Apartments and offices in Brussels BE

PROJECT SUMMARY
Vertical extension: replacement of the sloping roof by three levels of apartments.

SPECIAL FEATURES
Use of ecological materials and renewables
Densification of urban area

ARCHITECT
Jean-Paul Hermant

OWNER
PROVELO
Claude Rener

IEA – SHC Task 37
Advanced Housing Renovation with Solar & Conservation
QUITE AN APPRECIATED NEIGHBORHOOD
This renovation is in rue de Londres, close to the inner ring road of Brussels and benefits from proximity to services, shops, entertainment, offices, public transportation.
The high demand in this appreciated neighborhood of Ixelles, close to the city centre, motivated the addition of roof apartments.

WELL INTEGRATED CONTEMPORARY INTERVENTION
The facade is typical Brussels architecture from the end of the 19th century, showing a well-balanced and punctuated composition framed by carriage entrances enhanced with balconies and underlined by its framework in blue stone.

The existing roof structure was worn out and the roof tiles damaged, making a new roof mandatory. Instead of replacing the roof, the roof was removed and two duplexes and two triplexes were built in a light wooden frame construction on top of the building.

The terraced cross section follows the profile of the neighboring pitched roofs. The terraces are valuable space for relaxation and a small vegetable garden for each attica each floor.
The lower floors of the existing building are used as offices and a workshop used by a non-profit organization encouraging inner city bicycle use.
The original stables in the courtyard were also renovated and are used by a carpenter.
An existing staircase and lift provide vertical access. A central corridor linking both, leads to the apartments. This layout of the premises divides the space into a north zone overlooking the street and south zone overlooking the inner block and its yard. To give the northern apartments a view to the south, a third level was constructed above the duplexes. The southern facade is designed to admit sunlight in a controlled manner. Large pergola-style fixed "sun-visors" create a charming outdoor space with wooden horizontal surfaces (floor and "ceiling"). The wood softens the strong presence of the metallic elements accentuating the verticality.

**BUILDING CHOICES**
A wooden construction was chosen to minimize weight which the existing structure must carry. The existing bearing walls stability were fragile and carried by almost non-existing foundations. The vertical extension was covered in zinc, attached to a pinewood lathwork. Wood construction also made possible a nearly thermal bridge free construction.
### Construction

#### Roof construction  
*U-value: 0.112 W/(m²·K)*

<table>
<thead>
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<th>Material</th>
<th>Thickness</th>
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<tbody>
<tr>
<td>EPDM light grey</td>
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<tr>
<td>Cork insulation panel</td>
<td>200 mm</td>
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<tr>
<td>Cellulose insulation + rafter</td>
<td>200 mm</td>
</tr>
<tr>
<td>Variable internal air barrier</td>
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</tr>
<tr>
<td>Battens</td>
<td>35 mm</td>
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<tr>
<td>Plasterboard</td>
<td>12 mm</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>447 mm</strong></td>
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#### Wall construction  
*U-value: 0.244 W/(m²·K)*

<table>
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<th>Material</th>
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<tbody>
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<td>Plasterboard</td>
<td>12 mm</td>
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<td>Battens</td>
<td>35 mm</td>
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<tr>
<td>Variable internal air barrier</td>
<td></td>
</tr>
<tr>
<td>Wood fiber insulation panel/Cellulose + wood construction</td>
<td>180 mm</td>
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<tr>
<td>Wooden lathwork</td>
<td>22 mm</td>
</tr>
<tr>
<td>Zinc</td>
<td>2 mm</td>
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<td><strong>Total</strong></td>
<td><strong>251 mm</strong></td>
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#### Windows:
- Window frame: eucalyptus FSC
- High performance double glazing
MATERIALS, WASTE

Retrofitting the building instead of demolition it and construction a new building was considered more ecological. The latter would have resulted in demolition waste and use of new materials with resulting pollution as well as energy and material consumption. Using this logic, it was decided to only limit the renovation work for the existing building and recycle some dismantled materials for use in the newly built floors. In this construction you will find untreated structural wood, larch floors, clay surfaces, eucalyptus window frames, wood fiber and cellulose, cork and EPDM.

