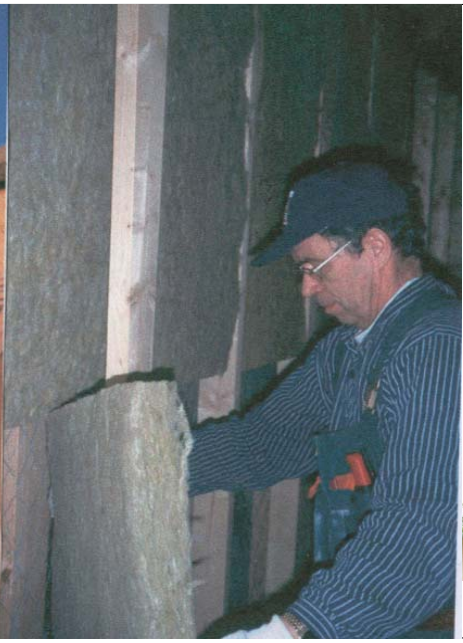
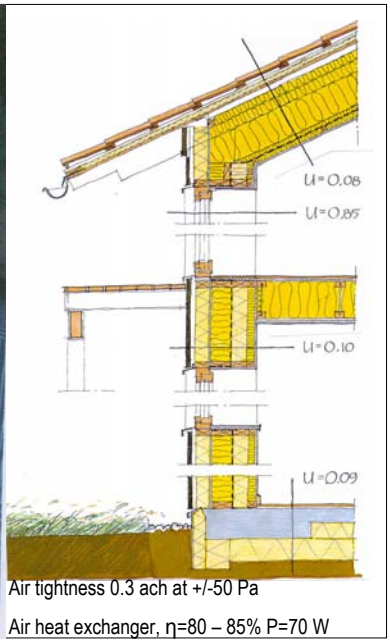
Göteborg, Sweden

International Energy Agency

IEA – SCH Task 28 / ECBCS Annex 38:

Sustainable Solar Housing





Air tightness 0.3 ach at +/-50 Pa

Air heat exchanger, η=80 – 85% P=70 W

The project

In an environment of great natural beauty at Lindås, 20 km south of Göteborg, the city owned company Egnahemsbolaget has built 20 terrace houses in which a traditional heating system has been replaced by a heat exchanger in combination with an exceptionally well insulated construction. Solar collectors on the roof provide half the energy needed for the supply of hot water.

The terrace houses were designed by EFEM arkitektkontor, and are the result of a research project extending over four years, carried out in cooperation with Chalmers University of Technology, Energy and Building Design at Lund University, the Swedish National Testing and Research Institute (SP) and the Swedish Council for Building Research (Formas).

The buildings were designed to provide a pleasant indoor environment with minimum energy use. The courtyard facade towards the south has large windows to make full use of solar heat. Balconies and roof overhang provide protection against excessive solar radiation during the summer. Owing to the terrace construction with houses of 11 m depth, there are few external walls, and these are exceptionally well insulated and airtight. The roof window above the staircase gives light in the middle of the house, and is also used for effective ventilation in the summer.

Objectives

The goals were to show that it is possible to build houses in a Scandinavian climate with no special heating system and to normal costs.

Marketing strategy

There were no special efforts done to market the houses. They were advertised as “Comfortable row houses in a beautiful nature with a low energy demand.”

Building construction U- value: W/m^{2}K

External wall: 0.10

Framed construction with 43 cm insulation.

Roof: 0.08

Masonite beams with 48 cm insulation.

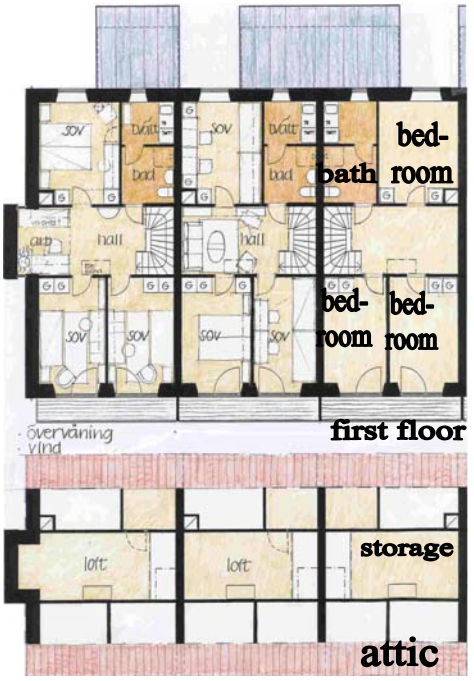
Floor: 0.11

Concrete slab laid on 25 cm insulation.

Windows: 0.85

Three pane windows with two metallic coats and krypton or argon fill. Energy transmittance is 50% and light transmittance is 64-68%.

