Low-cost apartments incorporating smart materials, Hamburg, Germany

Project data

Project group
Building and civil engineering works

Client
IBA Hamburg

Project background
Private investment

Estimated start of construction
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Comment of the Holcim Awards jury Europe

The jury identified the strength of the project in its innovative concept for construction and material that uses pre-fabricated lightweight-concrete elements which incorporate recycled foamed glass as an internal aggregate. On top of that is an overall design scheme with competent solutions for a public housing development in every relevant aspect – an ambitious design and a zero-carbon energy concept even in the context of low-income communities.

Project description by author

Our proposal is a prize-winning scheme selected for construction in Hamburg, Germany in the context of the IBA (international building exhibition) there and as sponsored by the City of Hamburg and Arch+ magazine. The Smart Material House provides six flexible live-work types for a four-story apartment house within a new master plan for housing and new landscapes. The apartments are available at a low price to eligible families or individuals from the community. The supporting ambition to combine high-performance aspects with formal/spatial possibilities we propose to combine fast-track construction with prefabricated lightweight-concrete walls. The prefabricated construction elements can be assembled quickly on site, reducing overall construction costs. The approach was to consider these materials as a starting point regarding their production and delivery methods then discover what kind of formal and spatial possibilities they offered us.

Working with structural engineer Mike Schlaich, lightweight concrete is used as a multi-tasking construction element that is self-insulating utilizing recycled foamed glass as an internal aggregate. 1/3 the weight of conventional concrete it also has 1/3 the carbon impact as conventional poured or precast concrete. Offset by the combined use of wood construction with its negative carbon impact allows this building to approach a zero carbon material effect. The second planning partner Matthias Schulze of Transolar supported the project for low-energy and sustainable design.

The concrete walls are sculpturally formed off-site in formworks constructed of laser-cut sheet steel. With three base types an additional three can be generated by flipping the wall element 180° on its head. The forms also allow different pour heights responding to different clear heights spatially. The combination of varying window elements allowed us a wide range of facade and room differentiation. The sculptural forms of the elements provide a structurally self-supporting element which “spatializes” internal and externally dynamically shaped rooms and external loggias.

Structurally, the concrete wall elements can overlap and stagger as they stack over each other generating a highly-articulated plastically-modeled exterior elevation, which avoids cold-bridge problems by the use of these self-insulated materials. Wall-depth wood window frames with triple-insulated glass inserts complete the enclosure.

This logic allows the entire house to be constructed like a house of cards in terms of speed whilst generating enormous stability due to the form of the wall-elements. The goal was to exploit the advantages of lightweight concrete technically while at the same time its possibilities for plastic three-dimensional form making.

Relevance to target issues by author

Innovation and transferability – Progress
The Smart Material House uses infra-lightweight concrete (Infraleichtbeton), which utilizes a recycled foamed glass as an aggregate. Using recycled glass infra-lightweight concrete can be categorized as a low CO2 material. The embodied energy is even less compared to normal concrete. The self-insulated material is employed in pre-cast building wall element. These supporting walls are combined with wood glue-laminated floor decking (a minus CO2 material) like a house of cards so the entire system can be prefabricated and erected on site within days saving time and money. The walls consist of two types, which are reversibly (upside down) generating four types, which can be curved at different heights. The scheme takes advantage of the positive aspects of wall thickness for better insulation and to produce a dynamic spatial effect to the exterior and interior.

Ethical standards and social equity – People
The project provides social housing in a lower-income community outside of Hamburg under the auspices of the IBA Hamburg 2006/II-a German initiative for the urban improvement of social, cultural, and ecological aspects for targeted communities. The Smart Material House provides six flexible live-work types for a four-story apartment house within a new master plan for housing and new landscapes. The apartments are available at low price to eligible families or individuals from the community.

Environmental quality and resource efficiency – Planet
The strategy is both a material one as well as being of technological high-performance. In regard to the material aspect, the low mass materials are fire sustainable timber and recycled products in the self-insulated concrete. Avoiding additional insulation the embedded energy of the monolithic wall is minimized and simplifies the recycling process of the building after its lifetime. The homogenous concrete walls are (the concrete is both the interior and exterior finish) embedded with tube conduit that provides conductive heating and cooling through water (a highly efficient system). This is combined with a closed air supply and return system. The wooden windows are addionally operable and combine triple glazing with an acoustical outlaying fixed panel to protect the apartments from nearby traffic noise. The roof is planted with local vegetation and photovoltaic panels are placed on the carport roof.

Economic performance and compatibility – Prosperity
The project takes initial advantage of tax incentives for community development and low sales prices of the building lots from the city. The construction cost is low due to the redundancy in construction elements, compactness of the structure and spans, advantages of pre-fabrication/spread transportation, ease of assembly, no basement, and economic building materials. The efficiency of the heating/cooling/acoustic systems will also dramatically reduce operating and maintenance life cycle costs.

Contextual and aesthetic impact – Proficiency
Within the context of a post-industrial Wilhelmsburg, the Smart Material House is a compact free-standing structure characterized by the exposed concrete walls and floors. These surfaces condition the interior spaces dynamically, which are also flexible allowing an open loft-like space or partitioning with orthogonal walls as desired. The thick walls recastell a baroque-like aesthetic of pach long since abolished under the auspices of modernism and the modern curtain wall.