Landskrona, Sweden

International Energy Agency

IEA – SCH Task 28 / ECBCS Annex 38:

Sustainable Solar Housing

The project

In the south of Sweden, 35 apartments have been built during 2003-2004. The municipal housing company, AB Landskronahem, had an architectural contest in 1999, and in 2003 a project team was formed. One and a half year later, tenants were moved in.

The team, that designed the apartments, consisted of: project leader from the municipal housing company, an external project leader, an architect, a building physicist, a structural engineer, a technical engineer, a electric engineer, a landscape architect , a contractor and two tenants.

The layout of the apartments are quite traditional. All apartments have a living room, a kitchen, a bathroom and a storage. The number of bedrooms vary between one and four. The sizes of the apartments vary between 70 and 115 m² usable floor area.

The apartments are for rental, and the tenants were moved in during the summer of '04.

Objectives

The goal of the project was:

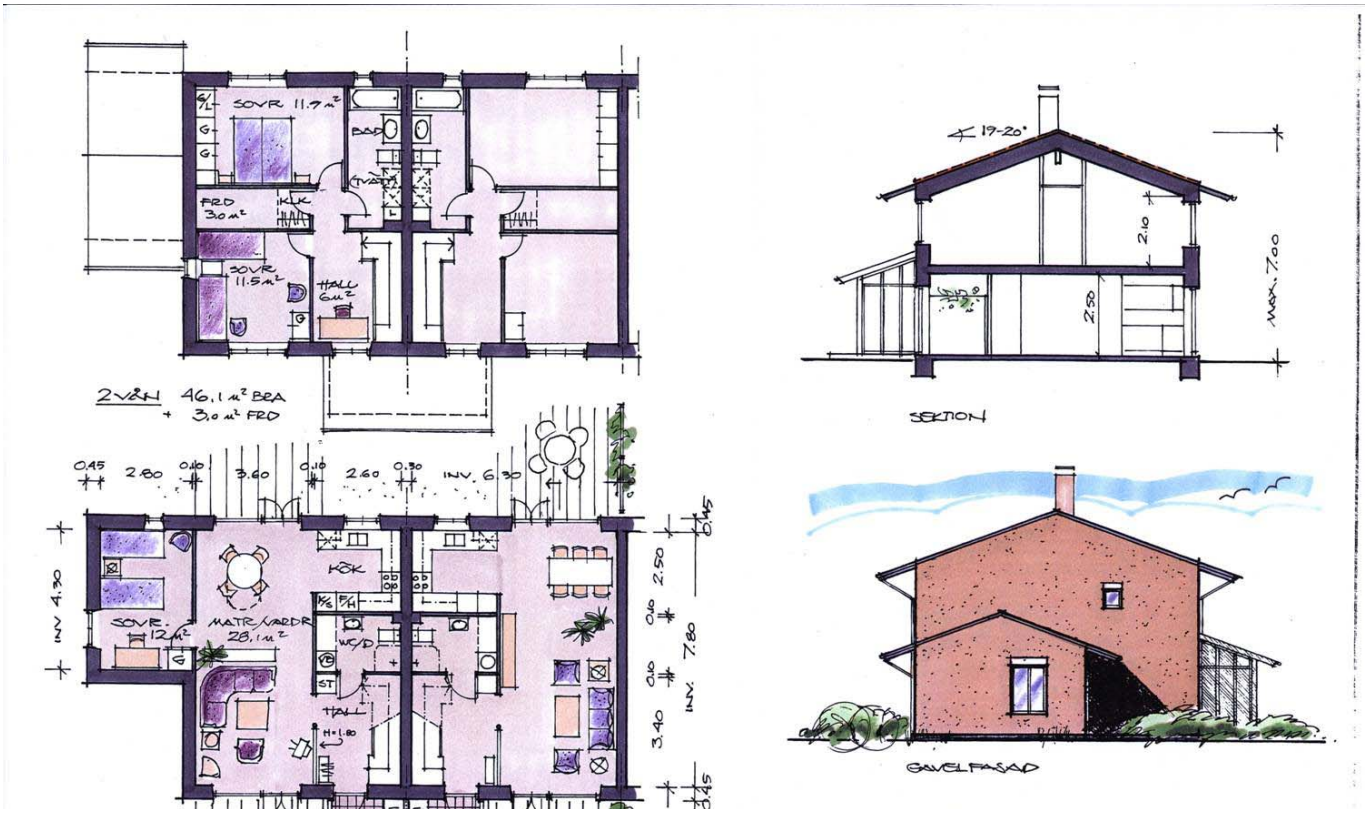
- to get a rental cost for the apartments of maximum 100 €/m² usable floor area during the operation period
- to use highly thermal performance of constructions in order to exclude conventional heating i.e. radiators or floor heating systems
- to secure moisture proof buildings
- sustainability e.g. special solution for achieve good air tightness, choice of materials.

Building construction

The floor construction consists of 100 mm concrete, 350 mm polystyrene and 200 mm macadam. The U-value is approx. 0,10 W/(m²·K).