External door: 0.80



Technical systems: Ventilation and Heating

The exhaust air in a counter flow heat exchanger heats supply air. It provides 80% heat recovery. In the summer the heat exchanger can be turned off (automatic bypass) and the house ventilated without preheating of the supply air and by opening windows.

Part of the space heating demand is covered by heat gains from the occupants, ca 1200 kWh/year and energy efficient appliances and lighting, 2900 kWh/year which partly is useful to heat the building. The remaining space heating demand is covered by electric resistance heating, 900 W, in the supply air.

The houses have been designed for normal Scandinavian climatic conditions. Very low outdoor temperatures over extended periods are rare and are regarded extreme. In such cases the indoor temperature may drop by a degree or two.

The houses are neither more nor less complicated to live in than ordinary houses. If it is cold outside, the occupants do not open the windows to create a through draft. If it is warm and sunny, they lower the blinds or the awnings outside the southerly windows.

Hot water supply

Solar collectors of 5 m^2 per house provide the energy for half the hot water demand. The 500 l storage tank is equipped with an electric immersion heater to cover the rest of the demand.

Energy performance

The energy performance of the buildings are as calculated. The average energy consumption is higher than the calculated according to user habits (higher indoor temperature, more TV-sets, home computers, stand by appliances). The variation in energy use for the house units is large. The total delivered energy demand varies between 45 and 97 kWh/m²a for different households. Savings compared to houses built according to the national building code and practice is 50 – 75%.

Heating of space and ventilation air: (electricity)	14.3 kWh/m²
Domestic hot water (electricity):	15.2 kWh/m²
Fans and pumps:	6.7 kWh/m²
Lighting and appliances:	31.8 kWh/m²
Delivered energy demand:	**68.0 kWh/m²**
Domestic hot water (solar energy):	8.9 kWh/m²
Total monitored energy demand:	**76.9 kWh/m²**

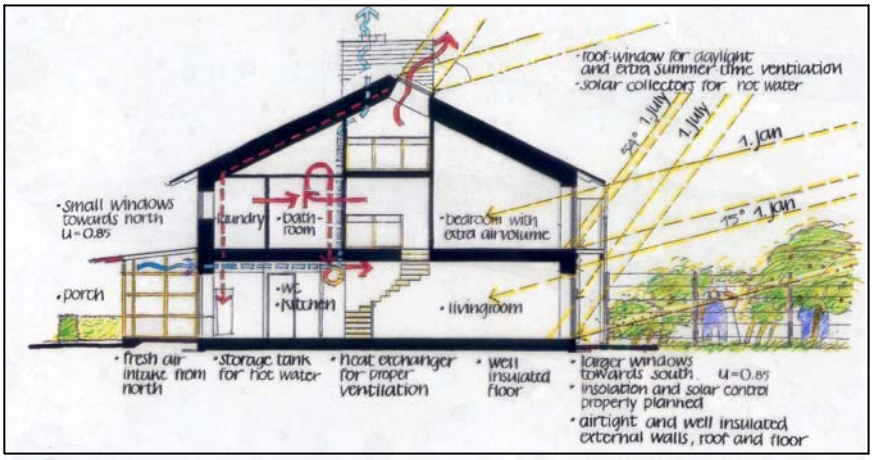


Illustration: Hans Grönlund, EFEM arkitektkontor

Planning tools

For the energy performance, passive solar energy design and for the indoor climate the computer program DEROB – LTH was used (Maria Wall).

Cost and benefits

Building costs are estimated to be normal. The extra measures in the form of greater air tightness and insulation, adaptation to "passive solar heating" and heat recovery in the ventilation are paid for by the much lower costs of the heating system and the savings in energy costs .

Financing

The project was in the planning and evaluation phase financed by Formas and EU (through the CEPHEUS project). Investment costs were carried by Egnahemsbolaget, Göteborg.

Innovative products

Swedish standard products have been used.

Project team

Client:Egnahemsbolaget
Contractor: PEAB
Architect: EFEM arkitektkontor, Göteborg
Constructional engineer: WSP, Göteborg
HVAC consultant:
Bengt Dahlgren AB, Göteborg
Electrical services consultant:
Probeko, Göteborg
Site works consultant:
Landskapsgruppen, Göteborg

Those in charge of the different areas of the research project:

Project manager: Hans Eek,
EFEM arkitektkontor, Göteborg
Energy and Building Design LTH: Maria Wall
Building Physics CTH: Carl-Erik Hagentoft and Fredrik Ståhl
The Swedish National Testing and Research Institute: Svein Ruud and Leif Lundin

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Literature and links

http://www.ebd.lth.se click “Research”
http://www.goteborg2050.nu

formas

EGNAHEMSBOLAGET

efem arkitektkontor

www.iea-shc.org

www.ecbcs.org