Row House Henz-Noirfalise in Eupen, Belgium

PROJECT SUMMARY
Transforming a 19th century row house into a Passive House

SPECIAL FEATURES
Inside insulation of the facade

ARCHITECT
Fhw architectes scprl
www.fhw.be

OWNER
Henz-Noirfalise

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

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

View from the house over Eupen

The inside wall insulation and continuous air tightness screen: turning a set back into an advantage

BACKGROUND

This house is close to the centre of Eupen, a medium-sized city in north-east Belgium. It was worth renovating because of its good size, privileged site in the urban centre, pedestrian's access to public transport, shops and schools, and its panoramic city.

New construction or renovation?

The house was overall in poor condition, needing a new roof, windows and heating system. The fragmented additionsto the rear were out of date. Last but not least, a health condition of the family demanded very clean air and hence mechanical ventilation and an air tight envelope.

Increased comfort was important, not only thermally and acoustically, but also for air quality and daylight quality.

Considering all these requirements, the extra investment to reach the Passive House Standard was relatively low. A VAT for renovation of 6%, compared to a VAT for new constructions of 21%, made this ambitious renovation more economical than building a new Passive House structure.

Aerial view of the city of Eupen, with location of the house.

Reflection on the programme

The functioning of the house was preserved. A technical room was added with space to store bicycles. The living room has a generous volume and is now better oriented to the south and the garden.

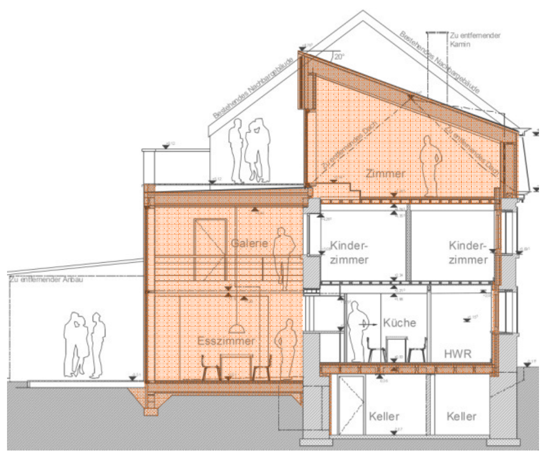
Before

After

SUMMARY OF THE RENOVATION

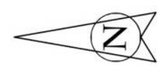
- Insulation: walls (280 + 60mm), attic floor (260 + 40mm) and roof (360mm)
- New roof construction
- Addition in wooden frame construction, replacing the old fragmented additions, increasing the floor area from 130 to 180m²
- Facade renovated with a continuous layer of inside insulation, cutting through the existing floor slabs and wooden beams
- New windows placed behind the old units (which wll be removed later).
- External shading by natural vegetation and solar collectors.
- New kitchen (ground floor) and bathroom (first floor)

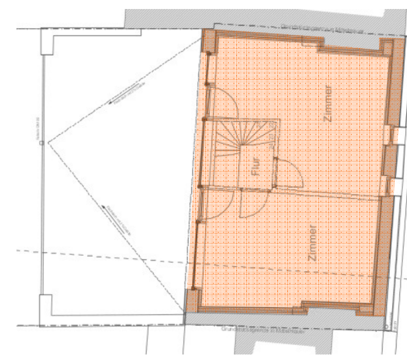
Section



Ground Floor

First Floor





Second Floor

Problem of air tightness on old beam. Note the ‘intelligent’ air and vapour tightness screen The screen’s vapor resistance is varying depending on the relative humidity, going from 0.25m to 10.5m.

