9 mode most of the time.

  Auto Wide: Automatically adjusts the picture size to the 16:9 aspect ratio.

  16:9: Sets the picture to 16:9 wide mode.

Wide Zoom: Magnifies the picture size more than 4:3.

Adjusts the Position by using ▲, ▼ buttons.

Zoom: Magnifies the 16:9 wide pictures vertically to fit the screen size.

Adjusts the Zoom or Position by using ▲, ▼ button.

4:3: Sets the picture to basic (4:3) mode.

Do not watch in 4:3 format for a long time. Traces of borders displayed on the left, right and centre of the screen may cause image retention (screen burn) which are not covered by the warranty.

Screen Fit: Displays the full image without any cut-off when HDMI (720p / 1080i / 1080p) or Component (1080i / 1080p) signals are inputted.

- Smart View 1 for LED 5 series 32" and above: Reduces the 16:9 picture by 50%.
- Smart View 2 for LED 5 series 32" and above: Reduces the 16:9 picture by 25%.

NOTE

- Smart View 1 for LED 5 series 32" and above is enabled only in HDMI mode.
- Smart View 2 for LED 5 series 32" and above is enabled only in DTV and HDMI modes.
- The picture size can vary depending on the input resolution when content is played using Videos under Media Play.

- Zoom/Position: Adjust the picture size and position. It is only available in Zoom.
- Position: Adjust the picture position. It is only available in Screen Fit or Wide Zoom.

NOTE

- After selecting Screen Fit in HDMI (1080i / 1080p) or Component (1080i / 1080p) mode, you may need to centre the picture:
  1. Select the Position. Press the ENTER button.
  2. Press the ▲, ▼, ◄ or ► button to move the picture.
- If you want to reset the position you adjusted, select Reset in the Position screen. The picture will be set to its default position.
- If you use the Screen Fit function with HDMI 720p input, 1 line will be cut at the top, bottom, left and right as in the overscan function.

- 4:3 Screen Size: Available only when picture size is set to Auto Wide. You can determine the desired picture size at the 4:3 WSS (Wide Screen Service) size or the original size. Each European country requires different picture size.

■ PIP TOOLS

MENU → Picture → PIP → ENTER

You can watch the TV tuner and one external video source simultaneously. For example, if you have a cable box connected to the Cable In jack, you can use PIP to watch programs from the cable box and watch a movie from a Blu-ray player attached to the HDMI In jack. PIP does not function in the same mode.

NOTE

- If you turn the TV off while watching in PIP mode, the PIP window will disappear.
- You may notice that the picture in the PIP window becomes slightly unnatural when you use the main screen to view a game or karaoke.

- PIP settings

Main picture	Sub picture
Component, HDMI, HDMI2/DVI	TV

- PIP: Activate or deactivate the PIP function.
- Aerial: Select either Air or Cable as the input source for the sub-screen.
- Channel: Select the channel for the sub-screen.
- Size (/): Select a size for the sub-picture.
- Position (/ / /): Select a position for the sub-picture.
- Sound Select: You can choose the desired sound in PIP mode.

❑ Changing the Picture Options

■ Advanced Settings

MENU → Picture → Advanced Settings → ENTER

(available in Standard / Movie mode)

You can adjust the detailed setting for the screen including colour and contrast.

When connecting a PC, you can only make changes to the White Balance and Gamma.

- Dynamic Contrast: Adjust the screen contrast.
- Black Tone: Select the black level to adjust the screen depth.
- Flesh Tone: Adjust the flesh tone colour.

- RGB Only Mode: Displays the Red, Green and Blue colour for making fine adjustments to the hue and saturation.
- Colour Space: Adjust the range of colours available to create the image.
  To adjust Colour, Red, Green, Blue and Reset, set Colour Space to Custom. for PDP TV
- White Balance: You can adjust the colour temperature of the picture to make white objects look white, and the overall picture appear natural.
  2 Point: You can adjust each of the 3 colour's luminosity with the offset menu and the brightness with the gain menu. To restore the default values, select Reset.

10 Point for PDP TV: You can adjust the white balance by adjusting the brightness of each of the 10 sections of red, green, and blue colours of the input signal. To choose a section, select a desired section in Level field.

You can use the 10 Point function only when the Picture Mode is set to Movie. Some external devices may not support the function.

- Gamma: Adjust the primary colour intensity.
- Motion Lighting: Reduce power consumption by brightness control adapted motion.

  This function is not supported in 3D mode. for PDP 4900

  Only available in Standard mode.

  When changing a setting value of Backlight for LED TV / Cell Light for PDP TV, Brightness or Contrast, Motion Lighting will be set to Off.

■ Picture Options

MENU → Picture → Picture Options → ENTER

When connecting a PC, you can only make changes to the Colour Tone.

- Colour Tone

  Warm1 or Warm2 will be deactivated when the picture mode is Dynamic.

  Settings can be adjusted and stored for each external device connected to an input on the TV.

- Digital Clean View: If the broadcast signal received by your TV is weak, you can activate the Digital Clean View feature to reduce any static and ghosting that may appear on the screen.

  When the signal is weak, try other options until the best picture is displayed.

Auto Visualisation: When changing analogue channels, displays signal strength.

- Only available for analogue channels.
- When the **INFO** button is pressed, the signal strength bar is displayed.
- When bar is green, you are receiving the best possible signal.

- MPEG Noise Filter: Reduces MPEG noise to provide improved picture quality.
- HDMI Black Level: Selects the black level on the screen to adjust the screen depth.
  - Available only in HDMI mode (RGB signals).

- Film Mode: Sets the TV to automatically sense and process film signals from all sources and adjust the picture for optimum quality.
  - The Cinema Smooth function is only activated when HDMI 24Hz signal is inputted. for PDP TV
  - Available in TV mode and external input mode which supports SD (480i / 576i) and HD (1080i) except in PC mode.
  - If the screen does not seem natural, change its option to Off / Auto1 / Auto2 in Film Mode.

- LED Clear Motion for LED TV: Removes drag from fast scenes with a lot of movement to provide a clear picture.
  - It will be deactivated when the picture mode is set to Natural.
  - The screen may become slightly darker when you play LED Clear Motion.
- Black Optimiser for PDP TV: Realizes of the black colour deeply and expands the contrast ratio.
  - When connecting a PC, it will be set to off and deactivated.
  - When the TV is operating other applications, it will be deactivated. (ex. Media Play, PIP, Teletext)

■ Picture Off TOOLS

MENU → Picture → Picture Off → ENTER

The screen is turned off but the sound remains on. Press any button except volume button to turn on the screen.

■ Reset Picture

MENU → Picture → Reset Picture → ENTER

Resets your current picture mode to its default settings.

❑ Changing the Preset Sound Mode

■ Sound Mode

MENU → Sound → Sound Mode → ENTER

- Standard: Selects the normal sound mode.
- Music: Emphasises music over voices.
- Movie: Provides the best sound for movies.
- Clear Voice: Emphasises voices over other sounds.
- Amplify: Increase the intensity of high-frequency sound to allow a better listening experience for the hearing impaired.

If Speaker Select is set to External Speaker, Sound Mode is disabled.

❑ Adjusting Sound Settings

■ Sound Effect

(standard sound mode only)

MENU → Sound → Sound Effect → ENTER

- DTS TruSurround
  This function provides a virtual 5.1 channel surround sound experience through a pair of speakers using HRTF (Head Related Transfer Function) technology.
- DTS TruDialog
  This function allows you to increase the intensity of a voice over background music or sound effects so that dialogue can be heard more clearly.

- Equaliser
  Use Equaliser to customize sound setting for each speaker.
  Balance: Adjusts the balance between the right and left speaker.
  100Hz / 300Hz / 1kHz / 3kHz / 10kHz (Bandwidth Adjustment): Adjusts the level of specific bandwidth frequencies.
  Reset: Resets the equaliser to its default settings.

If Speaker Select is set to External Speaker, Sound Effect is disabled.

■ 3D Audio for PDP 4900

MENU → Sound → 3D Audio → ENTER

3D audio technology provides the immersive sound corresponding to the pop-up effect of 3D video by audio depth control in perspective.

Available in only when watching 3D image.

■ Speaker Settings

MENU → Sound → Speaker Settings → ENTER

- **Speaker Select** TOOLS

  A sound echo may occur due to a difference in decoding speed between the main speaker and the audio receiver. In this case, set the TV to **External Speaker**.

  When **Speaker Select** is set to **External Speaker**, the volume and **MUTE** buttons will not operate and the sound settings will be limited.

When **Speaker Select** is set to **External Speaker**.

- **TV Speaker**: Off, **External Speaker**: On

When **Speaker Select** is set to **TV Speaker**.

- **TV Speaker**: On, **External Speaker**: On

If there is no video signal, both speakers will be mute.

- **Auto Volume**

  To equalize the volume level on each channel, set to **Normal**.

  Night: This mode provides an improved sound experience compared to **Normal** mode, making almost no noise. It is useful at night.

  To use the volume control on the source device connected to the TV, set **Auto Volume** to **Off** on the TV. Otherwise, a change to the volume control of the source device may not be applied.

■ Additional Settings

MENU → Sound → Additional Settings → ENTER

- DTV Audio Level (digital channels only): This function allows you to reduce the disparity of a voice signal (which is one of the signals received during a digital TV broadcast) to a desired level.
  - According to the type of broadcast signal, MPEG / HE-AAC can be adjusted between -10dB and 0dB.
  - To increase or decrease the volume, adjust between the range 0 and -10 respectively.

- Digital Audio Out: Digital Audio out is used to provide digital sound, reducing interference going to speakers and various digital devices such as a DVD player.
  Audio Format: You can select the Digital Audio output format. The available Digital Audio output format may differ depending on the input source.
  - By connecting to 5.1ch speakers in a Dolby Digital setup, maximize your interactive 3D sound experience.

  Audio Delay: Correct audio-video sync problems, when watching TV or video, and when listening to digital audio output using an external device such as an AV receiver (0ms ~ 250ms).

- Dolby Digital Comp: This function minimizes signal disparity between a dolby digital signal and a voice signal (i.e. MPEG Audio, HE-AAC, ATV Sound).
  - Select Line to obtain dynamic sound, and RF to reduce the difference between loud and soft sounds at night time.

  Line: Set the output level for signals greater or less than -31dB (reference) to either -20dB or -31dB.

  RF: Set the output level for signals greater or less than -20dB (reference) to either -10dB or -20dB.

■ Reset Sound

MENU → Sound → Reset Sound → ENTER

Reset all sound settings to the factory defaults.

❑ Selecting the Sound Mode TOOLS

When you set to **Dual I-II**, the current sound mode is displayed on the screen.

	Audio Type	Dual I-II	Default
A2 Stereo	Mono	Mono	Automatic change
	Stereo	Stereo ↔ Mono	
	Dual	Dual I ↔ Dual II	Dual I
NICAM Stereo	Mono	Mono	Automatic change
	Stereo	Mono ↔ Stereo	
	Dual	Mono → Dual I ↖ Dual II ↙	Dual I

- If the stereo signal is weak and an automatic switching, occurs, then switch to the mono.
- Only activated in stereo sound signal.
- Only available when the **Source** is set to **TV**.

❑ Executing initial setup

■ Setup

MENU → **System** → **Setup** → **ENTER**

Configure the channels and the time when setting up the TV for the first time or when resetting the unit.

- Execute the initial setup following instructions that the TV guides.

❑ Setting the Time

■ Time

MENU → **System** → **Time** → **ENTER**

The current time will appear every time you press the **INFO** button.

- **Clock**: Setting the clock is for using various timer features of the TV.
  - If you disconnect the power cord, you have to set the clock again.

  Clock Mode: Set up the current time manually or automatically.
  - **Auto**: Set the current time automatically using the time from a digital channel.

The aerial must be connected in order to set the time automatically.

– Manual: Set the current time manually.

Depending on the broadcast station and signal, the auto time set up may not be correct. In this case, set the time manually.

Clock Set: Set the Date and Time.

Available only when Clock Mode is set to Manual.

You can set the Date and Time directly by pressing the number buttons on the remote control.

Time Zone (depending on the country): Select your time zone.

This function is only available when the Clock Mode is set to Auto.

When selecting Manual in Time Zone, GMT and DST will be activated.

Time Offset (depending on the country): Adjusts the time when your TV receives the time information via Internet. Set the right time by selecting an offset.

The current time will be set through a network, if the TV fails to receive the time information including the broadcast signal from TV stations. (ex: Watching TV via set-top box, Satellite receiver, or etc)

❑ Using the Sleep Timer

MENU → System → Time → Sleep Timer → ENTER

- Sleep Timer TOOLS: Automatically shuts off the TV after a preset period of time. (30, 60, 90, 120, 150 and 180 minutes)

  Use the ▲/▼ buttons to select a period of time, and then press ENTER. To cancel the Sleep Timer, select Off.

❑ Setting the On / Off Timer

MENU → System → Time → On Timer <or> Off Timer → ENTER

- On Timer: You can set up three separate On Timer configurations. (On Timer 1, On Timer 2, On Timer 3)

  Setup: Select Off, Once, Everyday, Mon~Fri, Mon~Sat, Sat~Sun or Manual to set at your convenience. If you select Manual, you can set up the day you want to activate the timer.

  The ✓ mark indicates the day you've selected.

  Time: Set the hour and minute.

  Volume: Set the desired volume level.

Source: To select the source of the content that will play when the TV turns on. You can:

- Select TV and have the TV display a specific air or cable channel.
- Select USB and have the TV play back photo or audio files from a USB device.
- Select a source on your TV (HDMI1, HDMI2/DVI, AV, Component, etc.) that you have connected a set-top box to, and have the TV display a channel from the set-top box.

The USB device must be connected to your TV before you can select USB.

If you select a source other than **TV** or **USB**, you must:

- Have a cable or satellite set-top box attached to that source
- Set the set-top box to the channel you want to watch when the TV goes on
- Leave the set-top box turned on.

