RENOVATION REPORT

The renovation reports are grounded in the findings of the pilot projects conducted as part of the ISOL'ution project. They synthesise practical lessons learned and identify key considerations for the reuse of insulation materials in various building typologies and material types.

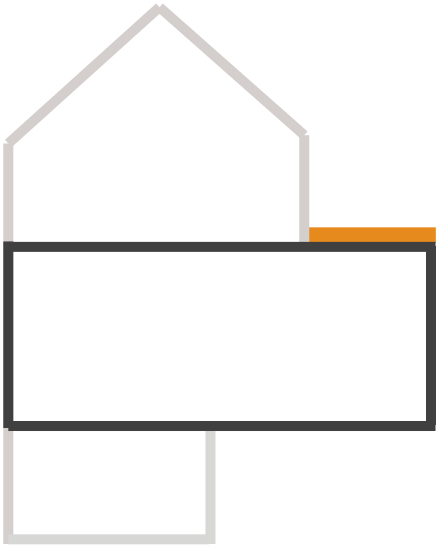
SITE 4

OUTSIDE INSULATION OF A FLAT ROOF

EXISTING SITUATION

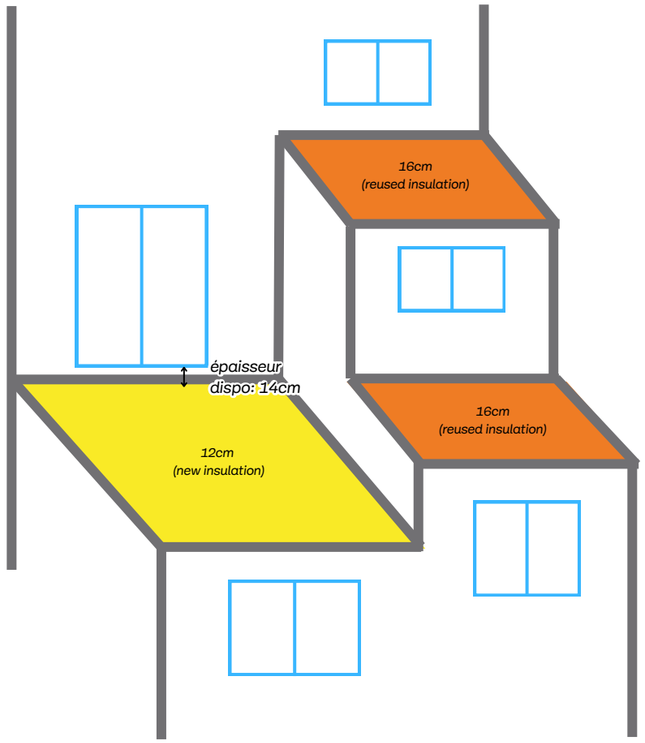
House divided into four flats with several extensions at the garden side.

Location of intervention	*house with multiple units*
Affected floors	*3*
Housing units	*4*
Year of construction/major renovation	*<1930*
Type of construction	*roof with a wooden structure*
Component to be insulated	*roof extension rear façade*
Surface area of the envelope	*258 M2*
Points to consider	*The height between the window and the roof is not always sufficient.*



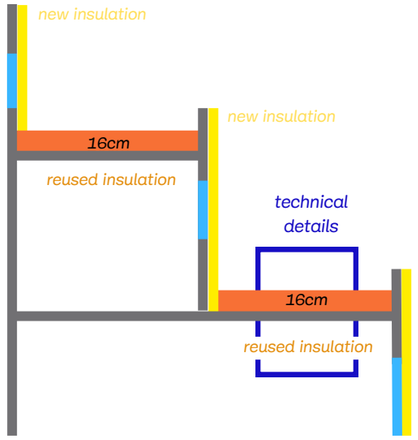
Section schématique de la typologie

TECHNICAL DECISION



simplified diagram of reused insulation

Elements to be insulated	roof of extension rear façade
Side of insulation	exterior
Surface to be insulated	20 m2
Anchoring method	PU adhesive
Type of insulation used	rigid synthetic plates
Execution by	HBNC, SRL



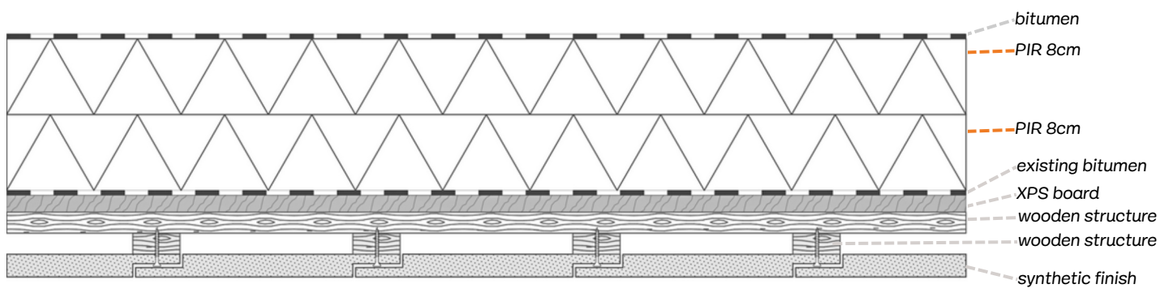
simplified section

new insulation reused insulation structure

Explanation of technical details

The budgets for this project was relatively limited. The main motivation for insulating came from the fact that several owners were experiencing humidity problems. These were caused partly by a leak in a pipe, which was repaired, but also by condensation. To resolve this, the rear façade and the roofs of the extension were insulated.