CONSTRUCTION

Roof construction *U-value: 0,14 W/(m²·K)*

(top down)

Bituminised soft fibreboard	22 mm
Cellulose insulation + rafter	360 mm
Battens	48 mm
Interior plaster	9 mm
Total	439 mm

Wall construction *U-value: 0,135 W/(m²·K)*

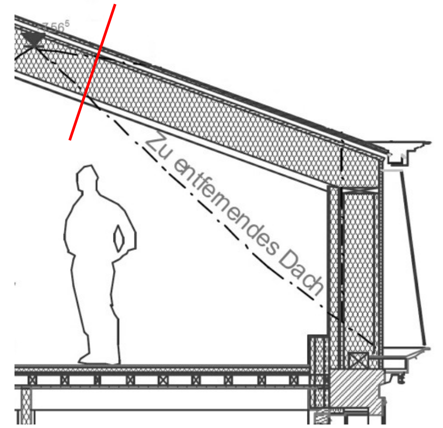
(interior to exterior)

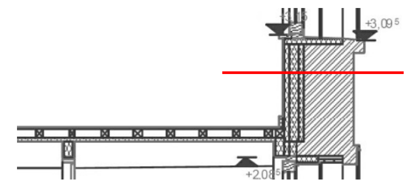
Clay	20 mm
Wood fibre insulation panel	60 mm
Variable internal air barrier	- mm
Wood construction + cellulose	280 mm
Quarry (existing)	500 mm
Exterior stucco (existing)	15 mm
Total	875 mm

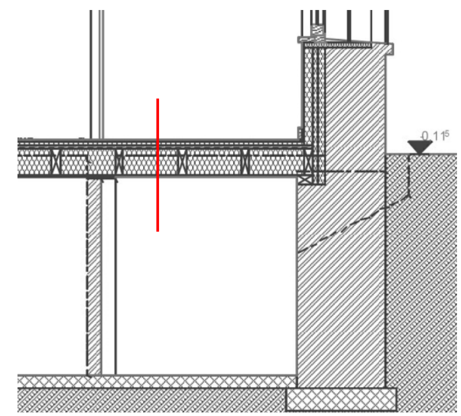
Basement ceiling *U-value: 0,165 W/(m²·K)*

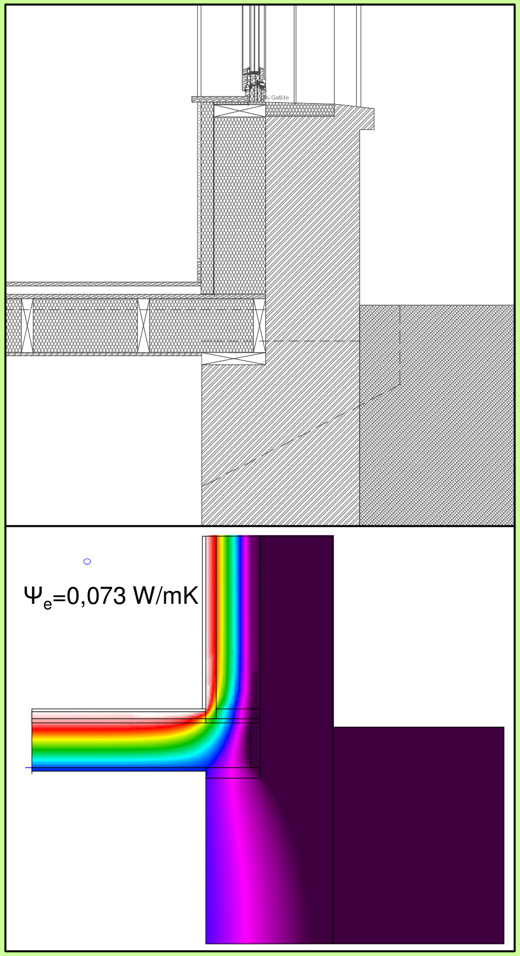
(top down)

Floor	20 mm
Wood fibres insulation	40 mm
Wood boards	22 mm
Cellulose insulation + beams	260 mm
Wood fibre panel	18 mm
Total	360 mm









Construction detail and thermal conductivity image of the connection floor slab - façade

