# 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**
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SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

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

The new graded roof construction follows the silhouette of the old roof.

The façade towards the street was left untouched

## 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 trans-portation.

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..


Aerial view of the neighbourhood of the building, in the centre of Brussels

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.

The modifications are hardly visible from the street.

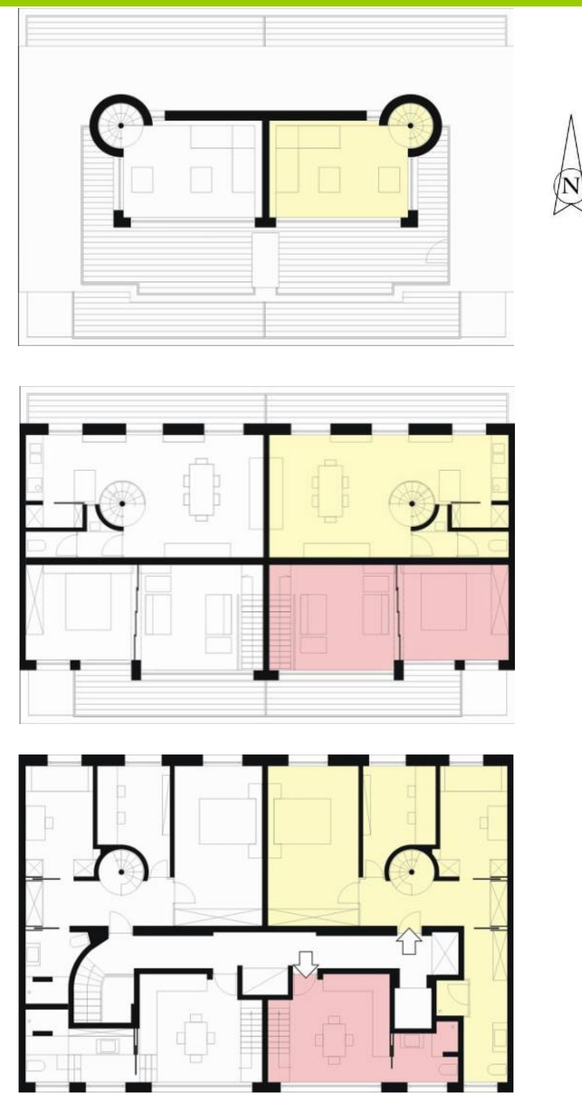
Southern terraces of the triplexes

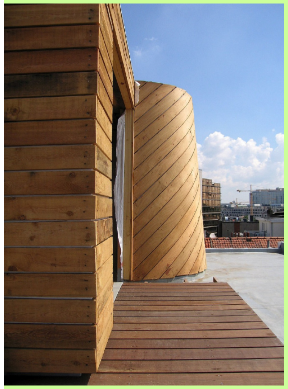
An existing staircase and lift provide vertical access. A central corridor linking both, leads to the apartments. This layout of the premises divides the space into a north zone overlooking the street and south zone overlooking the inner block and its yard. To give the northern apartments a view to the 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.

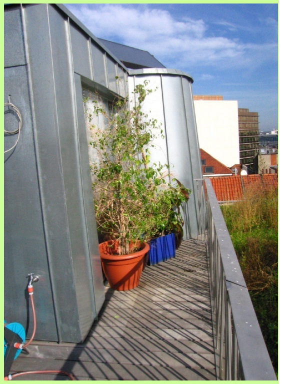
## BUILDING CHOICES

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.







View on the terraces and the staircase during construction and after finishing

View of the north-facing triplex and duplex terraces. Part of the wall already has a zinc finishing.

