Per-Erik Eriksson, SP Wood Technology, Smart Housing Småland

Housing prototype 1.0

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Smart Housing Småland’s Housing protoype 1.0

Smart Housing Småland's first housing prototype. Photo: David Hertzberg

The housing prototype is an apartment module for multi-family housing and is the result of a series of workshops where house manufacturers, scientists and architects participated. It contains a lot of rethinking and illustrates some of what can be accomplished within the innovation environment Smart Housing Småland in the long run.

Industrialized construction in factory

The prototype was built completely at the factory and transported on a single truck. Volume elements with load-bearing wood frame technology are used today for up to six-storey buildings. With some further development work, the prototype’s fully glazed external short end walls can be used as load-bearing walls in such buildings. By building industrially we can enhance both competition and productivity in residential construction. Wood is light-weight and therefore well suited for prefabricated construction.

Floor plan and space efficiency

The apartment floor plan has the kitchen and the bathroom in the middle and two separate rooms, one at each end of the volume module. In this way, it is possible for to two households to share the

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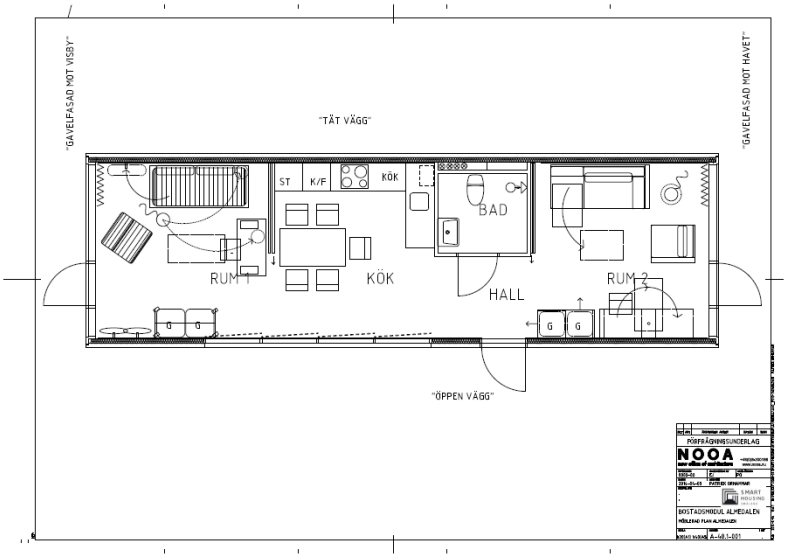
48 square meters while maintaining full handicap accessibility and a full-sized kitchen. Alternatively, it can be used as a standard two-room apartment.

Future apartments must be more space-efficient. A solution to this can be an increased use of glass. Today's plane glass can be used for multifunctional purposes. Glass can be a load bearing wall. Anyone who has a smartphone knows that it can carry a lot of interactive features. But above all it means day-light. In this case day-light into the kitchen area is enabled through the large window openings at the ends and room separation with sliding doors with glass. One of the sliding doors is equipped with "privacy" glass where transparency can be turned on and off with electricity. Having a kitchen without direct natural light from windows was one of the aspects that were discussed in depth during the workshop series and which can be evaluated in the prototype.

Interior of the housing prototype. Photo: David Hertzberg



Drawing: NOOA

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Building design and energy efficiency

The apartment volumes can be stacked to six-storey buildings. Two variants have been illustrated, a tower block and an access balcony building. The tower block has an interior stair case, which means that a variety of volume module elements are required. The access balcony building is the easiest to build, since the same volume module can be used throughout and the prototype would only have to be modified slightly with entrance from the short side. With the innovative glazed short end exterior walls, clad entirely with exterior glass (called "step" glass), two of the building's facades become fully glazed, with glass facade installed already in the factory.