INSULATING THE INSIDE OF THE FACADE

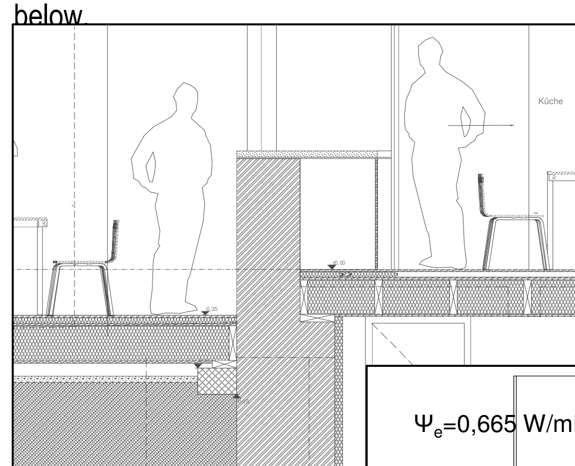
Because of city regulations prohibited exterior insulatiion of the facade. The solution was to erect a wooden I-beam construction on the room side of the exterior wall. The void created was filled with cellulose. This layer cuts through all floor slabs, and even through the existing wooden support beams, ending next to the new roof construction. This makes possible a continuous insulating and air tight layer, free of thermal bridges where the floor slab meets the wall.

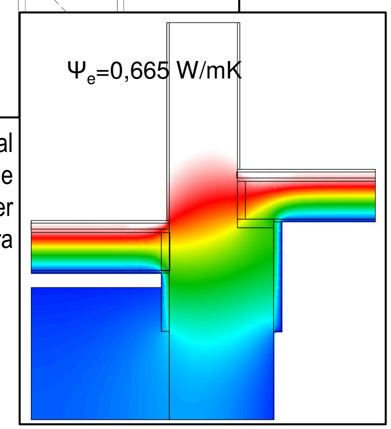
The air tightness layer has a variable vapour resistance, allowing the construction to dry out in

The I-beam construction cutting through the floor slab and support beam (left) and ending above the upper floor level, next to the new roof construction (right). The brick wall clearly shows were the old roof was.

THERMAL BRIDGE INSIDE

The new floor slab on the right, and the extension on the left, are divided by the existing wall. Because of its location on the room side of the house wall and by adding perimeter insulation on the bearing wall, the thermal bridge can be reduced, as shown in the figure below.





Construction detail and thermal conductivity image of the connection. The effect of the higher ground temperatures from the extra insulation is clearly visible.

COST STATEMENT

- Given the mandatory measures (cfr. background), the extra investment towards passive house standard was relatively low. The 6 % VAT made renovation cheaper than building a new passive house (21%).

- The costs were somewhat reduced because Mr. Henz was able to do the design work himself (12% or appr. 20.000 € saved). He also did a part of installation himself to lower the costs (air tightness, part of finishing & carpentry: appr. 8500 €).

-The costs of the renovation measures relevant to energy savings (insulation, air tightness, ventilation & heating, windows) amounts up to 27 500 € (excl. woodwork costs).

- The cost of renovation measures without energy-relevance (eg. renewal of kitchen, bathroom, floor finishing, redecoration, roof covering, demolition …) amounts up to 78 000 €.

- Extra costs (20 900 €) in total were made for 'sustainability': Rain water collection (9100 €), ground-air heat exchanger (2800 €), solar collectors (8000€) and heat production through pellet stove instead of gas (+1000€).

SUMMARY OF COSTS

Total investment cost (incl VAT excl subsidies)	±171 240 €
Total cost per m² (180 m²) Cost per m³ (455 m³)	951 €/m² 376 €/m³
Yearly cost for energy use* Before renovation: After renovation:	 2 140 €/y or 16.5 €/m²y 150 €/y or 0.83 €/m²y
* Prices for natural gas & pellets, January 2008	

