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Movable House

Project description

"Movable house" is a project in motion. The experimental residential building is developed by Rahbaran Hürzeler Architects in collaboration with ZPF Ingenieure Engineers and the Institute of Energy in Building of the FHNW University of Applied Sciences and Arts Northwestern Switzerland.

Architectural concept

The movable house is not designed with a specific site in mind, but can be realised almost anywhere. A requirement for such a structure is that it can be put up and disassembled quickly and the transport of all of its elements can be done easily and efficiently. Be it in wide open nature, as infill within the urban context or even parasitically attached to an already existing building – the prefabricated elements can be assembled at different locations.

The floor plan is based on a 10x10m square. Four cores divide the area into differently sized living spaces. These rooms are connected by a centrally located circular common area and create a sequence of rooms on a diagonal axis. Theses fully glazed living spaces open out towards the landscape under a wide cantilevering roof.

The cores are spacious closet-like volumes and contain the secondary use areas such as kitchen and bathrooms as well as the entire range of building services. The compact planning of these cores maximises the living area and allows for installation free spaces.

One of the goals of this pilot-project is to gauge the limits of the structural and building physics parameters and the deployment of new materials in combination.

Structure and construction

An overall theme of the movable house is to minimise the layers and use of materials. Therefore the building itself has no load-bearing structure in the classic sense, but supporting elements that are furniture, ceiling and floor all at the same time while also containing the thermal insulation and energy storage mediums. The challenge lay in the development of a load-bearing structure which could stand up to all of these requirements.

The load-bearing structure of the house consists of four wooden cores which support the cantilevering concrete roof. The closet-like cores are made from 40mm thick laminated veneer lumber made from beech boards. The roof is assembled by seven prestressed concrete elements that are 10m long, 2m wide and only 6 cm thick. These elements come with preinstalled insulation between the rib structure of each slab element. The floor is made from five equally sized concrete elements that are 11cm thick. Thanks to the integrated wax and salt-based phase change material (PCM) modules the storage capacity is equal to that of a 30cm concrete slab with 4K temperature change. All concrete elements are made from white cement with added Carrara marble. The exposed concrete ceiling is left untreated, the floor elements are sanded on site to achieve a terrazzo appearance. The beech wooden closet volumes are unclad and recognisable as a structure. The load-bearing structure therefore significantly defines the space through its materiality and surface.

An engineered joinery detail was specially developed for the connection between the structural elements roof, closet and floor: steel crescents with a high tensile force of 25kN connect the wooden cores with the concrete plates and tension the elements together to form a single piece of "furniture".

Changeable envelope

The facade is made up of white-painted floor-to-ceiling wooden windows and prefabricated wooden infill cladding. An encircling external textile curtain envelopes the building from all sides and lends it an expression of lightness and variability. The curtain can be rearranged by the dwellers to protect from the sun or prying eyes.

Lush gardens

The garden is laid out as a gently sculptured hilly landscape. A winding path leads indirectly towards the new building. The close to nature shaping of the garden with its lush vegetation is in stark contrast with the strictly geometrical house itself. By embedding the house into the landscape with its natural-stone walls and rich vegetation a constantly changing scenery is created as a backdrop for the living spaces.

Energy and sustainability

Within the framework of an Innosuisse project the Institute of Energy in Building of the FHNW University of Applied Sciences and Arts Northwestern Switzerland conducts research on optimisation of prefabricated material and cost-saving roof and floor systems in order to develop a basis for industrial production. The movable house serves as a prototype and test bed for the roof and floor elements. The environmental impact during the manufacturing process of the elements and the thermal behaviour within the building itself will be examined. The focus will lie on the compensation of the reduced energy storage mass through the use of phase change materials (PCM).

The Institute has developed the energetic concept and has optimised it by running dynamic building simulations. Data will be gathered over the coming year with the help of sensors that are built into the elements and the ground and subsequently analysed. The findings will then be used to advance development of the applied systems.

The movable house combines different aspects of sustainable building: economically the investment costs are reduced by the material-saving construction and the prefabricated elements. Lower heating demands, simple building services that do not require much maintenance and the in-house production of solar electricity enable the reduction of everyday running costs. Socio-cultural aspects also take effect through area-efficient floor plans and reduced area use per resident.
The newly developed, prefabricated roofing system together with the wooden elements enable a high degree of structural and functional flexibility as well as an extraordinary quality of design. The savings in material through the prefabricated roofing system, the use of renewable resources and the simple assembly and dismantling all combine to improve the sustainability of the building construction. In everyday use the energy efficiency of the building envelope, the use of geothermal heating and the on-site production of solar electricity have a beneficial effect. The good thermal insulation and optimised use of solar energy lead to the heating demand undercutting the regulatory requirements by 40 per cent. The annual production of the photovoltaic systems exceeds the total requirements of the building.