When you select a source other than **TV** or **USB**, the Aerial and Channel options will disappear.

Aerial (when the **Source** is set to **TV**): Select **ATV** or **DTV**.

Channel (when the **Source** is set to **TV**): Select the desired channel.

Music / Photo (when the **Source** is set to **USB**): Select a folder in the USB device containing music or photo files to be played when the TV is turned on automatically.

- If there is no music file on the USB device or the folder containing a music file is not selected, the timer function does not operate correctly.
- When there is only one photo file in the USB device, the slide show will not play.
- If a folder name is too long, the folder cannot be selected.
- Each USB you use is assigned its own folder. When using more than one of the same type of USB, make sure the folders assigned to each USB have different names.

- It is recommended that you use a USB memory stick and a multi card reader when using **On Timer**.
- The **On Timer** function may not work with USB devices with a built-in battery, MP3 players, or PMPs made by some manufacturers because these devices take a long time to be recognised.

- **Off Timer**: You can set up three separate **Off Timer** configurations. (**Off Timer 1**, **Off Timer 2**, **Off Timer 3**)

  Setup: Select **Off**, **Once**, **Everyday**, **Mon~Fri**, **Mon~Sat**, **Sat~Sun** or **Manual** to set at your convenience. If you select **Manual**, you can set up the day you want to activate the timer.

  The ✓ mark indicates the day you've selected.

  Time: Set the hour and minute.

❑ Economical Solutions

■ Eco Solution

MENU → System → Eco Solution → ENTER

- Energy Saving: This adjusts the brightness of the TV in order to reduce power consumption.
- Eco Sensor for PDP TV / LED 5 series 32" and above: To enhance your power savings; the picture settings will automatically adapt to the light in the room.

  If you adjust the Backlight for LED TV / Cell Light for PDP TV, the Eco Sensor will be set to Off.

Min. Backlight for LED TV / Min Cell Light for PDP TV: When Eco Sensor is On, the minimum screen brightness can be adjusted manually.

If Eco Sensor is On, the display brightness may change (become slightly darker or brighter) depending on the surrounding light intensity.

- No Signal Power Off: To avoid unnecessary energy consumption, set how long you want the TV to remain on if it's not receiving a signal.

  Disabled when the PC is in power saving mode.
- Auto Power Off: If the TV remains turned on for four hours without any user input, the TV will automatically turn off to prevent overheating.

  In some areas, you can establish a period of up to 8 hours.

❑ Other Features

■ Menu Language

MENU → System → Menu Language → ENTER

Set the menu language.

■ Auto Protection Time for LED TV

MENU → System → Auto Protection Time → ENTER

- Auto Protection Time (Off / 2 hours / 4 hours / 8 hours / 10 hours):

If the screen remains idle with a still image for a certain period of time defined by the user, the screen saver is activated to prevent the formation of ghost images on the screen.

■ Screen Burn Protection for PDP TV

MENU → System → Screen Burn Protection → ENTER

To reduce the possibility of screen burn, this unit is equipped with Pixel Shift screen burn prevention technology. Pixel Shift moves the picture slightly on the screen. The Time function setting allows you to programme the time between movement of the picture in minutes.

Your TV also has the following additional screen burn protection functions:

- Pixel Shift
- Auto Protection Time
- Scrolling
- Side Grey

- Pixel Shift: Using this function, you can set the TV to move pixels minutely on the PDP screen in a horizontal or vertical direction to minimize after images on the screen.

  Available Pixel Shift Settings and Optimum Settings

	Item	TV / HDMI
Horizontal	0~4	4
Vertical	0~4	4
Time (minute)	1~4 min	4 min

  The Pixel Shift value may differ depending on the monitor size (inches) and mode.

  This function is not available in the Screen Fit mode.

- Auto Protection Time: If the screen displays a still image for a certain period of time you define, the TV activates the screen saver to prevent the formation of burnt in ghost images on the screen.

- **Scrolling**: This function removes after-images on the screen by illuminating all the pixels on the PDP according to a pattern. Use this function when there are after images or symbols on the screen, especially when you displayed a still image on the screen for a long time.
  - The after-image removal function has to be executed for a long time (approximately 1 hour) to effectively remove after-images on the screen. If the after-image is not removed after you apply the function, repeat the function again.
  - Press any key on the remote control to cancel this feature.
- **Side Grey**: When you watch TV with the screen ratio set to 4:3, using the **Side Grey** function can prevent damage to the edges of the screen by adjusting the white balance on the extreme left and right sides.

■ General

MENU → System → General → ENTER

- **Game Mode**: When connecting to a game console such as PlayStation™ or Xbox™, you can enjoy a more realistic gaming experience by selecting game mode.
  - NOTE
    - Precautions and limitations for game mode
      - To disconnect the game console and connect another external device, set **Game Mode** to **Off** in the setup menu.
      - If you display the TV menu in **Game Mode**, the screen shakes slightly.

    - **Game Mode** is not available in **TV** mode.
    - After connecting the game console, set **Game Mode** to **On**. Unfortunately, you may notice reduced picture quality.
    - If **Game Mode** is **On**:
      - **Picture Mode** is set to **Standard** and **Sound Mode** is set to **Movie**.
- **Panel Lock**: Lock or unlock all the keys on the panel at once. when Panel Lock is on, none of the keys on the panel will work.
- **Boot Logo**: Display Samsung logo when the TV is turned on.

■ Change PIN

MENU → System → Change PIN → ENTER

Change your password required to set up the TV.

The PIN input screen appears before the setup screen.

Enter your 4-digit PIN. Change the PIN using the Change PIN option.

■ DivX® Video On Demand

MENU → System → DivX® Video On Demand → ENTER

Shows the registration code authorised for the TV. If you connect to the DivX web site and register with 10-digit registration code, you can download the VOD activation file.

Once you play it using Videos, the registration is completed.

For more information on DivX® VOD, visit http://vod.divx.com.

❑ Using the Source List

■ Source List

MENU → Applications → Source List → ENTER

When you press the **SOURCE** button, Source screen will be displayed at once.

You can only choose external devices that are connected to the TV. In Source, connected inputs are highlighted.

For the detailed information, refer to “Changing the Input Source” in User Manual.

❑ Connecting a USB Device

1. Turn on your TV.
2. Connect a USB device containing photo, music and movie files to the USB port on the side of the TV.
3. When USB is connected to the TV, popup window appears. You can select the **Photos**, **Videos** or **Music** directly.

It might not work properly with unlicenced multimedia files.

Need-to-Know List before using Media Contents

- MTP (Media Transfer Protocol) is not supported.
- Supported file systems are FAT and exFAT.
- Certain types of USB Digital camera and audio devices may not be compatible with this TV.
- Media Play only supports sequential jpeg format.
- Media Play only supports USB Mass Storage Class (MSC) devices. MSC is a Mass Storage Class Bulk-Only Transport device. Examples of MSC are Thumb drives, Flash Card Readers (USB HUB are not supported). Devices should be connected directly to the TV's USB port.

- Before connecting your device to the TV, please back up your files to prevent them from damage or loss of data. SAMSUNG is not responsible for any data file damage or data loss.
- Do not disconnect the USB device while it is loading.
- The higher the resolution of the image, the longer it takes to display on the screen.
- The maximum supported JPEG resolution is 15360 x 8640 pixels.
- For unsupported or corrupted files, the "Not Supported File Format" message is displayed.
- The scene search and thumbnail functions are not supported in the **Videos**.

- MP3 files with DRM that have been downloaded from a non-free site cannot be played. Digital Rights Management (DRM) is a technology that supports the creation, distribution and management of the content in an integrated and comprehensive way, including the protection of the rights and interests of the content providers, the prevention of the illegal copying of contents, as well as managing billings and settlements.
- A USB device that requires high power (more than 500mA or 5V) may not be supported. The HDD (Hard Disk Drive) connected to USB is not supported.
- If the TV has been no input during time set in **Auto Protection Time**, the screen saver will run.
- The power-saving mode of some external hard disk drives may be released automatically when connected to the TV.

- If a USB extension cable is used, the USB device may not be recognised or the files on the device may not be read.
- If a USB device connected to the TV is not recognised, the list of files on the device is corrupted or a file in the list is not played, connect the USB device to the PC, format the device and check the connection.
- If a file deleted from the PC is still found when Media Contents is run, use the “Empty the Recycle Bin” function on the PC to permanently delete the file.
- If the number of files and folders saved on a USB storage device is approximately over 4000, the files and folders may not appear and some folders may not be opened.

Disconnecting a USB Device

1. Press the **SOURCE** button.
2. Select a desired USB device, and then press the **TOOLS** button. The **Tools** menu appears.
3. Select **Disconnect USB Device**, and then wait until the selected USB device is disconnected. You can remove a USB device from the TV.

To remove a USB device from the TV, we recommend use **Disconnect USB Device** function.

❑ Using the Media Contents

MENU → Applications → Media Play → ENTER

Enjoy photos, music and movie files saved on a USB Mass Storage Class (MSC) device.

1. Press the **MEDIA.P** button.
2. Press ◄/► button to select desired menu (Photos, Videos, Music), then press the **ENTER** button.
3. Press ◄/► button to select desired device, then press the **ENTER** button again.
4. Press the ▲/▼/◄/► button to select the desired file in the list, then press the **ENTER** button or ► (Play) button.

Playing the selected files

1. Press the ▲ button to select Options at the top of each main screen and select Play Selected.
2. Select the desired files.
   - The check box appears to the left of the selected files.
   - Press **ENTER** button again to deselect the file.
3. Press the ▲ button to select Play.
   - You can select or deselect all files pressing the Select All / Deselect All.

❑ Playing the Photos / Videos / Music

During playing a file, press the ▲/▼/◄/► button to select the desired menu.

- When the option menu is not displayed, press the **TOOLS** button or **ENTER** button.
- You can also use ►/❚❚/■/◄◄/►► buttons on the remote control during playback.
- If you press the **INFO** button during playback, you can view the playback information.

Playback menu

Button	Operation	Photos	Videos	Music
◀ / ▶	Previous / Next	•		
▶ / ■	Start Slide Show / Stop Slide Show	•		
	Play / Pause	Mini Player*	•	•
⏮ / ⏭	Previous / Next	Mini Player*	•	•
◀◀ / ▶▶	Rewind / Fast Forward		•	•

* When setting the Background Music to Mini Player in Photos, these buttons previous appear.

Setting menu

- **Photos**

Button	Operation	
	Slideshow Settings	You can set the Speed and Effects during the slide show.
	Zoom	You can zoom the image.
	Rotate	You can rotate images in full screen mode.
	Background Music / Mini Player	You can set background music when watching a slide show. / You can control simple playback menus.
	Settings	Picture Mode / Sound Mode: You can adjust the picture or sound setting. Information: You can see detailed information about the played file.

During the slide show, all files in the file list will be displayed in order.

When you press the ▶ (Play) button (or ▲ button → Options → Slide Show) in the file list, slide show will be started immediately.

During the slide show, you can adjust the slide show speed using ◀◀ (REW) or ▶▶ (FF) button.

- Supported Photo Formats

  For the details, refer to “Specifications” in User Manual.

Videos

Button	Operation	
	Search	Search Titles: You can move the other file directly. Search Time Bar: You can search the video using ◄ and ► button at one minute interval or entering the number directly. It may not be supported depending on the input source.
	Repeat Mode	You can play movie files repeatedly.
	Picture Size	You can adjust the picture size to your preference.

Button	Operation	
	Settings	Subtitle Settings: You can play the video with subtitles. This function only works if the subtitles are the same file name as the video. Picture Mode / Sound Mode: You can adjust the picture or sound setting. Audio Language: You can change the audio language if the video has more than one language. Information: You can see detailed information about the played file.

If video time information is unknown, play time and progress bar are not displayed.

In this mode, you can enjoy movie clips contained on a Game, but you cannot play the Game itself.

- Supported Subtitle / Video Formats

  For the details, refer to “Specifications” in User Manual.

- **Music**

Button	Operation	
	Repeat	You can play music files repeatedly.
	Shuffle	You can play the music randomly.
	Sound Mode	You can adjust the sound setting.

Only displays the files with supported music file extension. Other file extensions are not displayed, even if they are saved on the same USB device.

If the sound is abnormal when playing music files, adjust the **Equaliser** in the **Sound** menu. (An over-modulated music file may cause a sound problem.)

- Supported Music Formats

  For the details, refer to “Specifications” in User Manual.

Setting the Encoding language

Set the encoding language if the text is not supported.

1. Press the ▲ button to select **Options** at the top of music main screen and select **Encoding**.
2. Select the desired encoding language.

❑ Using the 3D function

for PDP 4900

Viewing TV using the 3D function

IMPORTANT HEALTH AND SAFETY INFORMATION FOR 3D PICTURES.

Read and understand the following safety information before using the TV’s **3D** function.

⚠ WARNING

- Some viewers may experience discomfort while viewing 3D TV such as dizziness, nausea and headaches. If you experience any such symptom, stop viewing 3D TV, remove 3D Active Glasses and rest.
- Watching 3D images for an extended period of time may cause eye strain. If you feel eye strain, stop viewing 3D TV, remove your 3D Active Glasses and rest.

- A responsible adult should frequently check on children who are using the 3D function. If there are any reports of tired eyes, headaches, dizziness, or nausea, have the child stop viewing 3D TV and rest.
- Do not use the 3D Active Glasses for other purposes (such as general eyeglasses, sunglasses, protective goggles, etc.)
- Do not use the 3D function or 3D Active Glasses while walking or moving around. Using the 3D function or 3D Active Glasses while moving around may result in injuries due to running into objects, tripping, and/or falling.

Before using 3D function...

- 3D Active Glasses from Samsung's previous product (IR type) or other manufacturers not be supported.
- When the TV is initially powered on, may take some time until the 3D display is optimised.

