PROJECT SUMMARY

SPECIAL FEATURES
- Gap-Solar Façade
- decentral ventilation system with heat recovery and air heating

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Co-operative

APT building on Makartstrase, Linz AT

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

The enclosure of this building with 50 flats, which is almost five decades old, was in a good condition. The exterior walls of poured concrete were not insulated. The space heating demand of the building was 124 kWh/(m²a). Parts of the cellar ceiling were later insulated. The energy improvement of the building technical systems, reduction of thermal bridges and air tightening of the envelope were key aspects of the modernization. After renovation in 2006, the apartment building complies with Passive House Standard, needing only 11 kWh/(m²a) for space heating. The renovation was co-sponsored by the state of Upper Austria and the House of the Future Program of the Austrian Ministry of Transport, Innovation and Technology (BMVIT).

SUMMARY OF THE RENOVATION

• high insulation of the facades, floors, roofs
• triple glazing windows, including an anti-glare shield
• decentral mechanical ventilation with heat recovery and air heating
• insulated outside walls with the "Gap-Solar Façade"
• enlarging the apartments by closing the balconies
• using prefabricated wall units the full width and height of an apartment
• domestic hot water by district heating

OBJECTIVES OF THE RENOVATION

• reduce heating costs to a minimum
• optimise ventilation and building services
• ecologically renovate and use renewable resources
• use pre-fabrication
• renovate with a least distribution of residents
CONSTRUCTION

**Roof construction**  
*U*-value: 0.094 W/(m²·K)  
(top down)  
- Eternit fibre cement tile  
- roof structure construction  
- rock wool 400 mm  
- floor screed 30 mm  
- crushed slag course 100 mm  
- reinforced concrete 140 mm  
- plaster 20 mm  
Total 690 mm

**Wall construction**  
*U*-value: 0.158 W/(m²·K)  
(interior to exterior)  
- plaster 20 mm  
- slag concrete 300 mm  
- insulation 60 mm  
- OSB airtight 16 mm  
- mineral wool 130 mm  
- MDF 4 mm  
- solar comb 50 mm  
- air gap (slightly ventilated) 31 mm  
- ESG float glass panel 6 mm  
Total 617 mm

**Basement ceiling**  
*U*-value: 0.206 W/(m²·K)  
(top down)  
- existing floor 100 mm  
- reinforced concrete 150 mm  
- porous concrete 50 mm  
- rock wool 100 mm  
Total 400 mm

Window:  
- triple glazing  
  - *U*₁: 0.71 W/(m²·K)  
  - *U*₂: 0.95 W/(m²·K)
BUILDING SERVICES

The building will meet the Passive House Standard by means of prefabricated ventilated Gap-Solar Façade, reinforced insulation of top floor and cellar ceiling, enlargement of existing balconies including parapet insulation, glazing with Passive House quality windows including integrated sun protection.

A controlled room ventilation system with heat recovery (efficiency 70%), air heating and single room ventilators is installed. The existing space heating system was in a good condition. Therefore this system is used, additionally to the room ventilation system, though with lower supply temperatures and new room thermostats. Domestic hot water is heated by district heating, instead of decentral gas heating.

Expected energy savings of about 450,000 kWh/a will decrease annual CO₂ emissions from about 140,000 to 29,000 kg. Before modernization: heating costs for a flat of 59 m² were € 40.80 /month, afterwards they are € 4.73 /month.
Summary of U-values W/(m²·K)

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attic floor</td>
<td>0.9</td>
<td>0.09</td>
</tr>
<tr>
<td>Walls</td>
<td>1.3</td>
<td>0.16</td>
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<tr>
<td>Basement ceiling</td>
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<td>0.21</td>
</tr>
<tr>
<td>Windows</td>
<td>ca. 2.8</td>
<td>0.95</td>
</tr>
</tbody>
</table>

1) Dynamic U-value with solar input (Gap-Solar Facade)

ENERGY PERFORMANCE

Space + water heating (primary energy) *

Before: 172.5 kWh/(m²a)
After: 38.7 kWh/(m²a)
Reduction: 78 %

* according to OIB Richtlinie 6

INFORMATION SOURCES

Passiv House renovation, Makartstrasse, Linz, report of energy end environment research 21/2007, bmvit.

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RENEWABLE ENERGY USE

The Gap-Solar Facade system consists of a special cellulose honeycomb protected behind a glass facade. Solar radiation enters and warms the honeycomb. A warm buffer zone is created on the outside wall, reducing heat losses from the building interior.

The efficiency of the gap-solar facade depends on the amount of sunlight and the facade orientation. On the south facing facade room heat losses over the heating season drastically reduced, with an average dynamic U-value of the wall of approx. 0.08 W/m²K.
PROJECTS in AUSTRIA

PROJECT SUMMARY

P1 Apartment building in Kierling
P2 5 story apartment house in Linz
P3 Enhancement house Wimmer in St. Valentin
P4 Single-family house in Pettenbach
P5 Old people’s home in Landeck
P6 Housing in Purkersdorf
P7 Historic building in Irdning
P8 Enhancement in Mautern
P9 Attic conversion in Innsbruck
P10 House Schilchegger in St. Martin
P11 Single-family house Kraiger in Kufstein
P12 Apartment buildings in Dornbirn

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