The external walls consist of 450 mm polystyrene and mineral wool divided in four different layers. The external layer of polystyrene has a cement plaster making up the façade. The framework is made up by wooden studs and aluminum profiles. The internal surface is covered with gypsum board. In the wall there is also a plastic sheet in order to make the house air tight. The external wall has a U-value of 0,10 W/(m²·K).

The external roof is made up by light weight roof trusses filled with 550 mm loose filled mineral wool. The roof is covered with tongued and grooved timber, asphalt impregnated polyester felt, batten and finally roofing tiles. The internal surface is covered with a plastic sheet, a thin polystyrene board, mineral wool and finally, gypsum board. The U-value is 0,08 W/(m²·K).



The windows are triple-glazed with low emission coating and gas in between. The windows facing south and west have also an extra coating in order to decrease the solar radiation through the windows. The g-value is 0,34. The U-value for the windows, including frames, varies between 0,9 and 1,0 W/(m²·K) depending on window size. The glassed area corresponds to approx. 20% of the floor area.

The window area facing south-north and east-west are 50/50% respectively. The reason for this is that the houses do not need a special orientation to take care of the solar gains since the constructions are highly insulated combined with high performance of windows and heat recovery from ventilation.

When we need solar energy for space heating, i.e. during winter, the gains are low. In opposite, when we do not need space heating, i.e. during summer, the solar gains are high. The consequence is that the orientation of windows is of minor importance when it comes to space heating. Instead it is important to reduce solar radiation during late spring, summer and early fall to prevent overheating problems. The apartments have been equipped with windows with low g-value and a large roof overhang, 1 m. In this way the solar gains will be limited. All windows are operable in order to give the tenants freedom to open them whenever they want.

The project has besides energy efficiency, dealt with moisture and dehydration issues. The construction has during the design phase been examined and improved concerning moisture prevention (rain, moisture in air, moisture from the production phase, surface water, water in soil). The goal has been to dehydrate the concrete constructions to 85% relative humidity and wooden constructions to a moisture content by mass below 18%. Measurements and mechanical dehydration have also been made during the construction phase.

The apartments are planned, designed and built with high quality concerning air tightness. Special drawings and instructions were made. Also, two carpenters were specially engaged to explicitly work with the plastic sheet making the apartments air tight. A blower door test was carried out after the plastic sheet was fixed. The air tightness was measured as 0,1 litre/(m²·s) at 50 Pa differential pressure – Swedish record in air tightness!

In order to prevent the tenants from penetrating the plastic sheet during the occupation phase, the sheet has been placed inside the construction, i.e. nails and screws may be fixed in the gypsum wallboard without penetrating the plastic sheet. This sheet is placed approx. 70 mm into the construction from the inside of the wall.

The heat capacity of the apartments are fairly low. The reason for this is to be able to receive a good thermal comfort even if the sun will affect the indoor temperature. Being able to open windows, the indoor temperature will decrease faster than having a medium or high heat capacity.

Technical systems

Each apartment has a supply and exhaust air ventilation system with heat recovery (air-to-air heat exchanger). The efficiency is approx. 85% depending on the outdoor temperature.

The very limited space heating demand is covered by electric resistance heating, 700 W, in the supply air.

The air flow rate is according to the Swedish Building Code and corresponds to approx. 0,5 ach, depending on the size of the apartment.

Household appliances, e.g. refrigerator and freezer, as well as the hot water boiler are energy efficient. The domestic hot water is heated by electricity.

Energy performance

The total energy demand is calculated as approx. 50-60 kWh/(m²·a). Modern apartments built during the end of the '90s and beginning of 2000 use approx. 120-150 kWh/(m²·a), whereas 30-50% stands for space heating. The savings in these 35 apartments are therefore approx. 70-90 kWh/(m²·a).

Calculated energy demand

Space heating demand	0-5 kWh/m²a
Domestic hot water demand	25-30 kWh/m²a
Household electricity	20-25 kWh/m²a

Planning tools

The indoor temperature and space heating demand were calculated with the computer program IDA Indoor Climate and Energy 3.0 (Equa, 2003).

Costs and benefits

The apartments cost not more than conventional apartments. The cost for heating system has been saved, and instead put on the insulation thickness and window quality.

The minimal space heating demand reduces the operational costs with approx. 25 %, giving a renting cost of approx. 100 €/(m²·a).

Modern apartments built during the end of the '90s and beginning of 2000 have a renting cost of approx. 130 €/(m²·a).

Financing

The project is commercial and the owner is the municipal housing company AB Landskronahem in southern part of Sweden. No special subsidies were received.

Project team

Concept self heating houses : W Strolz, K Adalberth

Project leader	W Strolz, prime project ab
Building Physicists	K Adalberth, prime project ab
Architecture	Mernsten Arkitektkontor AB
Structural engineer	B Ekström/H Larsson, WSP
Technical engineer	G Nyberg, EVP i Helsingborg AB
Electric engineer	J Viberg, Elteknik AB
Landscape architect	C Högard Landskapsgruppen Syd
Main contractor	B Ravemark, Skanska

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Literature and links

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