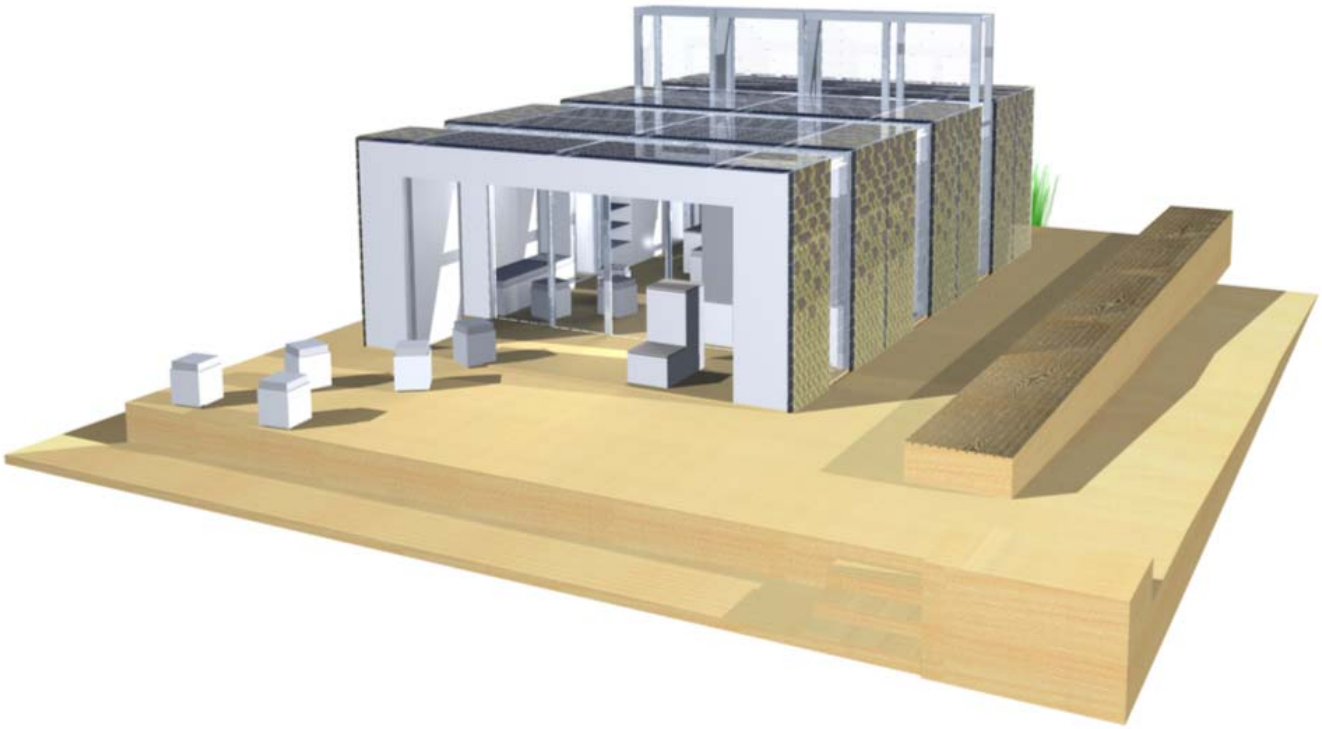
Architectural Brief Report

Team HFT Stuttgart



1. General

home+ is a small residential building prototype of 74 m², designed for 1 or 2 people. The building should be deployable all around the world and be developed to be accordingly mobile, as well as being powered only with solar energy. The clearness of design as well as the multifunctional use of elements by integration emphasize the composition of design and technology. There are three main characteristics of home+: The rhythm of modules and gaps forming a well structured east and west facade, the open space of the interior in north-south direction and the central ventilation tower, the heart of home+, raising above the building's roof.

