One-Family House in Walenstadt, CH

PROJECT SUMMARY
Housing renovation and addition of a room
Reduction of heating energy: 80%

SPECIAL FEATURES
Solar drain-back-system
Contemporary design character

ARCHITECT
Architecture office FEBI
www.febi.ch

OWNER
Hubert Fehr, Architect FEBI

IEA – SHC Task 37
Advanced Housing Renovation with Solar & Conservation
BACKGROUND
This single-family house from 1942 was purchased by a young couple in 1997. Three years later the oil furnace had to be replaced. This was an incentive to develop a completely new energy concept for the house. The owner, an architect, achieved a sustainable renovation during the following five years. He achieved an 80% reduction in heating energy demand while drastically improving the living standard.

SUMMARY OF THE RENOVATION
• Insulation of the building envelope: roof (220 mm), façade (200 mm) basement ceiling (80 mm).
• New triple glazed windows (U-value glass: 0.5 W/m² a, g-value: 0.55).
• New roof cladding.
• 13 m² solar collectors, 800 litre combi-tank.
• Wooden pellet furnace (3 kW) as replacement of the oil heating (11 kW).
• New ventilation system (HRC 80%).
• Addition of a bathroom.
### CONSTRUCTION

**Roof construction**  \( U\text{-value: 0.18 W/(m}^2\text{K)} \)
(from top to bottom)
- Roof tiles / solar collector  \( 100 \text{ mm} \)
- Wooden strapping  \( 24 \text{ mm} \)
- Air gap, wooden cross strapping  \( 60 \text{ mm} \)
- Weatherproofing paper
- Mineral wool insulation  \( 220 \text{ mm} \)
- Weatherproofing
- Roof planking (tongue and groove)  \( 19 \text{ mm} \)
- Rafters (existing)  \( 180 \text{ mm} \)

Total  \( 603 \text{ mm} \)

**Wall construction**  \( U\text{-value: 0.19 W/(m}^2\text{K)} \)
(interior to exterior)
- Interior plaster  \( 15 \text{ mm} \)
- Masonry wall (existing)  \( 330 \text{ mm} \)
- Mineral wool insulation  \( 200 \text{ mm} \)
- Air gap, wooden cross strapping  \( 30 \text{ mm} \)
- Eternit cladding  \( 8 \text{ mm} \)

Total  \( 583 \text{ mm} \)

**Basement ceiling**  \( U\text{-value: 0.37 W/(m}^2\text{K)} \)
(top to bottom)
- Parquet flooring  \( 15 \text{ mm} \)
- Chipboard  \( 30 \text{ mm} \)
- Wooden beams, false floor partial insulation with cellulose. (existing)  \( 200 \text{ mm} \)
- Reed-Plaster ceiling (existing)  \( 20 \text{ mm} \)
- Mineral wool insulation  \( 80 \text{ mm} \)

Total  \( 345 \text{ mm} \)
### Summary of U-values W/(m²·K)

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof</td>
<td>0.80</td>
<td>0.18</td>
</tr>
<tr>
<td>Walls</td>
<td>1.15</td>
<td>0.19</td>
</tr>
<tr>
<td>Basement ceiling</td>
<td>0.90</td>
<td>0.37</td>
</tr>
<tr>
<td>Windows*</td>
<td>2.6 - 3.0</td>
<td>0.8 - 1.1</td>
</tr>
</tbody>
</table>

* including frame

### RENEWABLE ENERGY USE

13 m² of solar flat plate collectors on the roof with an 800 litre storage tank cover 100% of the hot water demand in summer and help considerably to meet the space heating energy demand during fall and spring. The drain-back-system prevents the system from overheating.

### ENERGY PERFORMANCE

Space + water heating (primary energy)*

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ca. 230 kWh/m²</td>
<td>47 kWh/m²</td>
</tr>
<tr>
<td>Reduction</td>
<td>80 %</td>
<td></td>
</tr>
</tbody>
</table>

*Swiss Standard: SIA 380/1: 2001

### BUILDING SERVICES

Before the renovation, this single-family house needed 3,500 litre of heating oil per year, or the equivalent of seven tons of wooden pellets. Today, after the renovation of the building envelope and replacement of the oil furnace with a wooden pellets furnace 1½ tons are sufficient. A new ventilation system with heat recovery (efficiency 80%) and rotating heat exchanger were installed. The ventilation system’s electrical consumption amounts to 4.5 kWh/m²a. The fans have 99 W connected power.

**INFORMATION SOURCES**

Enz, D.: *Bauerneuerung für die Zukunft*, Flumroc AG, Postfach, CH-8890 Flums, 36 pages (German, French, Italian) [www.flumroc.ch](http://www.flumroc.ch)

March 2007

Brochure co-authors

daniela.enz@aeu.ch
robert.hastings@aeu.ch