

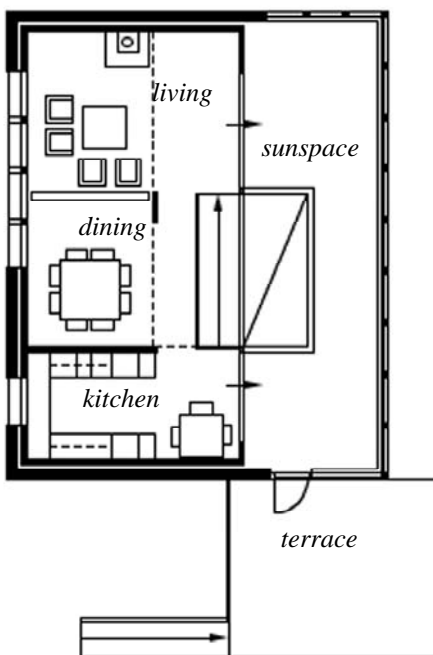
# HEIMDAL SOLAR HOUSES

TRONDHEIM, NORWAY

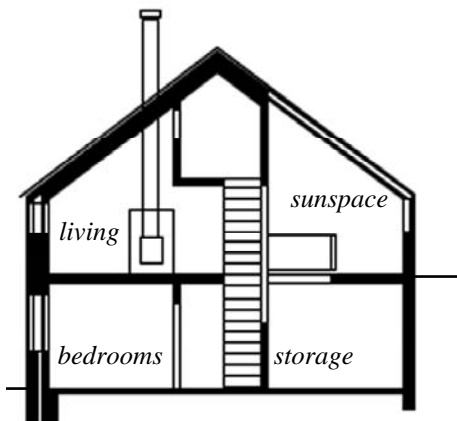
Completed: 1982  
Monitored: 1982-86

Latitude:  
63 deg. 30 min. N

Single-family dwelling,  
195 m<sup>2</sup> gross  
300 m<sup>3</sup> heated



plan 1st floor with sunspace and living areas



section with sunspace and living areas

### Keywords:

Solar dwelling, sunspace, air collector in sunspace, double shell construction system.

### Description:

The building is located outside of Trondheim, Norway, and is part of a research-project involving 14 houses with different energy-saving measures. 3 of them are solar buildings.

The solar dwelling has a building-integrated unheated sunspace to the south. In addition, a double shell construction allows solar-heated air from the sunspace to circulate in the air space that envelops the inner, well-insulated building. The energy savings are partly due to the solar energy collected, reduced heat loss and to the effect of the air space as a preheater of ventilation air.

Preconstruction calculations of energy performance indicated a reduction in energy consumption of approximately 50%. Monitoring results from a 4 year monitoring period showed that this has been achieved.

### The Systems:

The double shell concept is based on the idea of creating a solar heated, semiclimatized zone between an inner and an outer shell of a building. In such a system, any increase in temperature is useful, and even radiation of low intensity has some effect.

The temperature differences can be kept at lower levels than in conventional systems, thus reducing heat loss. In addition, double walls like

this act as counter current heat exchangers for infiltration air.

The wall cavity, or air space, is 50mm wide on the north side, while it is 3 meters wide on the south side (sunspace). Air flows are controlled by fans and the fact that hot air rises. A waterbased heat storage is used to temper the climate in the sunspace, and to pre-heat domestic hot water.

### Construction:

The main construction of the sunspace is laminated wood. On the outside the glass-frames are made of impregnated wood.

Double-zealed glass are used both to the outside and between the sunspace and the heated areas. Total glazed areas to the outside is 50 m<sup>2</sup>, and the glazed area to the heated zones are 20 m<sup>2</sup>, including 2 large sliding doors for easy access to the sunspace. This also provide a great del of daylight to the living areas and to the ground floor. Shading are mounted on the inside - light fabrics - and this works because of the shape of the volume and the height of the sunspace.

The rest of the wall between living areas and sunspace is insulated with 100 mm mineral wool.

The sunspace floor is also made of wood, and there is no thermal mass constructions in the building.

The roof-slope is 37 degrees, allowing snow to slide off in the winter. The glazed construction has opening windows for natural ventilation in the walls and in the roof.



The sunspace is an integrated part of the building design. It is unheated, and serves as a living space when the natural conditions makes it comfortable. In addition, it is a buffer-zone between heated areas and outdoor climate, and in combination with air solar collectors, fans that distribute solar-heated air to the building, reduces the heat demand by app. 50%.

