Husby Amfi

Stjørdal, Norway

International Energy Agency

IEA – SHC Task 28 / ECBCS Annex 38:

Sustainable Solar Housing

Three room apartment, 73 m2

The project

Two buildings with a total of 51 apartments are being built in Stjørdal north of Trondheim in central Norway. The buildings are owned by a housing cooperative presently consisting of three buildings from 1970. The existing buildings have 110 apartments. The construction of the new buildings started in March 2004 and will be completed during the fall of 2005.

The apartments are planned for wheelchair users and the buildings have lifts and parking spaces in the basement. Most of the apartments have two or three bedrooms, some have three bedrooms and one apartment has four bedrooms. The average size is 72 m^2. The buildings are south facing with a nice view and are not exposed to any kind of shading from hills or other buildings.

Objectives

Low energy demand and low environmental impact have been focused from the start of the planning phase. Auxiliary energy demand should be less than half of average energy demand for the same type of apartments built according to the Norwegian building code. Energy demand for room heating should be very low and heating of domestic hot water should be covered with renewable energy.

The energy design should also result in robust and user friendly homes with high quality indoor climate. The project should be cost effective in a way that make the concept interesting for other builders.

Building construction

Several measures will be implemented to improve the building envelope compared to normal building standards. These measures are optimized as regards energy and cost efficiency.

Windows are triple glazed with argon gas and have two low emission coatings, wooden frame and a total U-value of 1.0 W/m^2K.

Entrance doors have a U-value of 0.8 W/m^2K.

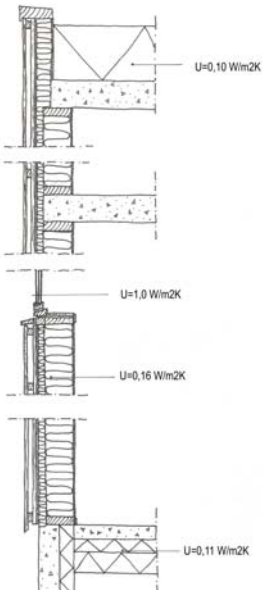
Exterior walls have 250 mm insulation and a U-value of 0.16 W/m^2K.

Roofs have up to 400 mm insulation and a U-value of 0.10 W/m^2K.

Floors on the ground are insulated with 250 mm expanded polystyrene and have a U-value of 0.11 W/m^2K.

Thermal bridges are minimized by the use of 50 mm insulation on wooden construction details and 100 mm insulation on concrete details. The infiltration loss is minimized by the use of double layers of wind proofing on exterior walls and focus on air tight details between wood and concrete and around the windows.

Wall: 250 mm mineral wool
Roof: 400 mm mineral wool
Slab on ground: 250 mm EPS
Floor against parking garage: 300 mm mineral w
Air tightness: below 0.8 ach
Thermal bridge value: below 0.03 W/mK



Technical systems

All apartments have mechanical ventilation and heat recovery with 75% efficiency or better. To reduce the electricity demand, A-labeled equipment for washing machines, dryers, refrigerators and lighting are used. Electricity use for fans are low **(**specific fan power: 2.0 kW/m^3/s).

The building site is south oriented and the solar energy is passively exploited. Most of the windows are south facing, extra heat will be stored in exposed concrete in ceilings and interior walls. Exterior shading and overhangs is used to avoid overheating and need for cooling. Cross ventilation can be carried out by opening windows that are located on the upper parts of the walls.

A user friendly and simple control system will be installed. A display with possibility to switch between “home” and “not home” is located by the entrance door. The “not home” position will result in lower temperature, less ventilation and that light and electric equipment is turned of. The display will also show the actual energy use compared to the calculated energy use.

Energy need for heating will be very low and the heating installations are reduced to a minimum. Only one electric heater is located in the living area, and the bathroom has electric floor heating. These simple heating installations will be sufficient because the ventilation system will distribute the heat to all rooms and there is no need for heaters under the super insulated windows.

To supply hot water, a heat exchanger and a heat pump will use heat from the grey water. This system reduces the electricity demand by 80% compared to a conventional electric hot water heater.

Energy performance

The net energy use for an average apartment of 73 m^2 is calculated to be 40% lower than for the same apartment built according to the Norwegian building code. The delivered energy use, with the free heat from the gray water taken into account, is reduced by 60% and the heating energy is reduced by 75 %.

Energy use (net)[1]
Heating of space and ventilation air: 16 kWh/m²a
Domestic hot water: 35 kWh/m²a
Fans and pumps: 5 kWh/m²a
Lighting and appliances: 33 kWh/m²a
Total net energy use: 89 kWh/m²a
Delivered energy[2]
Calculated delivered energy: 61 kWh/m²a

1] The efficiency of the energy deliverance system is not taken into account.
[2] Energy supplied to the building, in form of electricity, oil, bio-fuel, gas, district heating, etc., taking into account the efficiency of the energy systems. The energy produced by the building itself, for example using solar water heater, photovoltaic systems, heatpump or co-generation and delivered back to the market is subtracted.

Planning tools

Simulations of energy need and indoor climate are done with the program SCIAQ Pro 2.0. (ProgramByggerne, www.programbyggerne.no)

Simulations of daylight levels are done with the program Leso-Dial 3.1.

Costs and benefits

The extra costs for the energy concept, taking into account reduced costs for the heating system, is calculated to be 4-6% higher than for standard apartment buildings. This extra costs has a payback time of 5 to 10 years.

Innovative products

Building envelope

Window: www.nordan.no

Door: www.nordan.no

Ventilation and cooling

Heat recovery unit: Villavent VR 400 EV, www.villavent.no

and Flexit K3, www.flexit.no

Controls

Unit for control of lighting, heating and ventilation and visualization of energy use, www.ctm.no

Space heating and DHW

Heat pump: Gray water heat exchanger and heat pump, www.menerga.no

Financing

The energy concept design is financed by The Norwegian Housing Bank. Results from the project IEA SHC task 28, Solar Sustainable Housing have been important for the pre design. This project is financed by NFR (The Norwegian Research Council), Enova, The Norwegian Housing Bank and Sivilarkitekt Røstvik AS/SunLab/YIT (ABB). Results from the project "Passive Climatization" is also used and this project is financed by NFR. This brochure is financed by Enova.

Project team

Builder: Husby borettslag, Stjørdal

Architect: Arkideco AS, Stjørdal

Main contractor: Primahus AS, Stjørdal & Frost Entreprenør AS, Trondheim

Contractor electricity: Siemens, Trondheim

Contractor HVAC: ELNAN AS

Project leader: Prosjektutvikling Midt-Norge AS, Stjørdal

Building Consultant : Reum & Laugtug (Siv.Ing. Bjørseth AS), Stjørdal

Energy consultant: SINTEF avd. Arkitektur og byggteknikk

Contact persons

Tor Helge Dokka, SINTEF (tor.h.dokka@sintef.no)

Grethe Mahlum, Arkideco AS (gm@arkideco.no)

Literature and links

T. H. Dokka, G. Mahlum, M. Thyholt, "*Forslag til energikonsept for Husby Amfi"*, SINTEF Rapport STF22 A02520, September 2002.

T. H. Dokka, G. Mahlum, *"Valgte tekniske løsninger og simulering av energibruk og inneklima ved Husby Amfi*.", SINTEF rapport STF22 A03508, May 2003.

Enovas Byggoperatør, "*Bygningsnettverkets energistatistikk, Årsrapport 2001"*, June 2001.

www.iea-shc.org **www.ecbcs.org**