WATER MANAGEMENT

The question of water treatment was answered in this project in several ways. The existing water tank was reused, a common clothes washing room was provided for all the tenants and the washing machine are supplied with solar hot water. The roofs terraces are used for vegetable gardens accessible from the apartments. The lower building of the annex has a green roof. The courtyard, with a few parking spaces, has a permeable covering and is surrounded by flowerbeds.
Solar Thermal system: DHW and heating
The 17 m² of roof, solar collectors were deliberately over-sized to cover some of the space heating demand as well as most of the domestic hot water demand.
A storage tank of 400 liters is heated first and provides the DHW, covering 70% of the annual demand. Next, a tank of 700 liter stores the heat for the very low temperature surface heating system.

Rational Energy Use
The rental apartments are equipped with a “chart for recording good energy behavior”. It explains correct everyday use of water, energy and operation of the ventilation system.

HEATING SYSTEM
The surface heating system circulates ‘hot’ water in the walls and the floors. The large surface area and good insulation allow it to operate at very low temperatures. In response to an external sensor, the surface temperature varies between 25° and 35° C.

Because Belgian has limited winter sunlight a complimentary heating energy source is needed. A geothermal heat pump (water/water) was selected. Four 70 meter deep bore holes were drilled. During winter, a heat pump transfers and elevates the heat from the refrigerant loop to the low temperature surface heating loop. During summer, the reverse strategy is possible, putting heat back into the earth. The heat pump is programmed to be used primarily nights, when electricity is least expensive, and heat is stored in the buffer tanks.

At the moment the heat pump and circulation pumps still draw on the electricity grid, but the owners participate in green electricity production.
POLICY OF THERMAL INERTIA

Wooden construction is easier to insulate than massive constructions, but lacks thermal inertia. Mass is needed to dampen temperature swing in winter to maximize usefulness of passive solar gains, in summer to minimize daytime overheating. For this reason, the central load bearing wall on the lower new storey is built with silicate blocks. These have a favourable ecological balance and a high thermal mass.

COST STATEMENT

The investment needed for this project was considerable. Using ecological materials increased costs by 25%. Excavation of the boreholes cost approximately €10,000. The heating system cost about double that of a conventional system. These overcosts are partially offset by the insulation subsidies (7€/m2), the solar subsidy (may be up to €6000), the minimal maintenance costs of the systems and building, low total electricity consumption and no fossil fuel consumption. All this together leads to an estimated pay back time of about fifteen years. A possible future increased real estate value can also be factored in.

Some notes on prices:
• Clay plaster costs the same as a standard plaster but has better thermal and moisture inertia.
• Silicate blocks do not cost much more than standard hollow bricks, but their thermal inertia is better and they are glued rather than mortared. This is faster and hence saves on labor costs.

In 2007, the architect received the Belgian Architecture Energy award with this project in the category “collective housing”.

Silicate block wall and surface heating tubing.
SUMMARY OF U-VALUES W/(m²·K)

<table>
<thead>
<tr>
<th></th>
<th>Before*</th>
<th>After</th>
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</thead>
<tbody>
<tr>
<td>Attic floor</td>
<td>0.77</td>
<td>0.11</td>
</tr>
<tr>
<td>Walls</td>
<td>2.78</td>
<td>0.24</td>
</tr>
<tr>
<td>Windows</td>
<td>5.1</td>
<td>1.31</td>
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</tbody>
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* Since there was no before situation, these are the values of the buildings below

BUILDING SERVICES

Heat pump: water/water system
4 bore holes of 70m deep
Radiant wall heating.
Central washing machines with pre-heated water from the solar collectors

RENEWABLE ENERGY USE

Solar flat plate collectors: 17m²
Storage tank volume: 400l for pre-heating heating
700l for distribution
Rain water tank: 15.000l

ENERGY PERFORMANCE

Space + water heating (primary energy)*
Before: (kWh/m²a)
After: 41 kWh/m²
* Walloon implementation of EPBD

INFORMATION SOURCES

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