Basically the idea originated from developing the building according to traditional construction principles of similar climate regions. The prototype primarily works with the highest possible thermal mass in the smallest possible building envelope to offer little absorption surface to the sun, to avoid heating up the building volume. Secondly, the highly insulated building should be able to cool itself as much as possible. The so-called "ventilation tower" improves ventilation and cooling by catching the wind, cooling down the air through humidification and by transporting it into the interior. This keeps the interior temperature low and avoids an active cooling system in most cases. Therefore, a purely passive operation of the building is attained for most of the year.

This tower also plays a primary role in the interior design and shows the inhabitant the active use of regenerative energy. To visitors of home+, we compare the ventilation tower with an open in-house feature fireplace which is a kind of symbol for comfortable heat. In a similar way, our ventilation tower visually explains and typifies comfortable cooling through the image of white wet fabric softly flapping in the wind within the glazed ventilation tower.

Another focus is to keep the amount of so-called "grey energy" as low as possible. Therefore the prototype is built of most possibly ecological building materials, for example the primary construction is made of wood. Because of the required mobility, the building is made of different modules, including the living areas, secondary rooms as well as the climatically activated building joints. This modularity and expandability offers a large flexibility for different configurations and therefore different kind of user schemes.

2. Exterior

The design is based on architectural and energetic considerations. The starting point is a compact, highly insulated volume, with a small surface to volume ratio. This volume consists of four layers (1):

The inner layer of the building, the main structure, is made of solid timber. As mentioned before, this material is ideal for two reasons: it provides a light weight structure and it is a very ecological material due to its CO2-saving potential.

The second layer is a highly efficient evacuated insulation (vacuum insulation). It provides a very low U-Value within a slim wall. This reduces heat losses in winter and thermal gains in summer and creates a high level of comfort.

The third layer is waterproofing to protect the structure. The chosen waterproofing membrane provides a maximum of solar reflectance to again reduce solar thermal loads in summer.

The fourth layer consist of glass/glass photovoltaic modules. This power envelope supplies the building with electrical energy. It is attached with a small gap to the other layers. The active solar photovoltaic layer appears delicate, it hovers above the main structure.

This volume, consisting of the four mentioned layers, contains and frames the interior and is segmented into four building modules (2). Each building module accommodates another use. The first module contains a loggia, the second a living room, the third a dining room and the last one the bedroom. Secondary rooms are included adjacent to the main areas. For example, the dining-room-module contains a kitchen or the bedroom-module a bathroom.

The modules are positioned with interspaces between them. These gaps are part of the design concept to emphasize the modularity. But the gaps are much more than only design. They are used for lighting, ventilation, pre-heating in winter and passive cooling in summer. They also allow for a visual connection to the outside and offer very different view axes within the building and to the outside by nicely framing the exterior.

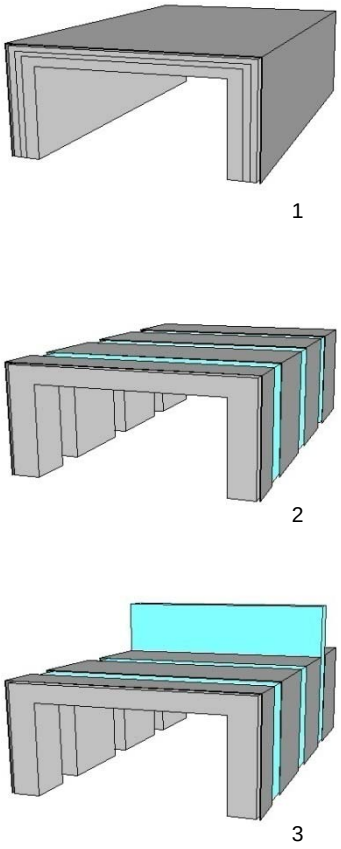


Figure 2: layers

One of these gaps is higher than the others, containing the “ventilation tower” (3). Based on traditional principles of climate control, the ventilation tower is a key element for the energy concept as well as for the outer appearance of the building and the interior space.