## CONSTRUCTION

**Roof construction** *U-value: 0,112 W/(m²·K)*

(top down)

| | |
|---|---|
| EPDM light grey | |
| Cork insulation panel | 200 mm |
| Cellulose insulation + rafter | 200 mm |
| Variable internal air barrier | - mm |
| Battens | 35 mm |
| Plasterboard | 12 mm |
| Total | 447 mm |

**Wall construction** *U-value: 0,244 W/(m²·K)*

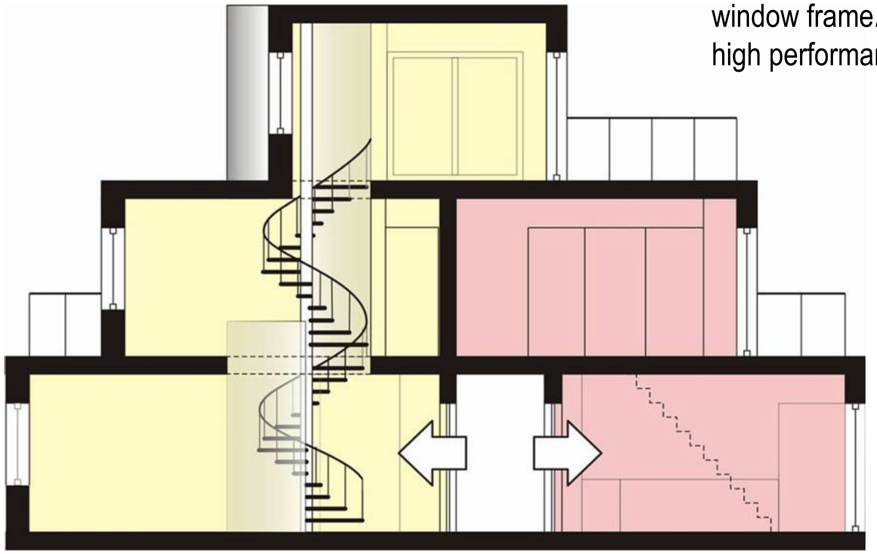
(interior to exterior)

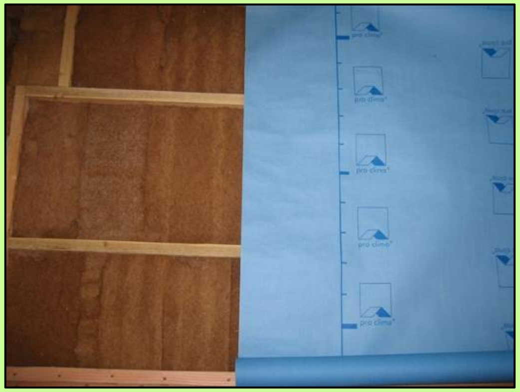
| | |
|---|---|
| Plasterboard | 12 mm |
| Battens | 35 mm |
| Variable internal air barrier | - mm |
| Wood fiber insulation panel/ Cellulose + wood construction | 180 mm |
| Wooden lathwork | 22 mm |
| Zinc | 2mm |
| Total | 251 mm |

**Windows:**

window frame: eucalyptus FSC

high performance double glazing





Wood fiber insulation and the vapor barrier

Natural cork insulation

## 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 polution 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.

Detail of the EPDM liner over the cork insulation

## WATER MANAGEMENT

The question of water treatment was answered in this project in sevaral 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.

Common washing room with automatic payment system

Re-activated water tank with pump.

## 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.

Silicate block wall and surface heating tubing.

## 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 usefullness 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.

AWARDS VAN DE BELGISCHE ARCHITECTUUR 2007 ENERGIE AWARDS
AWARDS DE L'ARCHITECTURE BELGE AWARDS DE L'ENERGIE

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

## 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.


Applying the clay plaster


South oriented façades of the apartments


Small gardens on the new graded roof

## SUMMARY OF U-VALUES W/(m²·K)

| | Before* | After |
|---|---|---|
| Attic floor | 0.77 | 0.11 |
| Walls | 2.78 | 0.24 |
| Windows | 5.1 | 1.31 |

* 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

BELGIAN SCIENCE POLICY

## 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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