There are three surfaces, one of which was insulated with 12 cm new insulation to achieve optimal insulation, as there was only 14 cm of height available between the window and the roof. The other two surfaces were insulated with two layers of 8 cm reused PIR panels.



technical detail

l'isolation des murs

isolation de la toiture

REUSED INSULATION MATERIAL USED

Synthetic PIR panels were used to insulate the flat roof. They had some irregularities and adhesive residue. These had to be filled or removed to achieve a flat surface and prevent air from getting trapped between the layers of the various roof materials.

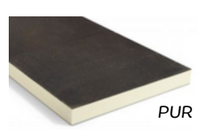
lot 1

Test results of the thermal conductivity

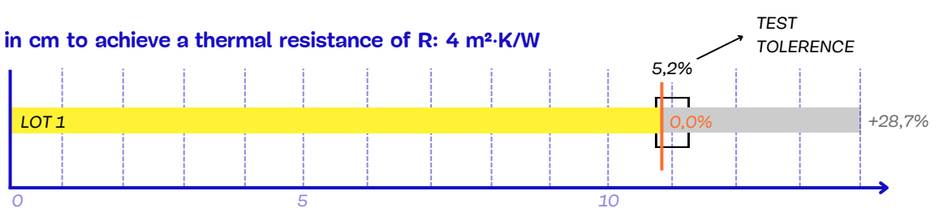
The table below consists of two parts. First, it lists the materials used and their technical characteristics. Secondly, their thermal resistance is compared using different lambda (thermal conductivity) values and different thicknesses. The thickness of the insulation panels is calculated based on the thermal resistance of an equivalent new insulator (orange), the average measured value (yellow) and the default value (grey). If the technical information on an insulation material is unknown or unavailable, a default thermal conductivity value from Annex A of Belgian standard NBN B 62-002 is used to calculate the thermal resistance. The thickness is calculated based on an R-value of 4m2.kW (this is the minimum thermal conductivity that applies in the Brussels RENOLUTION subsidy-scheme for roof insulation). The black box indicates the tolerance of the test-device to take into account for the results.

Materials	type	lot	quantity	thickness	average lambda test	new lambda	default value	supplier
polyuréthane PUR	synthétique	1	20 m2	8 cm	0,0272	0,0270	0,035	Trovo
					*1	*2	*3	

Insulation thickness in cm to achieve a thermal resistance of R: 4 m²·K/W

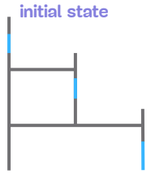
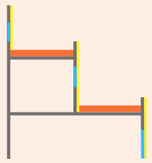
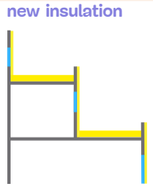


PUR



RENOVATION SCENARIOS

This table compares several scenarios: the original situation, a renovation with reused insulation materials, and a renovation with new materials. It examines various aspects: the wall composition, thermal conductivity of the insulation, price, overall environmental score, the share that insulation represents in the climate impact, the impact on climate change, and the thermal performance of the element. The TOTEM tool was used for these analyses. This table enables an informed decision to be made on whether or not to use reused materials for the insulation of a building element.

