PROJECT SUMMARY
Renovated 2004-2005
110 Apartments
The first large low-energy housing renovation project in Norway

ARCHITECT
Kari Kindem Thyholt, MNAL
Renovation: Grethe Mahlum, Arkideco

OWNER
Husby borettslag

Terrasse apartments Husby, Stjørdal, NO

IEA – SHC Task 37
Advanced Housing Renovation with Solar & Conservation
BACKGROUND

• Terraced apartments, built in 1970 according to building codes from 1969. Orientated towards south.

• An important aim of the project in 1970 was making use of non-productive, steep slopes at low construction costs. The project received national and international attention during the seventies for this concept. The buildings are built on an old slate quarry, and stand on pillars. There is a cavity between the floors and the ground slope.

• The motivations for the current renovation were:
  • High electricity consumption
  • Complaints about poor indoor climate
  • Inspiration from the low energy project at Husby Amfi (built by the housing cooperative)
  • The inadequate capacity of the electric transformer to meet the demand of both the old (Husby Terrasse) and the new (Husby Amfi) buildings.

SUMMARY OF THE RENOVATION

• 15 cm insulation added and gable walls made more air tight.
• Thermal bridges reduced at gable walls and at the floor/south wall joint. Floor heating slots at front windows and balcony doors filled with mineral wool).
• Balanced ventilation system (rotary wheel heat exchangers) in each flat, with assumed 80 % efficiency.
• New windows and balcony doors (triple glazing, $U = 1.0$ W/m²K).
• Replacing the old electric convector heaters with modern electric room heaters with thermostats (solar collector assessed, but poor profitability).

The south walls had previously received additional insulation (to a total of 150 mm) and new cladding. Therefore, these walls were not touched during the renovation.

No insulation of the floors was added due to too high costs and resistance of occupants having to move out during the renovation.

The triple glazed window panes reduce daylight admittance by approx. 10 %.
CONSTRUCTION

**Roof construction**  
*U-value: 0.48 W/(m²·K)*  
Concrete (existing) 120 mm  
Insulation (existing) 50 mm  
Concrete (existing) 130 mm  
Total 300 mm

**Floor construction**  
*U-value: 0.94 W/(m²·K)*  
Concrete (existing) 130 mm  
Insulation (existing) 15 mm  
Total 145 mm

**Gable wall construction**  
*U-value: 0.18 W/(m²·K)*  
Facade panels 20 mm  
Asphaltered cardboard 13 mm  
Concrete 150 mm  
Plaster Board 13 mm  
Insulation (existing) 50 mm  
Insulation (new) 150 mm  
Total 396 mm

The old electric convector heaters in front of the balcony doors were removed and the cavities insulated and sealed.

After removing the panels and old insulation of the gable walls, 2 layers of insulation were added.
The occupants had to cover the ducts themselves, for instance in the kitchen shown here.

**Summary of U-values W/(m²·K)**

<table>
<thead>
<tr>
<th>Construction</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof</td>
<td>0.48</td>
<td>0.48</td>
</tr>
<tr>
<td>Floor</td>
<td>0.94*</td>
<td>0.94</td>
</tr>
<tr>
<td>Outside wall south</td>
<td>0.35**</td>
<td>0.35</td>
</tr>
<tr>
<td>Gable walls</td>
<td>0.64</td>
<td>0.18</td>
</tr>
<tr>
<td>Outside wall north (only top floor)</td>
<td>0.76</td>
<td>0.76</td>
</tr>
<tr>
<td>Windows</td>
<td>2.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Balcony door</td>
<td>3.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

* Before the renovation, room air was exhausted through the closed cavities beneath the floor. To use heat from the exhaust ventilation air, the tempered cavities reduced the floor heat losses. After the renovation exhaust air is routed through the new balanced, heat recovery ventilation system and the floor is colder.

**The south walls had earlier been renovated with 5 cm additional insulation to a total of 15 cm**

**ENERGY PERFORMANCE**

Total measured energy use (delivered/primary energy):

- Before: 265/623 kWh/m²
- After: 150/353 kWh/m²
- Reduction: 43%

* Primary energy factor for electricity: 2.35

Calculated energy use for space + water heating (delivered / primary energy)

- Before: 205 / 482 kWh/m²
- After: 90 / 212 kWh/m²
- Reduction: 56%

**INFORMATION SOURCES**

Kari Kindem Thyholt (Architect)
Arkideco
SINTEF Building and Infrastructure

**Brochure authors:**

Marit Thyholt, SINTEF Building and Infrastructure, Helene Slagstad, The Norwegian State Housing Bank
Contact person: Marit Thyholt, SINTEF Building and Infrastructure, +4790507586
marit.thyholt@sintef.no

**BUILDING SERVICES**

- Electric resistance panel heaters
- Electric water heating
- Balanced ventilation with rotary wheel heat exchanger