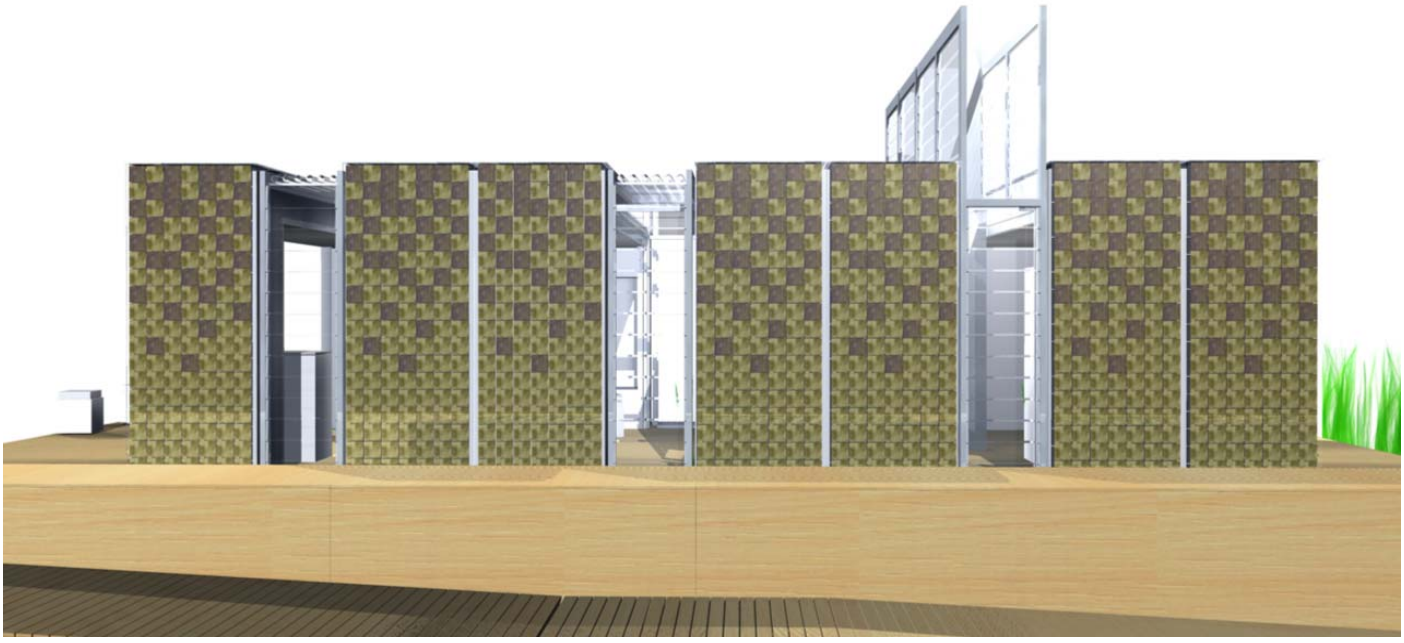


Figure 3: facade

The modules and the gaps are bound together by the building's power envelope, which consists of photovoltaic elements and thermal vacuum tube collectors. The elements are made of photovoltaic cells of three different colours: gold, bronze and black. The black cells are on the roof for maximum energy benefit. The gold cells are on the facade. These cells are bound together by a gradient-like “pixelation” of bronze cells over the roof-edge.

The modular design of the building not only facilitates the transport to and the assembly in Madrid, but also includes ideas about a modular building system for different requirements. By using the same building modules it is possible to create living and working space for singles, couples, small or even bigger families or apartment-sharing communities in detached and semi-detached, as well as in multi-family houses.