SUBSIDIES & PRIMES

	2007	2008
Renovation prime	6 500 €	6 500 €
Insulation of roof (102.7 m²)	5 €/m² (max 600 €)	8 €/m² (max 10 000 €)
Insulation of walls (118 m²)	10 €/m² (max 1000 €)	25 €/m² (max 10 000 €)
Insulation of floors (102.4 m²)	10 €/m² (max 1000 €)	25 €/m² (max 10 000 €)
Efficient windows (64.6 m²)	25 €/m² (max 1000 €)	40 €/m² (max 10 000 €)
Ventilation with heat recovery	75 % invest (max 1 500 €)	75 % invest (max 1 500 €)
Biomass heating	1 500 €	1 500 €
Collection of rain water	496 €	496 €
Solar collector	3 500 €	3 500 €
Approximate total	±16 000 €	± 21 500 €

DETAILED COST STATEMENT

	Investment cost [€]
Structural Works (Demolition)	9 550
Roof construction & wooden frameworks	51 000
Roof covering	14 500
External carpentry (windows)	19 000
Façade covering	na
Insulation works (materials / placement) Air tightness (materials / placement)	6 700 (1640)
Sanitary works Electricity	14 400 8 090
Ventilation & heating (+ hot water production) Space heating / hot water / … Ventilation installation	 14 200 6 400
Internal finishing, other non-energy-saving measures	27 400

Explanatory remarks

-Prices incl. VAT, without subsidies

-"Roof construction & wooden frameworks" includes carpentry for roof, interior facade, annex construction & floor elevation

-Internal finishing etc. = new kitchen, floors, interior carpentry, finishing materials, …

- Final costs for façade finishing not available at this moment

Combination of the solar panels also serving as sun shading for the upper windows.

Large glazed surface, oriented to the south, captures passive solar power.

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CONSUMPTION OF GREY ENERGY

The waste management during the construction phase, as well as the choice of building materials was an essential part of the concept.
Wood was used wherever possible, all with the FSC label (for the structure of the partitions and floors, for window frames), cellulose and wood-fibre were used as insulation materials, zinc to cover the pitched roof, and EPDM to cover the flat roof..

WATER CYCLE

Without easy access to the garden, and no space in front of the house, it was impossible to bury a large rain water tank outside. The solution was to place four tanks of 750 litres inside the cellar. The toilet, washing machine and service tap are supplied by the water tank.

Rainwater tanks in the cellar.

CONCLUSION

The poor condition of this old house left only two options: demolition or a thorough retrofit. Because of a reduced VAT the latter approach was chosen. The roof was rebuilt, transforming the attic into extra living space. Rear additions were removed to create one big south- facing living room. All windows were replaced. Energy was also an issue for the renovation, so achieving the PH Standard only required an improved air tightness and inner wall insulation of the facade.
Before the renovation, the house was expensive to heat and uncomfortable. Now, the house needs only 5% of the energy consumed beforehand, and not only is thermal comfort improved, but also natural light penetration into the house, and better air quality are enjoyed. A broader sustainable approach, considering water consumption, renewables, context and waste management, completes the integrated vision of this retrofit.

New windows behind the old windows

Structure of the wall

Old support beam shored in the new wall

Summary of U-values W/(m²·K)

	Before	After
Attic floor	5,5	0,14
Walls	3,14	0,135
Basement ceiling	2,2	0,165
Windows*	4,65	0,72

BUILDING SERVICES

Ventilation is done with 78% heat recovery and a ground-air heat exchanger. Solar collectors are backed up by a wood pellet stove for space heating (15%) and hot water demand (85%). Thermal mass of the old building increases usability of passive solar gains and summer comfort. Summer shading is provided by the projecting solar collectors for the uppers story and natural vegetation for ground and 1rst floor.

LEHR

CSTC - WTCB - BBRI

BELGIAN SCIENCE POLICY

RENEWABLE ENERGY USE

- Solar flat plate collector: 8m²
  storage volume: 600l

ENERGY PERFORMANCE

Space + water heating (primary energy)*
Before: 275 kWh/m².a
After: 12 kWh/m².a (primary energy factor for the pellet stove: 0.2)
Reduction: 96%

*Calculated with PHPP

INFORMATION SOURCES

Fhw-architectes, PHP vzw

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