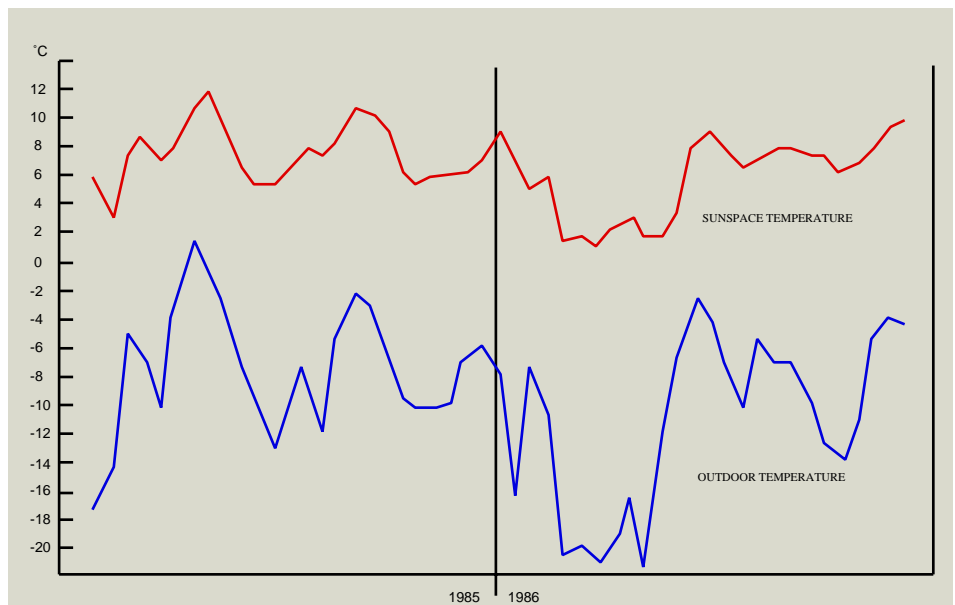
**Monitoring results:**

The dwelling was monitored over a period of 4 years. Continuous monitoring provided hourly data on energy consumption for space heating, water heating, lighting and appliances, because of the total integration of the sunspace. In addition, sunspace and indoor temperatures were monitored. Short term measurements provided data on heat transfer coefficients and infiltration. The computer program ENCORE was used for calculations. A dwelling of exactly the same size, shape and volume - heated and unheated - was used as reference.

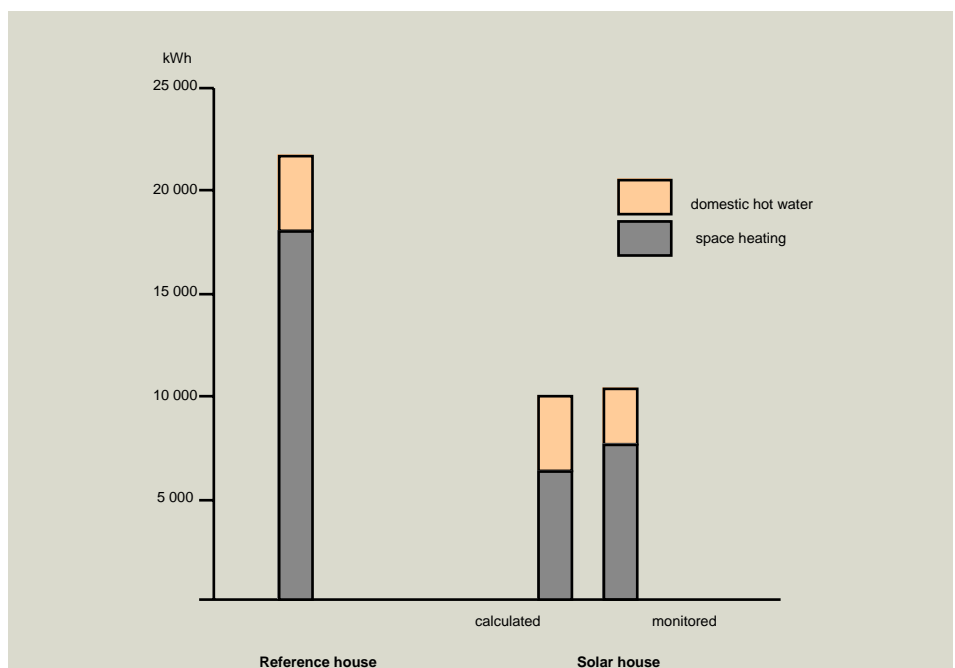
On the average, sunspace temperatures was 10 - 15 °C higher than the ambient temperatures throughout the year. Shading and sunspace volume contributed to reasonable thermal comfort in the sunspace.

The overall construction saves approximately 10.000 kWh a year.

The sunspace has been use for temporary occupancy from November to February, and permanent occupancy from March to October.



Sunspace temperatures - day averages - monitored from December 6th 1985 to January 25th 1986



Calculated and monitored annual energy consumption