- The 3D Active Glasses may not work properly if there is any other 3D product or electronic devices turned on near the glasses or TV. If there is a problem, keep other electronic devices as far away as possible from the 3D Active Glasses.
- Be sure to stay within the viewing angle and optimum TV viewing distance when watching 3D pictures. Otherwise, you may not be able to enjoy proper 3D effects.
- The ideal viewing distance should be three times or more the height of the screen. We recommend sitting with viewer's eyes on a level with the screen.
- If you can not play 3D videos in some of the BD players, take out the disk from player and put it again, or restart the BD player.

■ 3D

MENU → Picture → 3D → **ENTER**

This exciting new feature enables you to view 3D content.

"Full HD 3D Glasses™" Logo indicates compatibility between display products and 3D Glasses which are compliant with the "Full HD 3D Glasses™" format, and does not indicate picture quality of display products.

Some 3D modes may not be available depending on the format of the image source.

When you watch 3D images under flickering lighting such as a fluorescent lamp (50Hz ~ 60Hz) or a 3 wavelength lamp, you may notice some screen flickering. If this occurs, dim or turn off the light.

- **3D Mode**

  If you want to feel the 3D effect fully, please wear the 3D Active Glasses first, and then select **3D Mode** from the list below that provides the best 3D viewing experience.

3D Mode		Operation
Off	Off	Turns the 3D function off.
2D→3D	2D → 3D	Changes a 2D image to 3D. Some file format may not be supported.
	Side by Side	Displays two images next to each other.
	Top & Bottom	Displays one image above another.

  3D Mode is set to Off automatically when you access **Media Play** or **e-Manual** functions.

  3D Mode is set to memorised configuration value automatically, when changing the input source.

- **3D Perspective**: Adjust overall 3D perspective of on-screen image.
- **Depth**: Adjust overall depth.
- **L/R Change**: Swap the left and right pictures.
- **3D → 2D**: Displays the image for the left eye only.

  This function is deactivated when 3D Mode set to " 2D→3D " or " Off ".

Support resolution (16:9 only)

- HDMI

Source	Resolution	Frequency (Hz)
/	1280 x 720p	50 / 59.94 / 60 Hz
	1920 x 1080i	50 / 59.94 / 60 Hz
	1920 x 1080p	23.98 / 24 / 25 / 29.97 / 30 / 50 / 59.94 / 60 Hz
Frame Packing	1280 x 720p	50 / 59.94 / 60 Hz
	1920 x 1080i	50 / 59.94 / 60 Hz
	1920 x 1080p	23.98 / 24 / 25 / 29.97 / 30 Hz

- Components & DTV

Source	Resolution	Frequency (Hz)
Components	1280 x 720p	50 / 59.94 / 60 Hz
	1920 x 1080i	50 / 59.94 / 60 Hz
	1920 x 1080p	23.98 / 24 / 25 / 29.97 / 30 / 50 / 59.94 / 60 Hz
DTV	1280 x 720p	50 / 59.94 / 60 Hz
	1920 x 1080i	50 / 59.94 / 60 Hz
	1920 x 1080p	25 Hz

- Videos / Photos (In Media Play)
  For the details, refer to “Specifications” in User Manual.

❑ Viewing the e-Manual

■ e-Manual

MENU → Support → e-Manual → ENTER

You can read the introduction and instructions about the TV features stored in your TV.

For the detailed information about e-Manual Screen, refer to “How to use the e-Manual” in User Manual.

❑ Using the Self Diagnosis

■ Self Diagnosis

MENU → Support → Self Diagnosis → ENTER

Self Diagnosis might take few seconds, this is part of the normal operation of the TV.

- Picture Test: Use to check for picture problems.
- 3D Picture Test for PDP 4900 series: Use to check for 3D picture problems.
- Sound Test: Use the built-in melody sound to check for sound problems.
  If you hear no sound from the TV’s speakers, before performing the sound test, make sure Speaker Select is set to TV Speaker in the Sound menu.

The melody will be heard during the test even if **Speaker Select** is set to **External Speaker** or the sound is muted by pressing the **MUTE** button.

- **Signal Information** (digital channels only): HDTV channel's reception quality is either perfect or the channels are unavailable. Adjust your aerial to increase signal strength.
- **Reset**: Reset all settings to the factory defaults except network settings.
  - The PIN input screen appears before the setup screen.
  - Enter your 4-digit PIN. Change the PIN using the **Change PIN** option.

❑ Updating the Software

■ Software Update

MENU → **Support** → **Software Update** → **ENTER**

The **Software Update** menu lets you upgrade your TV's software to the latest version.

When software is upgraded, video and audio settings you have made will return to their default settings. We advise you to write down your settings so that you can easily reset them after the upgrade.

- **Update now**
  The TV's firmware can be updated through either USB connection or broadcast signal.
  - By USB: Insert a USB drive containing the firmware upgrade file, downloaded from "www.samsung.com" into the TV.
    - Please be careful not to disconnect the power or remove the USB drive until upgrades are complete. The TV will be turned off and on automatically after completing the firmware upgrade.

– By Channel: Upgrade the software using the broadcasting signal.

If the function is selected during the software transmission period, software will be automatically searched and downloaded.

The time required to download the software is determined by the signal status.

- **Auto update**: This option upgrades the TV while it is in Standby Mode. This allows the TV to upgrade itself automatically while it is not in use. Because the TV's internal processes are operating, the screen may emit a faint glow, and this may continue for more than 1 hour until the software download is complete.
- **Manage Satellite Channels** for LED 5070 / 5270 / 4270 series
  (When the Aerial was set to **Satellite**) Manage software downloads via a satellite channel.

❑ Changing the Use Mode

■ Use Mode

MENU → Support → Use Mode → ENTER

Select the **Use Mode** suitable for your place. We strongly recommend you select **Home Use**.

- **Home Use**: **Home Use** is the default setting.
- **Store Demo**: **Store Demo** is for retail environments only. If you select **Store Demo**, some functions will not work, and the picture settings will be reset every 30 minutes.

❑ Viewing the Contact Samsung

■ Contact Samsung

MENU → Support → Contact Samsung → ENTER

View this information when your TV does not work properly or when you want to upgrade the software. You can find information regarding our call centres, and how to download products and software.

❑ Using the Football Mode

■ Football Mode TOOLS

MENU → Applications → Football Mode → ENTER

This mode provides optimised condition for watching sports games.

- A (Zoom): Pause playback and divide the picture into 9 parts. Select a part to zoom it in. Press this button again to resume.

When the Football Mode is on, the picture and sound modes are set to Stadium automatically.

If you turn the TV off while watching Football Mode, the Football Mode will be disable.

When the Data Service is running, the Zoom is not available.

❑ Using the Satellite System

for LED 5070 / 5270 / 4270 series

For the details, you can find an additional web manual on our website "www.samsung.com".

❑ Using the Wireless Network

for LED 5000 series (UK only) / for PDP 4900 series

For the details, you can find an additional web manual on our website "www.samsung.com".

❑ Managing the Network Connected Devices

for PDP 4900 series

For the details, you can find an additional web manual on our website "www.samsung.com".

◀

❑ Using the DLNA Functions

for PDP 4900 series

For the details, you can find an additional web manual on our website "www.samsung.com".

◀

MacBook Pro (17-inch, Mid 2009) - Technical Specifications

Languages

Size and weight
Height:
0.98 inch (2.50 cm)
Width:
15.47 inches (39.3 cm)
Depth:
10.51 inches (26.7 cm)
Weight:
6.6 pounds (2.99 kg)

Connections and expansion

- MagSafe power port
- Gigabit Ethernet port
- One FireWire 800 port (up to 800 Mbps)
- Three USB 2.0 ports (up to 480 Mbps)
- Mini DisplayPort
- Audio line in
- Audio line out
- ExpressCard/34 slot
- Kensington lock slot

Communications

- Built-in AirPort Extreme Wi-Fi wireless networking (based on IEEE 802.11n draft specification); IEEE 802.11a/b/g compatible
- Built-in Bluetooth 2.1 + EDR (Enhanced Data Rate)
- Built-in 10/100/1000BASE-T Gigabit Ethernet (RJ-45 connector)

Audio

- Built-in stereo speakers
- Built-in omnidirectional microphone (located under left speaker grille)
- Combined optical digital audio input/audio line in (minijack)
- Combined optical digital audio output/audio line out (minijack)

Environmental Status Report
MacBook Pro is designed with the following features to reduce its environmental impact:

- Highly recyclable aluminum and glass enclosure
- Mercury-free LED-backlit display
- Arsenic-free display glass
- BFR-free
- PVC-free internal cables
- Reduced packaging volume
- Meets ENERGY STAR Version 5.0 requirements
- Rated EPEAT Gold

Display

- 17-inch (diagonal) high-resolution LED-backlit glossy widescreen display with support for millions of colors
- Supported resolutions: 1920 by 1200 (native), 1680 by 1050, 1280 by 800, 1152 by 720, 1024 by 640, and 800 by 500 pixels at 16:10 aspect ratio; 1280 by 1024 pixels at 5:4 aspect ratio; 1280 by 1024 pixels at 5:4 aspect ratio stretched; 1600 by 1200, 1024 by 768, 800 by 600, and 640 by 480 pixels at 4:3 aspect ratio; 1600 by 1200, 1024 by 768, 800 by 600, and 640 by 480 pixels at 4:3 aspect ratio stretched; 720 by 480 pixels at 3:2 aspect ratio; 720 by 480 pixels at 3:2 aspect ratio stretched

Graphics and video support

- NVIDIA GeForce 9400M graphics processor with 256MB of DDR3 SDRAM shared with main memory
- NVIDIA GeForce 9600M GT graphics processor with 512MB of GDDR3 memory
- Dual display and video mirroring: Simultaneously supports full native resolution on the built-in display and up to 2560 by 1600 pixels on an external display, both at millions of colors
- Built-in iSight camera
- Mini DisplayPort

Pure digital video output
DVI output using Mini DisplayPort to DVI Adapter (optional)

VGA output using Mini DisplayPort to VGA Adapter (optional)

Dual-link DVI output using Mini DisplayPort to Dual-Link DVI Adapter supports 30-inch Apple Cinema HD



Display (optional)

Input

- Built-in full-size backlit keyboard with 78 (U.S.) or 79 (ISO) keys, including 12 function keys and 4 arrow keys (inverted "T" arrangement)
- Multi-Touch trackpad for precise cursor control; supports two-finger scrolling, pinch, rotate, swipe, three-finger swipe, four-finger swipe, tap, double-tap, and drag capabilities

Processor and memory

- 2.8GHz or 3.06GHz Intel Core 2 Duo processor with 6MB on-chip shared L2 cache running 1:1 with processor speed
- 1066MHz frontside bus
- 4GB (two 2GB SO-DIMMs) of 1066MHz DDR3 memory; two SO-DIMM slots support up to 8GB

Configure your MacBook Pro now, only at the Apple Online Store.

Storage

- 500GB 5400-rpm Serial ATA hard drive; optional 500GB 7200-rpm hard drive, or 128GB or 256GB solid-state drive[4]
- 8x slot-loading SuperDrive (DVD±R DL/DVD±RW/CD-RW)
- Maximum write: 8x DVD-R, DVD+R; 4x DVD-R DL (double layer), DVD+R DL (double layer), DVD-RW, DVD+RW; 24x CD-R; 10x CD-RW
- Maximum read: 8x DVD-R, DVD+R, DVD-ROM; 6x DVD-ROM (double layer DVD-9), DVD-R DL (double layer), DVD+R DL (double layer), DVD-RW, DVD+RW; 24x CD

Battery and power[5]

- Built-in 95-watt-hour lithium-polymer battery
- 85W MagSafe Power Adapter with cable management system
- MagSafe power port

Electrical and operating requirements

- Line voltage: 100V to 240V AC
- Frequency: 50Hz to 60Hz
- Operating temperature: 50° to 95° F (10° to 35° C)
- Storage temperature: -13° to 113° F (-24° to 45° C)
- Relative humidity: 0% to 90% noncondensing
- Maximum operating altitude: 10,000 feet
- Maximum storage altitude: 15,000 feet
- Maximum shipping altitude: 35,000 feet

What's in the box

- MacBook Pro
- Display cleaning cloth
- 85W MagSafe Power Adapter, AC wall plug, and power cord
- Install/restore DVDs
- Printed and electronic documentation

Software

- Mac OS X v10.5 Leopard (includes iTunes, Time Machine, Quick Look, Spaces, Spotlight, Dashboard, Mail, iChat, Safari, Address Book, QuickTime, iCal, DVD Player, Photo Booth, Front Row, Xcode Developer Tools)
- iLife '09 (includes iPhoto, iMovie, iDVD, iWeb, GarageBand)

17-inch Configuration

	2.8GHz MacBook Pro (MC226LL/A)
Enclosure	Precision aluminum unibody
Processor	2.8GHz Intel Core 2 Duo
L2 cache	6MB shared
System bus	1066MHz
Memory	4GB (two 2GB SO-DIMMs) of 1066MHz DDR3 SDRAM; supports up to 8GB
Hard drive[4]	500GB Serial ATA; 5400 rpm
Slot-loading optical drive	8x SuperDrive (DVD±R DL/DVD±RW/CD-RW)
Graphics	NVIDIA GeForce 9600M GT graphics processor; and NVIDIA GeForce 9400M graphics processor with 256MB of DDR3 SDRAM shared with main memory[3]
Graphics memory	512MB GDDR3
Video	Built-in iSight camera; Mini DisplayPort output port with support for DVI, VGA, and dual-link DVI (requires adapters, sold separately)
Display	17-inch (diagonal) high-resolution LED-backlit glossy widescreen display, 1920-by-1200

	resolution
Expansion	One FireWire 800 port (up to 800 Mbps), three USB 2.0 ports (up to 480 Mbps), ExpressCard/34 slot
Audio	Built-in stereo speakers, built-in omnidirectional microphone, combined optical digital input/analog line in, combined optical digital output/analog line out
Networking	Built-in 10/100/1000BASE-T (Gigabit) Ethernet
Wireless	Built-in AirPort Extreme Wi-Fi (based on IEEE 802.11n draft specification)[3]; built-in Bluetooth 2.1 + EDR (Enhanced Data Rate) module
Hardware accessories	85W MagSafe Power Adapter, AC wall plug, power cord
Limited warranty and service	Your MacBook Pro comes with 90 days of free telephone support and a one-year limited warranty. Purchase the AppleCare Protection Plan to extend your service and support to three years from your computer's purchase date. Only the AppleCare Protection Plan provides you with direct telephone support from Apple technical experts and the assurance that repairs will be handled by Apple-authorized technicians using genuine Apple parts. For more information, visit Apple support or call 800-823-2775.
Apple and the global environment	Learn more about Apple's dedication to reducing the environmental impact of our products and processes. The Apple Product Environmental Specification details the environmental attributes of our products.
Recycling	Apple takes a holistic view of materials management and waste minimization. Learn more about how to recycle your Mac.