Housing prototype 1.0 integrated into a multi-family six storey building. The facade is by solar cells and the balconies in wood. The multi-family building fits in an urban environment where the need for smaller apartments is extensive. Illustration: Tengbom, drawing: NOOA

Housing prototype 1.0 in an access balcony building. Façade of spruce shingles, glazed balconies in different colours. The pointed balconies allows for larger balconies with maintained interior day-light. Illustration: Tengbom, drawing: NOOA

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The design of the housing prototype for a relatively deep building provides excellent conditions for a very energy efficient building. Our calculations for an entire building — the access balcony building – assumes that the two fully glazed facades have a U-value less than or equal to 0.8. This can be achieved with triple glazing cassettes filled with argon gas. With an efficient heat pump solution for heating and hot water, the energy usage in southern Sweden would be as low as 40 kWh/sqm/year for this type of building (hot water dominates), which is just under 2000 kWh/year for the apartment. Adding an estimated household electricity usage for two single households (or one of two people) of about 3100 kWh/year, the total consumption is about 5000 kWh/year.

One long side of the prototype is clad with integrated solar panels (BIPV). Photo: David Hertzberg

Façade integrated solar panels

On the housing prototype, one long side is completely covered with solar panels. The solid black frameless panels of thin-film solar cells are integrated into the facade. At the 13x3 meters wall, 44 panels are mounted with a total output power of about 5 kW. A typical summer day, the daily energy output is approximately 30 kWh on a south-facing wall in southern Sweden. On an annual basis the energy output will be approximately 4000 kWh, i.e. almost as much as the entire apartment consumption including household electricity. In a full building, such a facade integrated solution on a south-facing closed wall could be combined with additional roof integrated solar panels and thereby generate a substantial part of the whole building's consumption while simultaneously replacing other façade materials and minimizing maintenance.

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Short facts

Living area: 48 sq.m used either as one two room apartment or as two residential units with shared kitchen and bathroom.

Accessibility: The apartment is designed in accordance with current building regulations for wheelchair accessibility in homes.

Dimensions: outside dimensions of the volume module is 4 15x13 .45 m. Interior width is approximately 3.75 metres

Weight: The complete volume module, including solar panels weighs approx. 14 tons.

Shipping: Shipped on a truck trailer. Transport requires escort in Sweden.

The prototype is being lifted into place at Linnaeus University campus of Växjö. Photo: Per-Erik Eriksson

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Participants in workshops for Housing prototype 1.0

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Linda Camara, Tengbom
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Magnus Silfverhielm, AIX
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Michael R Olsson, Hjältevadshus
Kristian Grimsbo, Flexator
Lotta Fonsell, Villa Vida
Kaj Granath, Jönköping University
Erika Lagerbielke, Erik Serrano, Johan Vessby and Michael Dorn, Linnaeus University
David Furendal, Screen Interaction
Henrik Teleman, Virserum Art Museum
Michael Ludvigsson, Glafo – Glass Research Institute
Per-Erik Eriksson, SP Technical Research Institute of Sweden

Companies that contributed to the manufacturing of Housing prototype 1.0

FACTORY MANUFACTURING OF THE PROTOTYPE: Hjältevadshus
GAVELPARTIER: Elitfönster, GFAB Sweden
FLOORS AND TERRACE: Södra
KITCHEN: Ballingslöv
PLYWOOD: Moelven
SOLAR PANELS: Solibro Research
GLASS FOR INTERIOR PARTITIONS: Forserum Safety Glass, Innoptec
CONTROL SYSTEM: WeBeHome
FOUNDATION: Flexator
ARCHITECTURAL SYSTEM DOCUMENTS: NOOA
INTERIOR: Virserum Art Museum; Lammhults; Smart Textiles
COMMUNICATION: Teleman Art and Production

About Smart Housing Småland

A large part of Sweden's timber and house manufacturing industry is located in the regions of Småland. Småland also has extensive production of windows and other flat glass products. Therefore, the regions/counties along with industry and with funding from Vinnova (Swedens's innovation Agency), created Smart Housing Småland, which is a ten-year project. Smart Housing Småland aims to establish a creative innovation environment, where research, enterprise, design and architecture and the public sector will collaborate. New products and new ways to produce will become a reality. Business aims both at today's housing shortage as well as to tomorrow's challenges.

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The innovation environment is operated and financed by

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