3. Interior

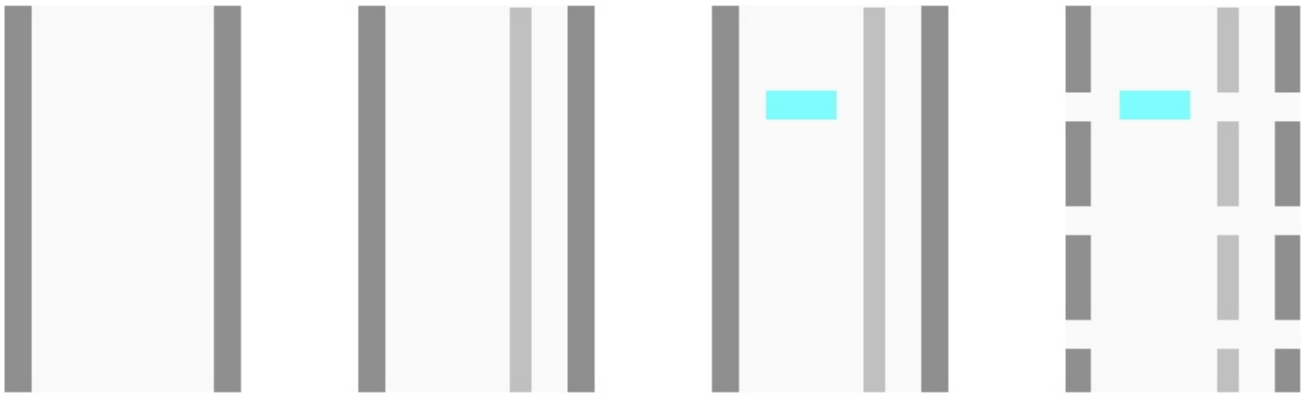
The concept allows for a clear visual understanding of the functions of each module from inside and outside. East and west facades are as closed as possible (1), the north and south facades provides a view to the outside for the inhabitants.

In the recommended layout, the building gets a clear north-south direction while remaining modifiable to the given situation. The eastern and western facades have been allocated with utility functions. The west side offers built-in storage zones. Each living area is expanded by a secondary area at the eastern end, separated by another zone of utility functions (2) that supports both, the living and the secondary area.

Therefore the building receives a clear structure in the north-south direction, which contains and frames the ventilation tower (3). It divides the larger living area in the south from the smaller and more private area in the north and provides the building with cool air.

This structure is subdivided and distinguished by the building joints (4). The joints provide illumination and ventilation on the interior and have climatic functions. Therefore they are called “Climate Gaps”.

Therefore every module of the building receives a process optimised function. This guarantees variability of the modules.



1 2 3 4

Figure 4: Interior

The building is entered from the south through a frontal bracket that serves as sun shading, supported by a curtain, and provides the living room with a covered terrace. The entrance is located in the secondary area in the east. This area leads, accompanied by multifunctional furnishing on left, through the house. This furnishing is not a room-high, closed wall but allows views between the areas through recesses to obtain the impression of the ample interior. In the living module, this furnishing is equipped with a media wall containing TV, HIFI and a touch panel serving as the interface for the building automatization.

The dining room follows, separated optically by a joint element with an kitchen in the secondary area and a kitchen block between. The furniture in the living and dining area is variable and allows multifunctional use of the largest interior space in the flat. Therefore, this space can be used for a dinner event for eight people. The living and dining area can be extended to the terrace by opening the glazing or optically separating it from the outside by a curtain.

In the next joint, the ventilation tower stands as a central element. As a partition, it divides the dining area and the bedroom. It is also equipped with reconfigurable furnishings to use the space as a home office by day. Adjacent to it the bathroom is located. The furnishing between bathroom and bedroom/home office includes a switchable glazing for optical separation with the guarantee of privacy.

As the other spaces are flexible for use in different ways, the spaces for toilet, shower and basin are arranged to create an optimized space-saving bathroom. The north facade is equipped with ample glazing to allow an excellent view to the landscape and with a curtain to ensure the privacy of the inhabitants.

To feel comfortable and to prevent immoderate energy losses by switching the lights, each area has its own natural light exposure by having overhead glazing in the gaps. There are evacuated tube collectors on the top of the gaps to protect the interior from direct irradiation. By orientating the absorber of the evacuated tubes like a shed roof towards the sun, the inhabitants are able to see the sky to the north. Each special use, like working or cooking, gets its own pointed lighting for optimized conditions. Artificial lighting supports the design by highlighting the gaps and the ventilation tower.

Figure 5: floor plan