Options

Time Capsule

Time Capsule is a full-featured AirPort Extreme base station with a built-in hard drive. Back up wirelessly and create a Wi-Fi network with one device.

- 500GB or 1TB server-grade hard drive
- Wi-Fi Certified for 802.11n draft 2.0
- USB port for connecting a USB printer or USB external hard drive

Configure to order

- 500GB (7200-rpm) hard drive
- 128GB or 256GB solid-state drive
- Up to 8GB of 1066MHz DDR3 SDRAM
- Antiglare display
- Apple Remote
- Apple Mini DisplayPort to DVI Adapter
- Apple Mini DisplayPort to Dual-Link DVI Adapter
- Apple Mini DisplayPort to VGA Adapter
- MagSafe Airline Adapter
- AppleCare Protection Plan
- Aperture
- Final Cut Express
- Logic Express
- iWork '09

Accessories

- Apple LED Cinema Display
- AirPort Extreme Base Station
- AirPort Express Base Station
- Apple Wireless Keyboard
- Apple Wireless Mighty Mouse
- Apple Keyboard with Numeric Keypad
- Apple Wired Mighty Mouse

1. Actual weight varies by configuration and manufacturing process.
2. Wireless Internet access requires a base station or other wireless access point and Internet access; fees may apply. Some ISPs are not currently compatible with AirPort.
3. Memory available to Mac OS X may vary depending on graphics needs. Minimum graphics memory usage is 256MB.
4. 1GB=1 billion bytes; actual formatted capacity less.
5. Testing conducted by Apple in May 2009 using preproduction 2.8GHz Intel Core 2 Duo-based MacBook Pro units with a Better Battery Life setting. Battery life depends on configuration and use. See www.apple.com/batteries for more information. The wireless productivity test measures battery life by wirelessly browsing various websites and editing text in a word processing document with display brightness set to 50%.

Last Modified: Jun 9, 2009

Additional Product Support Information



MacBook Pro (17-inch, Mid 2009)

4 BUILDING PHYSICS SIMULATIONS

4.1 Heating Loads

Model A

House in Netherlands (Existing House)

System Loads

Date/Time	Zone Heating kWh
01/01/2002	5359.2
01/02/2002	4518.5
01/03/2002	3519.1
01/04/2002	1938.6
01/05/2002	589.7
01/06/2002	146.0
01/07/2002	9.0
01/08/2002	26.9
01/09/2002	201.9
01/10/2002	1704.6
01/11/2002	3639.6
01/12/2002	5222.1

TOTAL (kWh)

26875.1

One Dwelling

8062.5

Model B

House in Netherlands (Existing House) + P-a-L GlassHouse

System Loads

Date/Time	Zone Heating kWh
01/01/2002	4021.7
01/02/2002	3212.8
01/03/2002	2053.1
01/04/2002	732.5
01/05/2002	129.8
01/06/2002	10.1
01/07/2002	0.0
01/08/2002	0.3
01/09/2002	12.6
01/10/2002	900.2
01/11/2002	2615.9
01/12/2002	4007.2

TOTAL (kWh)

17696.2

-34.15%

One Dwelling

5308.9

Model C1

House in Netherlands (Existing House) + P-a-L GlassHouse

Glazing changed in the North Façade (to double glazing)

System Loads

Date/Time	Zone Heating kWh
01/01/2002	4049.2
01/02/2002	3168.4
01/03/2002	1962.9
01/04/2002	665.2
01/05/2002	107.3
01/06/2002	12.2
01/07/2002	0.5
01/08/2002	0.7
01/09/2002	10.6
01/10/2002	844.9
01/11/2002	2605.2
01/12/2002	4080.2

TOTAL (kWh)

17507.3

-34.86%

One Dwelling

5252.2

Model C2

House in Netherlands (Existing House) + P-a-L GlassHouse

Glazing changed in the South Façade (to double glazing)

System Loads

Date/Time	Zone Heating kWh
01/01/2002	4587.8
01/02/2002	3834.2
01/03/2002	2726.6
01/04/2002	1185.2
01/05/2002	253.9
01/06/2002	30.3
01/07/2002	0.9
01/08/2002	1.3
01/09/2002	37.8
01/10/2002	1201.4
01/11/2002	3058.7
01/12/2002	4509.5

TOTAL (kWh)

21427.5

-20.27%

One Dwelling

6428.3

Model C3

House in Netherlands (Existing House) + P-a-L GlassHouse

Glazing changed in the South Façade and North Facades (to double glazing)

System Loads

Date/Time	Zone Heating kWh
01/01/2002	4096.3
01/02/2002	3425.5
01/03/2002	2410.3
01/04/2002	1025.6
01/05/2002	212.4
01/06/2002	24.0
01/07/2002	0.6
01/08/2002	1.1
01/09/2002	23.9
01/10/2002	1035.1
01/11/2002	2731.5
01/12/2002	4062.1

TOTAL (kWh)

19048.5

-29.12%

One Dwelling

5714.6

Model D

House in Netherlands (Existing House) + P-a-L GlassHouse

Roof construction and Insulations have been changed.

System Loads

Date/Time	Zone Heating kWh
01/01/2002	4524.0
01/02/2002	3553.0
01/03/2002	2253.3
01/04/2002	802.5
01/05/2002	133.0
01/06/2002	14.2
01/07/2002	0.5
01/08/2002	0.7
01/09/2002	14.7
01/10/2002	986.3
01/11/2002	2909.5
01/12/2002	4512.3

TOTAL (kWh)

19704.1

-26.68%

One Dwelling

5911.2

Model E1

House in Netherlands (Existing House) + P-a-L GlassHouse

Add Façade insulation for the North Part of the Façade

Date/Time	Zone Heating kWh

System Loads

01/01/2002	4336.3
01/02/2002	3395.1
01/03/2002	2117.1
01/04/2002	729.4
01/05/2002	119.6
01/06/2002	12.1
01/07/2002	0.3
01/08/2002	0.3
01/09/2002	12.4
01/10/2002	931.0
01/11/2002	2784.4
01/12/2002	4334.8

TOTAL (kWh)

18772.8

-30.15%

One Dwelling

5631.8

Model E2

House in Netherlands (Existing House) + P-a-L GlassHouse

Add Façade insulation for the South Part of the Façade

System Loads

Date/Time	Zone Heating kWh
01/01/2002	4228.9
01/02/2002	3384.2
01/03/2002	2189.7
01/04/2002	801.1
01/05/2002	137.7
01/06/2002	14.0
01/07/2002	0.4
01/08/2002	0.6
01/09/2002	14.6
01/10/2002	951.0
01/11/2002	2738.7
01/12/2002	4205.9

TOTAL (kWh)

18666.8

-30.54%

One Dwelling

5600.0

Model E3

House in Netherlands (Existing House) + P-a-L GlassHouse

Add Façade insulation for the South and North Parts of the Façade

System Loads

Date/Time	Zone Heating kWh
01/01/2002	4068.6
01/02/2002	3237.0
01/03/2002	2064.3
01/04/2002	732.2
01/05/2002	123.9
01/06/2002	12.4
01/07/2002	0.3
01/08/2002	0.4
01/09/2002	12.8
01/10/2002	892.9
01/11/2002	2621.5
01/12/2002	4050.8

TOTAL (kWh)

17816.9

-33.70%

One Dwelling

5345.1

Model F

House in Netherlands (Existing House) + P-a-L

All the solutions presented were combined within a si

System Loads

Date/Time	Zone Heating kWh
01/01/2002	1458.6
01/02/2002	1096.2
01/03/2002	578.2
01/04/2002	110.3
01/05/2002	6.3
01/06/2002	0.0
01/07/2002	0.0
01/08/2002	0.0
01/09/2002	0.0
01/10/2002	184.1
01/11/2002	853.9
01/12/2002	1441.7

TOTAL (kWh)

5729.4

-78.68%

One Dwelling

1718.8

*compared to the current condition

House in Netherlands (Existing House)

Relative Humidity %	Air Temperature °C	Radiant Temperature °C	Operative Temperature °C
41,84531	15,85303	14,19932	15,02617
40,352	15,9791	14,52298	15,25104
40,28542	16,52777	15,5274	16,02759
49,9488	17,29747	16,76667	17,03207
46,65418	19,83544	19,94234	19,88889
49,56804	21,53276	21,96896	21,75086
59,51482	22,55509	22,99006	22,77257
57,91628	22,13609	22,51372	22,3249
62,91111	19,34363	19,40619	19,37491
55,42117	17,6137	17,0314	17,32255
48,97298	16,41089	15,18	15,79544
43,35978	15,84933	14,22606	15,03769

House in Netherlands (Existing House) + P-a-L GlassHouse

Relative Humidity %	Air Temperature °C	Radiant Temperature °C	Operative Temperature °C
41,29443	15,93476	14,56622	15,25049
39,51117	16,23764	15,19887	15,71826
38,32961	17,25668	16,91817	17,08743
45,87113	18,79437	19,09178	18,94308
39,62983	22,63219	23,57335	23,10277
42,49415	24,18205	25,45704	24,81955
50,24472	25,0382	26,29985	25,66902
49,56973	24,54299	25,59054	25,06676
54,74614	21,72121	22,24021	21,98071
52,60949	18,37887	18,28199	18,33043
48,39586	16,5102	15,57288	16,04154
42,99295	15,87379	14,4766	15,1752

House in Netherlands (Existing House) + P-a-L GlassHouse

Glazing changed in the North Façade (to double glazing)

Relative Humidity %	Air Temperature °C	Radiant Temperature °C	Operative Temperature °C
40,83219	16,0807	14,91569	15,49819
39,04369	16,40232	15,55708	15,9797
37,85965	17,43226	17,25039	17,34132
45,26224	19,02021	19,4071	19,21366

39,07192	22,86079	23,82415	23,34247
42,02841	24,35622	25,62719	24,9917
49,74168	25,17555	26,43715	25,80635
48,92555	24,74069	25,79781	25,26925
53,57624	22,07615	22,61592	22,34604
51,8434	18,60858	18,61187	18,61023
47,96687	16,63845	15,85194	16,2452
42,55545	16,00974	14,79704	15,40339

House in Netherlands (Existing House) + P-a-L GlassHouse

Glazing changed in the South Façade (to double glazing)

Relative Humidity %	Air Temperature °C	Radiant Temperature °C	Operative Temperature °C
41,46505	15,87488	14,51145	15,19316
39,95556	16,02558	14,86382	15,4447
39,59988	16,68169	16,05141	16,36655
48,5841	17,70447	17,65587	17,68017
43,30181	21,05117	21,55701	21,30409
45,4824	22,99171	23,82914	23,41043
54,02514	23,97456	24,76313	24,36884
53,17626	23,42551	24,09076	23,75813
59,34194	20,31516	20,619	20,46708
54,48178	17,811	17,52701	17,669
48,77492	16,3822	15,38842	15,88531
43,03341	15,85645	14,50017	15,17831

House in Netherlands (Existing House) + P-a-L GlassHouse

Glazing changed in the South Façade and North Facades (to double glazing)

Relative Humidity %	Air Temperature °C	Radiant Temperature °C	Operative Temperature °C
40,98446	16,02524	14,86654	15,44589
39,50579	16,17864	15,20473	15,69168
39,21823	16,81704	16,32547	16,57126
48,28846	17,80117	17,82584	17,81351
43,14412	21,1146	21,6103	21,36245
45,28851	23,06428	23,86336	23,46382
53,85815	24,041	24,78559	24,4133
52,75776	23,55381	24,19398	23,87389
58,63152	20,52113	20,8298	20,67546
53,90682	17,96596	17,77345	17,8697
48,35535	16,50528	15,65944	16,08236
42,56754	16,00163	14,83215	15,41689

House in Netherlands (Existing House) + P-a-L GlassHouse

Roof construction and Insulations have been changed.

Relative Humidity %	Air Temperature °C	Radiant Temperature °C	Operative Temperature °C
41,25255	15,94949	14,60742	15,27845
39,44522	16,26218	15,25915	15,76066
38,24091	17,29221	16,98931	17,14076
45,73083	18,85209	19,1801	19,0161
39,47394	22,69697	23,65883	23,1779
42,34721	24,24066	25,53726	24,88896
50,09674	25,07959	26,35907	25,71933
49,37039	24,60141	25,67033	25,13587
54,38096	21,82296	22,36301	22,09298
52,38459	18,44335	18,37928	18,41131
48,31296	16,53323	15,62733	16,08028
42,94963	15,88882	14,51796	15,20339

House in Netherlands (Existing House) + P-a-L GlassHouse

Add Façade insulation for the North Part of the Façade

Relative Humidity %	Air Temperature °C	Radiant Temperature °C	Operative Temperature °C
40,50765	16,19264	15,22218	15,70741
38,65314	16,54293	15,91372	16,22832
37,32357	17,63806	17,69038	17,66422
44,10849	19,44085	20,07384	19,75734
37,54181	23,49397	24,68513	24,08955
40,63274	24,87777	26,35693	25,61735
48,24644	25,56119	27,03219	26,29669
47,47966	25,1561	26,39267	25,77439
51,48125	22,70438	23,39234	23,04836
50,75658	18,91274	19,09046	19,0016
47,50758	16,77432	16,17419	16,47425
42,19673	16,12779	15,11102	15,61941

House in Netherlands (Existing House) + P-a-L GlassHouse

Add Façade insulation for the South Part of the Façade

Relative Humidity %	Air Temperature °C	Radiant Temperature °C	Operative Temperature °C
40,95063	16,05445	14,84206	15,44826
39,18828	16,36537	15,45161	15,90849
38,08335	17,36909	17,10158	17,23534
45,67822	18,8722	19,19446	19,03333
39,68991	22,6209	23,53375	23,07733
42,60848	24,15064	25,37239	24,76151
50,45848	25,0006	26,2053	25,60295
49,75669	24,51634	25,52368	25,02001
54,60219	21,7647	22,2871	22,0259

52,28392	18,48512	18,44025	18,46269
48,00967	16,62703	15,80755	16,21729
42,64193	15,99308	14,75452	15,3738

House in Netherlands (Existing House) + P-a-L GlassHouse

Add Façade insulation for the South and North Parts of the Façade

Relative Humidity %	Air Temperature °C	Radiant Temperature °C	Operative Temperature °C
40,24345	16,28964	15,41656	15,8531
38,42394	16,64569	16,0875	16,36659
37,14622	17,73553	17,81186	17,77369
44,00902	19,4947	20,10585	19,80028
37,85203	23,39134	24,52413	23,95773
41,00141	24,75009	26,15039	25,45024
48,75677	25,44757	26,835	26,14128
47,9493	25,04212	26,21598	25,62905
51,73343	22,63454	23,30946	22,972
50,5619	18,9888	19,18339	19,08609
47,21254	16,87027	16,34413	16,6072
41,9289	16,22477	15,3092	15,76698

House in Netherlands (Existing House) + P-a-L GlassHouse

All the solutions presented were combined within a single model

Relative Humidity %	Air Temperature °C	Radiant Temperature °C	Operative Temperature °C
39,18705	16,85694	16,20388	16,53041
37,74821	17,07078	16,58346	16,82712
37,25466	17,83287	17,72304	17,77795
43,8322	19,69705	19,8931	19,79507
38,35564	23,37963	23,84296	23,6113
41,1841	24,72824	25,44722	25,08773
49,04614	25,18575	25,90504	25,54539
47,88596	24,94649	25,5449	25,2457
50,49666	23,22691	23,45632	23,34162
48,51951	19,85874	19,89125	19,875
46,53974	17,32081	16,90075	17,11078
40,68948	16,82975	16,15669	16,49322

Outside Dry-Bulb Temperature °C	TOTAL (kWh)	One Dwelling
4,199966		
3,700298		
5,320396		
8,448715	**25170,6**	**7551,2**
12,7331		
15,19701		
16,91179		
17,14177		
14,40677		
10,85202		
6,494965		
4,436021		

Outside Dry-Bulb Temperature °C	TOTAL (kWh)	One Dwelling
4,199966		
3,700298		
5,320396		
8,448715	**18200,9**	**5460,3**
12,7331		
15,19701	-27,69%	
16,91179		
17,14177		
14,40677		
10,85202		
6,494965		
4,436021		

Outside Dry-Bulb Temperature °C	TOTAL (kWh)	One Dwelling
4,199966		
3,700298		
5,320396		
8,448715	**15912,0**	

12,7331	15912,0	4773,6
15,19701	-12,58%	
16,91179		
17,14177		
14,40677		
10,85202		
6,494965		
4,436021		

Outside Dry-Bulb Temperature °C		
4,199966		
3,700298	TOTAL (kWh)	
5,320396		
8,448715	19367,3	One Dwelling
12,7331		5810,2
15,19701	6,41%	
16,91179		
17,14177		
14,40677		
10,85202		
6,494965		
4,436021		

Outside Dry-Bulb Temperature °C		
4,199966		
3,700298	TOTAL (kWh)	
5,320396		
8,448715	17064,0	One Dwelling
12,7331		5119,2
15,19701	-6,25%	
16,91179		
17,14177		
14,40677		
10,85202		
6,494965		
4,436021		

Outside Dry-Bulb Temperature °C
4,199966
3,700298
5,320396
8,448715
12,7331
15,19701
16,91179
17,14177
14,40677
10,85202
6,494965
4,436021

TOTAL (kWh)	One Dwelling
17834,2	**5350,3**
-2,01%	

Outside Dry-Bulb Temperature °C
4,199966
3,700298
5,320396
8,448715
12,7331
15,19701
16,91179
17,14177
14,40677
10,85202
6,494965
4,436021

TOTAL (kWh)	One Dwelling
13365,1	**4009,5**
-26,57%	

Outside Dry-Bulb Temperature °C
4,199966
3,700298
5,320396
8,448715
12,7331
15,19701
16,91179
17,14177
14,40677

TOTAL (kWh)	One Dwelling
16870,6	**5061,2**
-7,31%	

10,85202
6,494965
4,436021

Outside Dry-Bulb Temperature °C
4,199966
3,700298
5,320396
8,448715
12,7331
15,19701
16,91179
17,14177
14,40677
10,85202
6,494965
4,436021

TOTAL (kWh)	One Dwelling
12926,8	**3878,0**
-28,98%	

Outside Dry-Bulb Temperature °C
4,199966
3,700298
5,320396
8,448715
12,7331
15,19701
16,91179
17,14177
14,40677
10,85202
6,494965
4,436021

TOTAL (kWh)	One Dwelling
6422,8	**1926,8**
-74,48%	

*compared to the current condition

$RT_{60}=(24\ln 10^{1})*V/(c_{20}*Sa) \approx 0.1611 m^{-1}\ V/Sa;$
where:
c_{20}-speed of sound in the space (temp.=20°C)
V-volume of the enclosed space;
S-total surface of the room;
a-average absorption coefficient;
S·a-total absorption in Sabins;

Appendix 2:

Simulation A - Living Room

Reverberation Time Calculation
according to Sabine method

Project		Pret A Loger Living Room						
Room Volume		92	m³					
Time limit		0.8	s					
Diffuse factor		1.0						
nr	material	area [m²]	absorption-coefficient characteristic frequencies [Hz]					
			125	250	500	1k	2k	4k
1	Wooden Floor	36.9	0.15	0.11	0.10	0.07	0.06	0.07
2	Walls (plaster)	36.6	0.14	0.10	0.06	0.05	0.04	0.04
3	Ceiling (plaster)	36.9	0.14	0.10	0.06	0.05	0.04	0.04
4	Windows (wood 10%)	0.8	0.10	0.07	0.05	0.04	0.04	0.04
5	Doors (wood 60%)	6.1	0.10	0.07	0.05	0.04	0.04	0.04
6	Openings	3.8	1.00	1.00	1.00	1.00	1.00	1.00
7	Windows (glass 90%)	7.5	0.18	0.06	0.04	0.06	0.08	0.10
8	Doors (glass 40%)	4.0	0.18	0.06	0.04	0.06	0.08	0.10
9	-							
10	-							
11	-							
12	-							
13	-							
14	-							
15	-							

nr	material		characteristic frequencies [Hz]					
			125	**250**	**500**	**1k**	**2k**	**4k**
1	Wooden Floor	36.9	5.5	4.1	3.7	2.6	2.2	2.6
2	Walls (plaster)	36.6	5.1	3.7	2.2	1.8	1.5	1.5
3	Ceiling (plaster)	36.9	5.2	3.7	2.2	1.8	1.5	1.5
4	Windows (wood 10%)	0.8	0.1	0.1	0.0	0.0	0.0	0.0
5	Doors (wood 60%)	6.1	0.6	0.4	0.3	0.2	0.2	0.2
6	Openings	3.8	3.8	3.8	3.8	3.8	3.8	3.8
7	Windows (glass 90%)	7.5	1.3	0.4	0.3	0.4	0.6	0.7
8	Doors (glass 40%)	4.0	0.7	0.2	0.2	0.2	0.3	0.4
9	-		0.0	0.0	0.0	0.0	0.0	0.0
10	-		0.0	0.0	0.0	0.0	0.0	0.0
11	-		0.0	0.0	0.0	0.0	0.0	0.0
12	-		0.0	0.0	0.0	0.0	0.0	0.0
13	-		0.0	0.0	0.0	0.0	0.0	0.0
14	-		0.0	0.0	0.0	0.0	0.0	0.0
15	-		0.0	0.0	0.0	0.0	0.0	0.0
	Airborne sound absorption		0.0	0.0	0.0	0.3	0.7	2.2
	total open area in the room		22.4	16.4	12.7	11.3	10.9	13.0
	Reverberation [s]		**0.7**	**0.9**	**1.2**	**1.4**	**1.4**	**1.2**
	Time T =	**1.1**	**s**					

Simulation B - Living Room (adjusted)

Reverberation Time Calculation

according to Sabine method

Project	Pret A Loger Living Room		
Room Volume	92	m³	
Time limit	0.8	s	
Diffuse factor	1.0		

nr	material	area [m²]	absorption-coefficient characteristic frequencies [Hz] 125	250	500	1k	2k	4k
1	Wooden Floor	36.9	0.15	0.11	0.10	0.07	0.06	0.07
2	Walls (plaster)	36.6	0.14	0.10	0.06	0.05	0.04	0.04
3	Ceiling (plaster)	36.9	0.14	0.10	0.06	0.05	0.04	0.04
4	Windows (wood 10%)	0.8	0.10	0.07	0.05	0.04	0.04	0.04
5	Doors (wood 60%)	6.1	0.10	0.07	0.05	0.04	0.04	0.04
6	Openings	3.8	1.00	1.00	1.00	1.00	1.00	1.00
7	Windows (glass 90%)	7.5	0.18	0.06	0.04	0.06	0.08	0.10
8	Doors (glass 40%)	4.0	0.18	0.06	0.04	0.06	0.08	0.10
9	Furniture	12.0	0.32	0.40	0.42	0.44	0.43	0.48
10	Carpet	8.0	0.01	0.02	0.06	0.15	0.25	0.45
11	Drapery (60% glass)	6.9	0.05	0.07	0.13	0.22	0.32	0.35
12	Plants	1.0	0.15	0.15	0.15	0.15	0.15	0.15
13	-							
14	-							
15	-							

nr	material		characteristic frequencies [Hz] 125	250	500	1k	2k	4k
1	Wooden Floor	36.9	5.5	4.1	3.7	2.6	2.2	2.6
2	Walls (plaster)	36.6	5.1	3.7	2.2	1.8	1.5	1.5
3	Ceiling (plaster)	36.9	5.2	3.7	2.2	1.8	1.5	1.5
4	Windows (wood 10%)	0.8	0.1	0.1	0.0	0.0	0.0	0.0
5	Doors (wood 60%)	6.1	0.6	0.4	0.3	0.2	0.2	0.2
6	Openings	3.8	3.8	3.8	3.8	3.8	3.8	3.8
7	Windows (glass 90%)	7.5	1.3	0.4	0.3	0.4	0.6	0.7
8	Doors (glass 40%)	4.0	0.7	0.2	0.2	0.2	0.3	0.4
9	Furniture	12.0	3.8	4.8	5.0	5.3	5.2	5.8
10	Carpet	8.0	0.1	0.2	0.5	1.2	2.0	3.6
11	Drapery (60% glass)	6.9	0.3	0.5	0.9	1.5	2.2	2.4
12	Plants	1.0	0.2	0.2	0.2	0.2	0.2	0.2
13	-		0.0	0.0	0.0	0.0	0.0	0.0
14	-		0.0	0.0	0.0	0.0	0.0	0.0
15	-		0.0	0.0	0.0	0.0	0.0	0.0
	Airborne sound absorption		0.0	0.0	0.0	0.3	0.7	2.2
	total open area in the room		26.8	22.0	19.3	19.4	20.4	24.9
	Reverberation [s]		**0.6**	**0.7**	**0.8**	**0.8**	**0.8**	**0.6**
	Time T =	**0.7**	**s**					

Reverberation Time Calculation

according to Sabine method

Project	Pret A Loger		
	GlassHouse		
	-		
Room Volume	53	m³	
Time limit	0.8	s	
Diffuse factor	1.0		

nr	material	area [m²]	absorption-coefficient characteristic frequencies [Hz] 125	250	500	1k	2k	4k
1	Wooden Floor	13.4	0.15	0.11	0.10	0.07	0.06	0.07
2	Glass Walls (glass)	52.4	0.18	0.06	0.04	0.06	0.08	0.10
3	Openings	3.8	0.50	0.50	0.50	0.50	0.50	0.50
4	Windows (wood 10%)	1.1	0.10	0.07	0.05	0.04	0.04	0.04
5	Windows (glass 90%)	9.7	0.18	0.06	0.04	0.06	0.08	0.10
6	BrickFaçade	14.8	0.03	0.03	0.03	0.04	0.05	0.07
7								
8	-							
9	-							
10	-							
11	-							
12	-							
13	-							
14	-							
15	-							

nr	material		characteristic frequencies [Hz] 125	250	500	1k	2k	4k
1	Wooden Floor	13.4	5.5	1.5	1.3	0.9	0.8	0.9
2	Glass Walls (glass)	52.4	6.6	3.1	2.1	3.1	4.2	5.2
3	Openings	3.8	1.9	1.9	1.9	1.9	1.9	1.9
4	Windows (wood 10%)	1.1	0.1	0.1	0.1	0.0	0.0	0.0
5	Windows (glass 90%)	9.7	1.1	0.6	0.4	0.6	0.8	1.0
6	BrickFaçade	14.8	0.1	0.4	0.4	0.6	0.7	1.0
7			0.0	0.0	0.0	0.0	0.0	0.0
8	-		0.0	0.0	0.0	0.0	0.0	0.0
9	-		0.0	0.0	0.0	0.0	0.0	0.0
10	-		0.0	0.0	0.0	0.0	0.0	0.0
11	-		0.0	0.0	0.0	0.0	0.0	0.0
12	-		0.0	0.0	0.0	0.0	0.0	0.0
13	-		0.0	0.0	0.0	0.0	0.0	0.0
14	-		0.0	0.0	0.0	0.0	0.0	0.0
15	-		0.0	0.0	0.0	0.0	0.0	0.0
	Airborne sound absorption		0.0	0.0	0.0	0.3	0.7	2.2
	total open area in the room		15.3	7.6	6.2	7.4	9.2	12.3
	Reverberation [s]		**1.0**	**2.0**	**2.5**	**2.1**	**1.7**	**1.3**
	Time T =	**1.8**	**s**					

Simulation D - Glass House (adjusted)

Reverberation Time Calculation

according to Sabine method

Project	Pret A Loger	
	GlassHouse (+ furniture and details)	
	-	
Room Volume	53	m³
Time limit	0.8	s
Diffuse factor	1.0	

nr	material	area [m²]	absorption-coefficient characteristic frequencies [Hz] 125	250	500	1k	2k	4k
1	Wooden Floor	13.4	0.15	0.11	0.10	0.07	0.06	0.07
2	Glass Walls (glass)	20.9	0.18	0.06	0.04	0.06	0.08	0.10
3	Openings	3.8	0.50	0.50	0.50	0.50	0.50	0.50
4	Windows (wood 10%)	1.1	0.10	0.07	0.05	0.04	0.04	0.04
5	Windows (glass 90%)	9.7	0.18	0.06	0.04	0.06	0.08	0.10
6	Brick Façade	14.8	0.03	0.03	0.03	0.04	0.05	0.07
7								
8	Plants	4.0	0.15	0.15	0.15	0.15	0.15	0.15
9	Sound absorbing Panels	8.0	0.30	0.60	0.85	0.90	0.90	0.90
10	Sunshading (60% glass)	31.5	0.04	0.05	0.11	0.18	0.30	0.35
11	Furniture (wooden)	12.0	0.10	0.09	0.08	0.08	0.08	0.08
12	-							
13	-							
14	-							
15	-							

nr	material		characteristic frequencies [Hz] 125	250	500	1k	2k	4k
1	Wooden Floor	13.4	2.0	1.5	1.3	0.9	0.8	0.9
2	Glass Walls (glass)	20.9	3.8	1.3	0.8	1.3	1.7	2.1
3	Openings	3.8	1.9	1.9	1.9	1.9	1.9	1.9
4	Windows (wood 10%)	1.1	0.1	0.1	0.1	0.0	0.0	0.0
5	Windows (glass 90%)	9.7	1.7	0.6	0.4	0.6	0.8	1.0
6	Brick Façade	14.8	0.4	0.4	0.4	0.6	0.7	1.0
7			0.0	0.0	0.0	0.0	0.0	0.0
8	Plants	4.0	0.6	0.6	0.6	0.6	0.6	0.6
9	Sound absorbing Panels	8.0	2.4	4.8	6.8	7.2	7.2	7.2
10	Sunshading (60% glass)	31.5	1.3	1.6	3.5	5.7	9.5	11.0
11	Furniture (wooden)	12.0	1.2	1.1	1.0	1.0	1.0	1.0
12	-		0.0	0.0	0.0	0.0	0.0	0.0
13	-		0.0	0.0	0.0	0.0	0.0	0.0
14	-		0.0	0.0	0.0	0.0	0.0	0.0
15	-		0.0	0.0	0.0	0.0	0.0	0.0
	Airborne sound absorption		0.0	0.0	0.0	0.3	0.7	2.2
	total open area in the room		15.4	13.8	16.8	20.0	24.9	29.0
	Reverberation [s]		**1.0**	**1.1**	**0.9**	**0.8**	**0.6**	**0.5**
	Time T =	**0.8**	**s**					

Appendix - Reverberation Time
Appendix 1:

More details about the calculations can be found in the Appendix.

The calculation can be expressed by the following formula:

$L_{inside,i} = L_{outside,i} - R_i + 3 + 10 \log(S/A_{2,i})$;

where:

$L_{inside,i}$ - sound intensity inside(being measured);
$L_{outside,i}$ - sound pressure outside (measured);
R_i - sound insulation value (being calculated);
The index 'i' tells that each of the mentioned values are being considered for different octaves bands, meaning different frequencies. The 'R' value of the material often has to be estimated for complex wall structures, consisting of two or more construction materials. Considering the method expressed above, the sound insulation of the partition wall will also be evaluated for different frequencies. That is why it is important to convert the multiple values to a single one, in order to define the insulation characteristic of the façade.

The sound insulation has to be calculated according to ISO 140-5:1998, and have to be considered for each 1/3 octave bands. However, the assessment parameter will be not be based on each octave, but on the single Dls,2m,nT,w value (calculated according to ISO 717-1:1996). This value has to be higher than 42db in order to achieve the best comfort conditions. The adaptation to one-single value is an important step in the calculation and has to be done thoroughly according to the mentioned norms.

Honselersdijk House - Prêt-à-Loger renovation

BOA Geluidwering Gevels **Technische Universiteit Delft** *(c) dirActivity-software BV 2014*

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project	**nieuw, omschrijving**
Projectdatum	27-02-2014
Opdrachtgever	
Uitgevoerd door	

gebouw	**nieuwe berekening**
Rekenmethode	besluit geluidwering gebouwen
Spectrum	handinvoer
Uitgevoerd door	Sergiu Troian

	totaal	125	250	500	1000	2000
Ci		-3.0	-3.0	-3.0	-3.0	-3.0

situatie	**NL House**			totaal	125	250	500	1000	2000
Geluidbelasting	60	dB							
Opgegeven als Su,tot	14.4	m2	(Opp. uitw. gevelconstructie verblijfsgebied)						
nieuwe ruimte									
Su,ruimte	14.4	m2							
V	92	m3							
T,ref	0.5	s							
GA	**34.0**	**dB**		GA		40.5	41.1	54.6	61.2	62.8
Lp	26.0	dB		Lp		19.5	18.9	5.4	-1.2	-2.8
nieuwe gevel (achter tussenruimte: GlassHouse)									
Su,gevel	14.4	m2		Cl		0.0	0.0	0.0	0.0	0.0
Cg		dB							
GA,gevel	34.0	dB		GA,g	34.0	40.5	41.1	54.6	61.2	62.8
				Gi,g		37.5	38.1	51.6	58.2	59.8
Lp,gevel	26.0	dB		Lp,g	26.0	19.5	18.9	5.4	-1.2	-2.8

Gvldeel	Afm.	Cat.nr.	Msoort	Materiaal		Lp;p	Cvlg		totaal	125	250	500	1000	2000
paneel	7.40 m2	pa37b	paneel	BP4;Buigsl.constr. ca.55 kg/m2		15.4	1.5	RA	27.4	25.0	35.0	40.0	45.0	50.0
glas	5.40 m2	gw26	glas	Ra,weg = 26 en 27 dB(A)		25.5	0	RA	16.2	19.9	19.5	26.3	33.9	33.7
kozijn	1.60 m2	ko33	kozijn	Kozijn K2		9.9	1.5	RA	26.2	26.0	28.0	34.0	36.0	40.0
naad	7.60 m	na56	naad	Kozijn-steen; tweezijdig gekit + afdeklat		-6.0	0	RA	47.4	46.0	51.0	56.0	61.0	68.0
kier	15.20 m	k40	kier	O-profiel indrukking 3,5 mm		4.0	0	RA	36.5	41.0	44.0	44.0	38.0	39.0

GlassHouse (tussenruimte)														
Su,ruimte	14.4	m2												
V	31.7	m3						T60		1.0	1.2	1.0	0.7	0.6
Reductie	**8.7**	**dB**						Red		15.4	14.6	21.5	23.8	24.4
Lp	51.3	dB						Lp		44.6	45.4	38.5	36.2	35.6
nieuwe gevel														
Su,gevel	14.4	m2						Cl		0.0	0.0	0.0	0.0	0.0
Cg		dB												
Red,gevel	8.7	dB						Red	8.7	15.4	14.6	21.5	23.8	24.4
Lp,gevel	51.3	dB						Lp,g	51.3	44.6	45.4	38.5	36.2	35.6

Gvldeel	Afm.	Cat.nr.	Msoort	Materiaal		Lp;p	Cvlg		totaal	125	250	500	1000	2000
glas	12.60 m2	gw26	glas	Ra,weg = 26 en 27 dB(A)		50.8	0	RA	16.2	19.9	19.5	26.3	33.9	33.7
kozijn	1.80 m2	ko31	kozijn	Kozijn K1		37.2	1.5	RA	22.7	22.0	25.0	33.0	35.0	35.0
naad	43.40 m	na56	naad	Kozijn-steen; tweezijdig gekit + afdeklat		24.9	0	RA	47.4	46.0	51.0	56.0	61.0	68.0
kier	16.10 m	k30	kier	O-profiel indrukking 3 mm		39.7	0	RA	26.8	35.0	36.0	34.0	28.0	28.0

Paris House - Prêt-à-Loger design

situatie	**Paris House**			totaal	125	250	500	1000	2000
Geluidbelasting	60	dB							
Opgegeven als									
Su,tot	14.4	m2	(Opp. uitw. gevelconstructie verblijfsgebied)						
nieuwe ruimte									
Su,ruimte	14.4	m2							
V	92	m3							
T,ref	0.5	s							
GA	**30.3**	**dB**	GA		38.2	32.7	54.8	67.2	69.4
Lp	29.7	dB	Lp		21.8	27.3	5.2	-7.2	-9.4
nieuwe gevel (achter tussenruimte: GlassHouse)									
Su,gevel	14.4	m2	CI		0.0	0.0	0.0	0.0	0.0
Cg		dB							
GA,gevel	30.3	dB	GA,g	30.3	38.2	32.7	54.8	67.2	69.4
			Gi,g		35.2	29.7	51.8	64.2	66.4
Lp,gevel	29.7	dB	Lp,g	29.7	21.8	27.3	5.2	-7.2	-9.4

Gvldeel	Afm.	Cat.nr.	Msoort	Materiaal		Lp;p	Cvlg		totaal	125	250	500	1000	2000
paneel	7.40 m2	pa23	paneel	BP2b;Sandw.wol100; 20 kg/m2		27.5	1.5	RA	15.9	20.0	14.0	30.0	41.0	50.0
glas	5.40 m2	gw26	glas	Ra,weg = 26 en 27 dB(A)		25.5	0	RA	16.2	19.9	19.5	26.3	33.9	33.7
kozijn	1.60 m2	ko33	kozijn	Kozijn K2		9.7	1.5	RA	26.2	26.0	28.0	34.0	36.0	40.0
naad	7.60 m	na56	naad	Kozijn-steen; tweezijdig gekit + afdeklat		-6.1	0	RA	47.4	46.0	51.0	56.0	61.0	68.0
kier	15.20 m	k40	kier	O-profiel indrukking 3,5 mm		3.0	0	RA	36.5	41.0	44.0	44.0	38.0	39.0

GlassHouse (tussenruimte)									
Su,ruimte	14.4	m2							
V	31.7	m3	T60		1.0	1.2	0.7	0.6	0.5
Reductie	**9.1**	**dB**	Red		15.5	14.6	23.8	30.1	31.1
Lp	50.9	dB	Lp		44.5	45.4	36.2	29.9	28.9
nieuwe gevel									
Su,gevel	14.4	m2	CI		0.0	0.0	0.0	0.0	0.0
Cg		dB							
Red,gevel	9.1	dB	Red	9.1	15.5	14.6	23.8	30.1	31.1
Lp,gevel	50.9	dB	Lp,g	50.9	44.5	45.4	36.2	29.9	28.9

Gvldeel	Afm.	Cat.nr.	Msoort	Materiaal		Lp;p	Cvlg		totaal	125	250	500	1000	2000
glas	12.60 m2	gw26	glas	Ra,weg = 26 en 27 dB(A)		50.7	0	RA	16.2	19.9	19.5	26.3	33.9	33.7
kozijn	1.80 m2	ko31	kozijn	Kozijn K1		37.2	1.5	RA	22.7	22.0	25.0	33.0	35.0	35.0
naad	43.40 m	na56	naad	Kozijn-steen; tweezijdig gekit + afdeklat		24.8	0	RA	47.4	46.0	51.0	56.0	61.0	68.0
kier	16.10 m	k40	kier	O-profiel indrukking 3,5 mm		29.8	0	RA	36.5	41.0	44.0	44.0	38.0	39.0

Appendix 1:

Sound Insulation Adjacent Room

Nr	Name	Frequencies				
		125	250	500	1000	2000
1	Installation Characteristics	51,8	59,2	59,3	55,6	54,5
		63,94307058				
2	Sound Insulation Absorbtion Coefficient	0,35	0,4	0,5	0,7	0,65
3	Sound Insulation Area (m2)	7,6	7,6	7,6	7,6	7,6
4	Absorbtion area	2,66	3,04	3,8	5,32	4,94
5	Absorbtion Coefficient (rest of the surfaces	0,02	0,02	0,02	0,02	0,02
6	Area (rest of the surfaces)	0,95	0,95	0,95	0,95	0,95
7	Absorbtion Area	0,019	0,019	0,019	0,019	0,019
8	Total Absorbtion	2,679	3,059	3,819	5,339	4,959
9	10Log(4/A)	-1,7	-1,2	-0,2	1,3	0,9
10	Lp (after aborbtion)	53,5	60,4	59,5	54,3	53,6
11	Insulation of the separation walls	25	25	25	25	25
12	Volume of the room (V)	41	41	41	41	41
13	Reverberation time T=0.7	0,7	0,7	0,7	0,7	0,7
14	A=V/6T	9,761905	9,761905	9,761905	9,761905	9,761905
15	Separation Wall Area	2,3	2,3	2,3	2,3	2,3
16	10Log(S/A)	-6,27807	-6,27807	-6,27807	-6,27807	-6,27807
17	Sound Pressure in the bedroom	22,3	29,1	28,2	23,1	22,3
18	A-correction	-16	-9	-3	0	1
19	Sound Pressure corrected	6,3	20,1	25,2	23,1	23,3
20	Single Value Sound Pressure (dB)	29,31989494				

Appendix - HVAC Acoustics
Appendix 1:
System Calculations - Ducts (no lagging)

NR	Construction	Frequencies						Unit
		125	250	500	1000	2000	4000	Hz
1	Sound pressure (installation)	**54,1**	**58,7**	**71,3**	**74,1**	**67**	**65**	
2	Sound pressure damping in the room							
	Rooster area S=0.03m2							
	f/sqrt(S)	22	43	87	173	346	693	
	Direction Value Q (situation 4 from figure 39 [45	7,7	6,3	5,5	4,9	4,5	4,2	
3	Room Damping = 10log(Q/4*π*r + 4/A)	**6,9**	**7,1**	**7,3**	**7,5**	**7,5**	**7,6**	dB
4	End Reflection Rooster (situation 4 from figure 3	**4,5**	**1**	**0**	**0**	**0**	**0**	dB
5	Damping at the corner (round)	**0**	**0**	**0**	**1**	**2**	**3**	dB
6	Damping chanel (1.4m) ∅160 (tabel 9) per	0,1	0,1	0,1	0,3	0,3	0,3	dB
	full length	**0,14**	**0,14**	**0,14**	**0,42**	**0,42**	**0,42**	dB
7	Damping at the split = 0.5 (formula 46)	**3**	**3**	**3**	**3**	**3**	**3**	dB
8	Damping chanel (2.4m) ∅160 (tabel 9) per	0,1	0,1	0,1	0,3	0,3	0,3	dB
	full length	**0,24**	**0,24**	**0,24**	**0,72**	**0,72**	**0,72**	dB
9	Damping at the corner (round)	**0**	**0**	**0**	**1**	**2**	**3**	dB
10	Damping at the split = 0.5 (formula 46)	**3**	**3**	**3**	**3**	**3**	**3**	dB
	Total Damping	**17,7**	**14,5**	**13,7**	**16,6**	**18,7**	**20,8**	dB
11	Final Sound Pressure Level	36,4	44,2	57,6	57,5	48,3	44,2	dB
12	Mean Sound Pressure Level	52						dB
	Competition Demand	25						dB
13	Difference (damping needed)	27						dB
14	Sound characteristic of the rooster							dB
15	Room Damping = 10log(Q/4*π*r + 4/A)	**6,9**	**7,1**	**7,3**	**7,5**	**7,5**	**7,6**	dB
16	Sound pressure level of the rooster	-6,9	-7,1	-7,3	-7,5	-7,5	-7,6	dB
17	Final Sound Pressure Level (due to fan)	36,4	44,2	57,6	57,5	48,3	44,2	dB
18	Final Sound Pressure Level (due to rooster)							dB
19	Final Sound Pressure Value							dB
20	Mean Final Sound Pressure Value							dB
	Competition Demand	25						dB

System Calculations - Ducts (lagging considered)

NR	Construction	Frequencies						Unit
		125	250	500	1000	2000	4000	Hz
1	Sound pressure (installation)	**54,1**	**58,7**	**71,3**	**74,1**	**67**	**65**	
2	Sound pressure damping in the room							
	Rooster area S=0.03m2							
	f/sqrt(S)	22	43	87	173	346	693	
	Direction Value Q (situation 4 from figure 39 [45°]	7,7	6,3	5,5	4,9	4,5	4,2	
3	Room Damping = 10log(Q/4*π*r + 4/A)	**6,9**	**7,1**	**7,3**	**7,5**	**7,5**	**7,6**	dB
4	End Reflection Rooster (situation 4 from figure 39	**4,5**	**1**	**0**	**0**	**0**	**0**	dB
5	Damping at the corner (round)	**0**	**0**	**0**	**1**	**2**	**3**	dB
6	Damping chanel (1.4m) ∅160 (tabel 9) per 1	17	22	22	27	19	14	dB
	full length	17	22	22	27	19	14	dB
7	Damping at the split = 0.5 (formula 46)	**3**	**3**	**3**	**3**	**3**	**3**	dB
8	Damping chanel (2.4m) ∅160 (tabel 9) per 2	31	39	34	38	31	20	dB
	full length	31	39	34	38	31	20	dB
9	Damping at the corner (round)	**0**	**0**	**0**	**1**	**2**	**3**	dB
10	Damping at the corner (round)	**0**	**0**	**0**	**1**	**2**	**3**	dB
11	Damping at the split = 0.5 (formula 46)	**3**	**3**	**3**	**3**	**3**	**3**	dB
	Total Damping	**65,4**	**75,1**	**69,3**	**81,5**	**69,5**	**56,6**	dB
12	Final Sound Pressure Level	-11,3	-16,4	2,0	-7,4	-2,5	8,4	dB
13	Mean Sound Pressure Level	9,688038281						dB
	Competition Demand	25						dB
14	Difference (damping needed)							dB
15	Sound characteristic of the rooster	18	18	18	18	18	18	dB
16	Room Damping = 10log(Q/4*π*r + 4/A)	**6,9**	**7,1**	**7,3**	**7,5**	**7,5**	**7,6**	dB
17	Sound pressure level of the rooster	11,1	10,9	10,7	10,5	10,5	10,4	dB
18	Final Sound Pressure Level (due to fan)	-11,3	-16,4	2,0	-7,4	-2,5	8,4	dB
19	Final Sound Pressure Level (due to rooster)	11,1	10,9	10,7	10,5	10,5	10,4	dB
20	Final Sound Pressure Value	11,1	10,9	11,2	10,6	10,7	12,5	dB
21	Mean Final Sound Pressure Value	19,01370385						dB
	Competition Demand	25						dB

5 Daily Electrical Load Consumption - Competition

Week

	Consumption (Wh)												Total Consumption (Wh)
	30 June	1 July	2 July	3 July	4 July	5 July	6 July	7 July	8 July	9 July	10 July	11 July	
Fridge/Refrigerator	416,4	416,4	416,4	416,4	416,4	416,4	416,4	416,4	416,4	416,4	416,4	416,4	4996,8
TV	126	84	126	84	126	0	0	126	126	126	84	126	1134
Computer	510	340	510	340	510	0	0	510	510	510	340	510	4590
Clothes washer	120,41	120,41	120,41	120,41	120,41	0	0	120,41	120,41	120,41	120,41	120,41	1204,1
Clothes drying	365,384	365,384	365,384	365,384	365,384	0	0	365,384	365,384	365,384	365,384	365,384	3653,84
Dishwasher	456,72	456,72	456,72	456,72	456,72	0	0	456,72	456,72	456,72	456,72	456,72	4567,2
Oven	1325	1987,5	1325	1987,5	0	0	0	1325	1325	1325	1987,5	0	12587,5
Cooking	1600	3412,8	1600	3412,8	0	0	0	1600	1600	1600	3412,8	0	18238,4
Extraction system	139	296,487	139	296,487	0	0	0	139	139	139	296,487	0	1584,461
													52556,301
Weekly consumption (kWh)		27,904											
Monthly consumption (kWh)		123,574											
Annual consumption (kWh)		1451,008											

30th June						
		Kwh/half hour	**Load (W)**		**Daily Consumption (Wh)**	
Refrigerator		8,675	17,35		416,4	
Freezer					0	
TV		10,5	21		126	
Computer		42,5	85		510	
Clothes Washer		60,205	120,41		120,41	
Colthes Drying		182,692	365,38		365,384	
Dishwasher		228,36	456,73		456,72	
Oven		1325	2650		1325	
Cooking		800	1600		1600	
Extraction System		69,5	139		139	
					5058,914	
1st July						
		Kwh/half hour	**Load (W)**		**Daily Consumption**	
Refrigerator		8,675	17,35		416,4	
Freezer					0	
TV		10,5	21		84	
Computer		42,5	85		340	
Clothes Washer		60,205	120,41		120,41	
Colthes Drying		182,692	365,38		365,384	
Dishwasher		228,36	456,73		456,72	
Oven		1325	2650		1987,5	
Cooking		800	1600		3412,8	
Extraction System		69,5	139		296,487	
					7479,701	

2nd July						
		Kwh/half hour	**Load (W)**		**Daily Consumption**	
Refrigerator		8,675	17,35		416,4	
Freezer					0	
TV		10,5	21		126	
Computer		42,5	85		510	
Clothes Washer		60,205	120,41		120,41	
Colthes Drying		182,692	365,38		365,384	
Dishwasher		228,36	456,73		456,72	
Oven		1325	2650		1325	
Cooking		800	1600		1600	
Extraction System		69,5	139		139	
					5058,914	
3rd July						
		Kwh/half hour	**Load (W)**		**Daily Consumption**	
Refrigerator		8,675	17,35		416,4	
Freezer					0	
TV		10,5	21		84	
Computer		42,5	85		340	
Clothes Washer		60,205	120,41		120,41	
Colthes Drying		182,692	365,38		365,384	
Dishwasher		228,36	456,73		456,72	
Oven		1325	2650		1987,5	
Cooking		800	1600		3412,8	
Extraction System		69,5	139		296,487	
					7479,701	
4th July						
		Kwh/half hour	**Load (W)**		**Daily Conumption**	

Refrigerator		8,675	17,35		416,4	
Freezer					0	
TV		10,5	21		126	
Computer		42,5	85		510	
Clothes Washer		60,205	120,41		120,41	
Colthes Drying		182,692	365,38		365,384	
Dishwasher		228,36	456,73		456,72	
Oven		1325	2650		0	
Cooking		800	1600		0	
Extraction System		69,5	139		0	
					1994,914	
5th July						
		Kwh/half hour	**Load(W)**		**Daily Consumption**	
Refrigerator		8,675	17,35		416,4	
Freezer					0	
TV		10,5	21		0	
Computer		42,5	85		0	
Clothes Washer		60,205	120,41		0	
Colthes Drying		182,692	365,38		0	
Dishwasher		228,36	456,73		0	
Oven		1325	2650		0	
Cooking		800	1600		0	
Extraction System		69,5	139		0	
					416,4	

6th July						
		Kwh/half hour	Load (W)		Daily Consumption	
Refrigerator		8,675	17,35		416,4	
Freezer					0	
TV		10,5	21		0	
Computer		42,5	85		0	
Clothes Washer		60,205	120,41		0	
Colthes Drying		182,692	365,38		0	
Dishwasher		228,36	456,73		0	
Oven		1325	2650		0	
Cooking		800	1600		0	
Extraction System		69,5	139		0	
					416,4	
7th July						
		Kwh/half hour	Load (W)		Daily Consumption	
Refrigerator		8,675	17,35		416,4	
Freezer					0	
TV		10,5	21		126	
Computer		42,5	85		510	
Clothes Washer		60,205	120,41		120,41	
Colthes Drying		182,692	365,38		365,384	
Dishwasher		228,36	456,73		456,72	
Oven		1325	2650		1325	
Cooking		800	1600		1600	
Extraction System		69,5	139		139	
					5058,914	

8th July						
		Kwh/half hour	**Load (W)**		**Daily Consumption**	
Refrigerator		8,675	17,35		416,4	
Freezer					0	
TV		10,5	21		126	
Computer		42,5	85		510	
Clothes Washer		60,205	120,41		120,41	
Colthes Drying		182,692	365,38		365,384	
Dishwasher		228,36	456,73		456,72	
Oven		1325	2650		1325	
Cooking		800	1600		1600	
Extraction System		69,5	139		139	
					5058,914	
9th July						
		Kwh/half hour	**Load (W)**		**Daily Consumption**	
Refrigerator		8,675	17,35		416,4	
Freezer					0	
TV		10,5	21		126	
Computer		42,5	85		510	
Clothes Washer		60,205	120,41		120,41	
Colthes Drying		182,692	365,38		365,384	
Dishwasher		228,36	456,73		456,72	
Oven		1325	2650		1325	
Cooking		800	1600		1600	
Extraction System		69,5	139		139	
					5058,914	
10th July						

		Kwh/half hour	Load (W)		Daily Consumption	
Refrigerator		8,675	17,35		416,4	
Freezer					0	
TV		10,5	21		84	
Computer		42,5	85		340	
Clothes Washer		60,205	120,41		120,41	
Colthes Drying		182,692	365,38		365,384	
Dishwasher		228,36	456,73		456,72	
Oven		1325	2650		1987,5	
Cooking		800	1600		3412,8	
Extraction System		69,5	139		296,487	
					7479,701	
11th July						
		Kwh/half hour	Load (W)		Daily Consumption	
Refrigerator		8,675	17,35		416,4	
Freezer					0	
TV		10,5	21		126	
Computer		42,5	85		510	
Clothes Washer		60,205	120,41		120,41	
Colthes Drying		182,692	365,38		365,384	
Dishwasher		228,36	456,73		456,72	
Oven		1325	2650		0	
Cooking		800	1600		0	
Extraction System		69,5	139		0	
					1994,914	
					Total Consumption (Wh)	**52556,3**

	Daily Consumption (Wh)												
	30 June	1 July	2 July	3 July	4 July	5 July	6 July	7 July	8 July	9 July	10 July	11 July	Total
Light1 (outside front)	7	7	7	7	7	7	7	7	7	7	7	7	84
Light 2 (toilet	8	8	8	8	8	8	8	8	8	8	8	8	96
Light 3 (hall)	8	8	8	8	8	8	8	8	8	8	8	8	96
Light 4 (kitchen: 3x2Watt)	12	12	12	12	12	12	12	12	12	12	12	12	144
Light 4 (living room1: 2x4Watt)	16	16	16	16	16	16	16	16	16	16	16	16	192
Light 5 (back outside 1)(ceiling)	16	16	16	16	16	16	16	16	16	16	16	16	192
Light 5 (back outside 2)(ceiling)	16	16	16	16	16	16	16	16	16	16	16	16	192
Light 6 (back outside 3)(wall)	11	11	11	11	11	11	11	11	11	11	11	11	132
Light 7 (living room 2)	10	10	10	10	10	10	10	10	10	10	10	10	120
Light 8 (installation room)	10	10	10	10	10	10	10	10	10	10	10	10	120
Light 9 (model room)	16	16	16	16	16	16	16	16	16	16	16	16	192
Light 10 (stairs)	76	76	76	76	76	76	76	76	76	76	76	76	912
Light 11 (bathroom 1st floor)	60	60	60	60	60	60	60	60	60	60	60	60	720
Light 12 (bathroom spotlight: 5x4Watt)	40	40	40	40	40	40	40	40	40	40	40	40	480
Light 13 (parents' bedroom)	16	16	16	16	16	16	16	16	16	16	16	16	192

	Light1 (outside front)	Light 2 (toilet)	Light 3 (hall)	Light 4 (kitchen: 3x2Watt)	(living room1: 2x4Wat	(back outsid e	(back outside 2)(ceiling	(back outside 3)(wall)	(living room 2)	(install ation room)	Light 9 (model room)	Light 10 (stairs)	11 (bathro om 1st	(bathroom spotlight: 5x4Watt)	Light 13 (parents' bedroom)	Total Consumption (Wh)
Weekly Consumtion (Wh)	49	56	56	84	112	112	112	77	70	70	112	532	420	280	112	**2254**
Monthly Consumption (Wh)	196	224	224	336	448	448	448	308	280	280	448	21280	1680	1120	448	**28168**
Annual consumption (Wh)	2548	2912	2912	4368	5824	5824	5824	4004	3640	3640	5824	27664	21840	14560	5824	**117208**

30th June							
			Wh/half hour	Load (W)		Daily Consumption (Wh)	
Light1 (outside front)			1,75	3,5		7	
Light 2 (toilet)			2	4		8	
Light 3 (hall)			2	4		8	
Light 4 (kitchen: 3x2Watt)			3	6		12	
Light 4 (living room1: 2x4Watt) (dining room)			4	8		16	
Light 5 (back outside 1) (ceiling)			4	8		16	
Light 5 (back outside 2) (ceiling)			4	8		16	
Light 6 (back outside 3) (wall)			2,75	5,5		11	
Light 7 (living room 2)			2,5	5		10	
Light 8 (installation room)			2,5	5		10	
Light 9 (model room) (ceiling)			4	8		16	
Light 10 (stairs)			19	38		76	
Light 11 (bathroom 1st floor)			15	30		60	
Light 12 (bathroom spotlight: 5x4Watt)			10	20		40	
Light 13 (parents' bedroom)			4	8		16	
						322	
1st July							
			Wh/half hour	Load (W)		Daily Consumption (Wh)	
Light1 (outside front)			1,75	3,5		7	
Light 2 (toilet)			2	4		8	
Light 3 (hall)			2	4		8	
Light 4 (kitchen: 3x2Watt)			3	6		12	
Light 4 (living room1: 2x4Watt) (dining room)			4	8		16	
Light 5 (back outside 1) (ceiling)			4	8		16	
Light 5 (back outside 2) (ceiling)			4	8		16	
Light 6 (back outside 3) (wall)			2,75	5,5		11	
Light 7 (living room 2)			2,5	5		10	
Light 8 (installation room)			2,5	5		10	
Light 9 (model room) (ceiling)			4	8		16	
Light 10 (stairs)			19	38		76	
Light 11 (bathroom 1st floor)			15	30		60	
Light 12 (bathroom spotlight: 5x4Watt)			10	20		40	
Light 13 (parents' bedroom)			4	8		16	
						322	
2nd July							
			Wh/half hour	Load (W)		Daily Consumption (Wh)	
Light1 (outside front)			1,75	3,5		7	
Light 2 (toilet)			2	4		8	
Light 3 (hall)			2	4		8	
Light 4 (kitchen: 3x2Watt)			3	6		12	
Light 4 (living room1: 2x4Watt) (dining room)			4	8		16	
Light 5 (back outside 1) (ceiling)			4	8		16	
Light 5 (back outside 2) (ceiling)			4	8		16	
Light 6 (back outside 3) (wall)			2,75	5,5		11	
Light 7 (living room 2)			2,5	5		10	
Light 8 (installation room)			2,5	5		10	
Light 9 (model room) (ceiling)			4	8		16	
Light 10 (stairs)			19	38		76	
Light 11 (bathroom 1st floor)			15	30		60	
Light 12 (bathroom spotlight: 5x4Watt)			10	20		40	
Light 13 (parents' bedroom)			4	8		16	
						322	

3rd July							
			Wh/half hour	Load (W)		Daily Consumption (Wh)	
Light1 (outside front)			1,75	3,5		7	
Light 2 (toilet)			2	4		8	
Light 3 (hall)			2	4		8	
Light 4 (kitchen: 3x2Watt)			3	6		12	
Light 4 (living room1: 2x4Watt) (dining room)			4	8		16	
Light 5 (back outside 1) (ceiling)			4	8		16	
Light 5 (back outside 2) (ceiling)			4	8		16	
Light 6 (back outside 3) (wall)			2,75	5,5		11	
Light 7 (living room 2)			2,5	5		10	
Light 8 (installation room)			2,5	5		10	
Light 9 (model room) (ceiling)			4	8		16	
Light 10 (stairs)			19	38		76	
Light 11 (bathroom 1st floor)			15	30		60	
Light 12 (bathroom spotlight: 5x4Watt)			10	20		40	
Light 13 (parents' bedroom)			4	8		16	
						322	
4th July							
			Wh/half hour	Load (W)		Daily Consumption (Wh)	
Light1 (outside front)			1,75	3,5		7	
Light 2 (toilet)			2	4		8	
Light 3 (hall)			2	4		8	
Light 4 (kitchen: 3x2Watt)			3	6		12	
Light 4 (living room1: 2x4Watt) (dining room)			4	8		16	
Light 5 (back outside 1) (ceiling)			4	8		16	
Light 5 (back outside 2) (ceiling)			4	8		16	
Light 6 (back outside 3) (wall)			2,75	5,5		11	
Light 7 (living room 2)			2,5	5		10	
Light 8 (installation room)			2,5	5		10	
Light 9 (model room) (ceiling)			4	8		16	
Light 10 (stairs)			19	38		76	
Light 11 (bathroom 1st floor)			15	30		60	
Light 12 (bathroom spotlight: 5x4Watt)			10	20		40	
Light 13 (parents' bedroom)			4	8		16	
						322	
5th July							
			Wh/half hour	Load (W)		Daily Consumption (Wh)	
Light1 (outside front)			1,75	3,5		7	
Light 2 (toilet)			2	4		8	
Light 3 (hall)			2	4		8	
Light 4 (kitchen: 3x2Watt)			3	6		12	
Light 4 (living room1: 2x4Watt) (dining room)			4	8		16	
Light 5 (back outside 1) (ceiling)			4	8		16	
Light 5 (back outside 2) (ceiling)			4	8		16	
Light 6 (back outside 3) (wall)			2,75	5,5		11	
Light 7 (living room 2)			2,5	5		10	
Light 8 (installation room)			2,5	5		10	
Light 9 (model room) (ceiling)			4	8		16	
Light 10 (stairs)			19	38		76	
Light 11 (bathroom 1st floor)			15	30		60	
Light 12 (bathroom spotlight: 5x4Watt)			10	20		40	
Light 13 (parents' bedroom)			4	8		16	
						322	

6th July							
			Wh/half hour	Load (W)		Daily Consumption (Wh)	
Light1 (outside front)			1,75	3,5		7	
Light 2 (toilet)			2	4		8	
Light 3 (hall)			2	4		8	
Light 4 (kitchen: 3x2Watt)			3	6		12	
Light 4 (living room1: 2x4Watt) (dining room)			4	8		16	
Light 5 (back outside 1) (ceiling)			4	8		16	
Light 5 (back outside 2) (ceiling)			4	8		16	
Light 6 (back outside 3) (wall)			2,75	5,5		11	
Light 7 (living room 2)			2,5	5		10	
Light 8 (installation room)			2,5	5		10	
Light 9 (model room) (ceiling)			4	8		16	
Light 10 (stairs)			19	38		76	
Light 11 (bathroom 1st floor)			15	30		60	
Light 12 (bathroom spotlight: 5x4Watt)			10	20		40	
Light 13 (parents' bedroom)			4	8		16	
						322	
7th July							
			Wh/half hour	Load (W)		Daily Consumption (Wh)	
Light1 (outside front)			1,75	3,5		7	
Light 2 (toilet)			2	4		8	
Light 3 (hall)			2	4		8	
Light 4 (kitchen: 3x2Watt)			3	6		12	
Light 4 (living room1: 2x4Watt) (dining room)			4	8		16	
Light 5 (back outside 1) (ceiling)			4	8		16	
Light 5 (back outside 2) (ceiling)			4	8		16	

Light 6 (back outside 3) (wall)			2,75	5,5		11	
Light 7 (living room 2)			2,5	5		10	
Light 8 (installation room)			2,5	5		10	
Light 9 (model room) (ceiling)			4	8		16	
Light 10 (stairs)			19	38		76	
Light 11 (bathroom 1st floor)			15	30		60	
Light 12 (bathroom spotlight: 5x4Watt)			10	20		40	
Light 13 (parents' bedroom)			4	8		16	
						322	
8th July							
			Wh/half hour	Load (W)		Daily Consumption (Wh)	
Light1 (outside front)			1,75	3,5		7	
Light 2 (toilet)			2	4		8	
Light 3 (hall)			2	4		8	
Light 4 (kitchen: 3x2Watt)			3	6		12	
Light 4 (living room1: 2x4Watt) (dining room)			4	8		16	
Light 5 (back outside 1) (ceiling)			4	8		16	
Light 5 (back outside 2) (ceiling)			4	8		16	
Light 6 (back outside 3) (wall)			2,75	5,5		11	
Light 7 (living room 2)			2,5	5		10	
Light 8 (installation room)			2,5	5		10	
Light 9 (model room) (ceiling)			4	8		16	
Light 10 (stairs)			19	38		76	
Light 11 (bathroom 1st floor)			15	30		60	
Light 12 (bathroom spotlight: 5x4Watt)			10	20		40	
Light 13 (parents' bedroom)			4	8		16	
						322	

9th July							
			Wh/half hour	**Load (W)**		**Daily Consumption (Wh)**	
Light1 (outside front)			1,75	3,5		7	
Light 2 (toilet)			2	4		8	
Light 3 (hall)			2	4		8	
Light 4 (kitchen: 3x2Watt)			3	6		12	
Light 4 (living room1: 2x4Watt) (dining room)			4	8		16	
Light 5 (back outside 1) (ceiling)			4	8		16	
Light 5 (back outside 2) (ceiling)			4	8		16	
Light 6 (back outside 3) (wall)			2,75	5,5		11	
Light 7 (living room 2)			2,5	5		10	
Light 8 (installation room)			2,5	5		10	
Light 9 (model room) (ceiling)			4	8		16	
Light 10 (stairs)			19	38		76	
Light 11 (bathroom 1st floor)			15	30		60	
Light 12 (bathroom spotlight: 5x4Watt)			10	20		40	
Light 13 (parents' bedroom)			4	8		16	
						322	
10th July							
			Wh/half hour	**Load (W)**		**Daily Consumption (Wh)**	
Light1 (outside front)			1,75	3,5		7	
Light 2 (toilet)			2	4		8	
Light 3 (hall)			2	4		8	
Light 4 (kitchen: 3x2Watt)			3	6		12	
Light 4 (living room1: 2x4Watt) (dining room)			4	8		16	
Light 5 (back outside 1) (ceiling)			4	8		16	
Light 5 (back outside 2) (ceiling)			4	8		16	
Light 6 (back outside 3) (wall)			2,75	5,5		11	
Light 7 (living room 2)			2,5	5		10	
Light 8 (installation room)			2,5	5		10	
Light 9 (model room) (ceiling)			4	8		16	
Light 10 (stairs)			19	38		76	
Light 11 (bathroom 1st floor)			15	30		60	
Light 12 (bathroom spotlight: 5x4Watt)			10	20		40	
Light 13 (parents' bedroom)			4	8		16	
						322	
11th July							
			Wh/half hour	**Load (W)**		**Daily Consumption (Wh)**	
Light1 (outside front)			1,75	3,5		7	
Light 2 (toilet)			2	4		8	
Light 3 (hall)			2	4		8	
Light 4 (kitchen: 3x2Watt)			3	6		12	
Light 4 (living room1: 2x4Watt) (dining room)			4	8		16	
Light 5 (back outside 1) (ceiling)			4	8		16	
Light 5 (back outside 2) (ceiling)			4	8		16	
Light 6 (back outside 3) (wall)			2,75	5,5		11	
Light 7 (living room 2)			2,5	5		10	
Light 8 (installation room)			2,5	5		10	
Light 9 (model room) (ceiling)			4	8		16	
Light 10 (stairs)			19	38		76	
Light 11 (bathroom 1st floor)			15	30		60	
Light 12 (bathroom spotlight: 5x4Watt)			10	20		40	
Light 13 (parents' bedroom)			4	8		16	
						0	
						322	
						Total Consumption (Wh)	**3864**