roof	Element composition	Area to be insulated (m²)	**Thermal resistance of insulation R (m²·K/W)** *Indicates the ability of the insulation to slow down the flow of heat through the material. Calculated by dividing the thickness by the thermal conductivity (lambda). The higher the R value, the better the insulation.*	**Cost comparison** *This section is broken down into several sub-elements: the insulation material (I), all materials (M), labour (L) and additional costs. The price is first expressed per square meter, then as the total cost for the entire project. This allows for a clear comparison between the different options.*	**Environmental impact per life cycle stage (mPt/FU)** *The graph below illustrates the environmental score per life cycle stage element, based calculation with the TOTEM-tool. The total environmental score is broken down into the different phases of the life cycle, showing the respective contributions of production, construction, use and end-of-life. This representation makes it possible to identify in which life cycle stages the main impacts occur and to clearly compare the differences between the options of reuse and new material.*	**Impact per component (mPt/FU)** *This graph shows the relative share of materials and energy in the total environmental impact of an element, calculated using the TOTEM tool (in millipoints per m²). The energy impact is based on transmission losses, while the material impact covers the entire life cycle of the components. It also shows the extent to which insulation contributes to the material impact, thereby guiding choices towards the most sustainable solutions for renovation.*	**Impact on climate change (kg CO_2eq./FE)** *This graph shows the impact of elements on climate change (expressed in kg CO_2 eq. per functional unit) compared to an indicative reference scale. This scale was established based on the environmental impacts of all similar elements available in the TOTEM library.*	**Thermal performance (W/m²·K)** *This figure expresses the amount of heat that passes through a wall element per square metre for a difference of 1 Kelvin between its two sides. The lower the value, the better the thermal insulation of the element.*
initial state 	*Flat roof* *Wooden structure*	*0m2*				materials 1,15 / energy 36,45 / 37,39	*755,14 kgCO2 eq/m2*	*1,39 W/m2.K*
reused insulation 	*ON THE OUTSIDE* *+ 8 cm PIR insulation* *+ 8 cm PIR insulation* *+ Waterproofing*	*20 m2*	*lambda: 0,0272* *R: 5,88*	*PRICE: 55,5 €/m2: 1110 €* *I: 8€/m2: 160 €* *M: 14€/m2: 280€* *L: 35€/m: 700€* *T 130€*	maintenance 1,34 / waste 1,95 / production 0,46 / energy 3,27	materials 2,7 / energy 3,27 / insulation 0,54 / 7,02	*107,92 kgCO2 eq/m2*	*0,12 W/m2.K*
new insulation 	*+ 8 cm PIR insulation* *+ 8 cm PIR insulation* *+ Waterproofing*	*20 m2*	*lambda: 0,027* *R: 5,92*	*PRICE: 52€/m2 1040€* *I: 16€/m2: 320€* *M: 22 €/m2: 440€* *L: 30€/m: 600€*	maintenance 1,34 / waste 1,95 / production 1,72 / energy 3,27	materials 3,7 / energy 3,27 / insulation 1,8 / 8,28	*122,28 kgCO2 eq/m2*	*0,12 W/m2.K*

FEEDBACK

Design

side insulation

exterior

The flat roofs of the various annexes were insulated from the outside. The old roof covering was cleaned, and the insulation panels were laid directly on top. This method limits the risk of internal condensation and makes it easy to connect the roof insulation to the façade insulation, which was carried out at the same time.

fixation

glue

To achieve an airtight seal, the insulation panels were fixed using PU foam. This method is not reversible, making it more difficult to reuse the panels in the future. The panels have bitumen residue that was welded on during the previous application. This layer is very difficult to remove and creates a very uneven surface.

humidity

risk

The damp problems (due to a leak) were resolved before the insulation was installed. The new waterproofing limits future risks, but the lack of mechanical ventilation increases the risk of condensation in the event of poor ventilation. This requires special attention.

choice of materials

synthetic

The available height is limited, which is why synthetic insulation was chosen. PIR boards are highly resistant to compression and provide good thermal performance with reduced thickness. They are particularly suitable for flat roofs and facilitate the installation of a stable finish. However, they offer more limited protection against summer heat.

availability

average

PIR boards are fairly readily available on the reuse market. However, they often have numerous irregularities due to the waterproofing finish applied at high temperatures or the bonding used to fix the boards together. The choice of dimensions is also limited, which complicates their reuse.

price

average

The reused PIR boards were purchased at half of the price of new materials. However, their use entailed additional costs, such as raising the hight of the parapet and higher overal labour costs for two-layer installation. In the case of this project, these additional costs resulted in a final cost higher than that of using new materials.

phase shift

low

The insulation used here contributes minimally to slowing down the heat (in summer) that passes through the roof.

thermal bridge

solved

The roof insulation must be connected to the façade insulation at the level of the parapet. Any irregularities and cracks in the insulation are compensated for by applying two layers.

Installation

state of the insulation

low

The insulation was in relatively poor condition. It had several craters, bumps and significant cracks. However, these defects can be corrected fairly easily using PU foam. Bitumen residues were also present, they first had to be removed as making the surface uneven.

dimensions

various

The choice of dimensions for reused synthetic materials is limited and depends on availability on the reuse market (in this case 8 cm panels). This may require more manipulation, as two layers often need to be installed. Furthermore, there is not always enough space available to accommodate the additional thickness.

material handling

low

Handling reused insulation vertically is not significantly different from handling new insulation.

installation

complex

New techniques allow insulation and waterproofing to be applied together, making installation quicker and easier, which is not possible with reused insulation. Furthermore, these recovered panels do not have tongue and groove joints, making them more difficult and slower to install.

nuisance

average

The composition of these materials causes skin irritation. Workers must therefore protect themselves during transport, handling and installation.

logistics

faible

Due to the small surface area of the roofs, the insulation boards could be stored directly in the garden of the construction site. This reduced transport costs.

building irregularities

average

The extension consists of three volumes of varying shapes. The roof has numerous obstacles, such as chimneys, rainwater drains and antennas. These elements complicated the installation of rigid insulation panels, which require precise cutting and careful adaptation to ensure continuous coverage.

continuity insulation

very continuous

A double layer of insulation can be beneficial in compensating for irregularities in the panels and reducing heat loss. In addition, simultaneous insulation of the façade (with new materials) ensures optimal continuity of the thermal envelope.

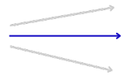
Thermal conductivity

sample preparation

complicated

Only one batch was used, which limited the number of tests that could be carried out. However, cutting the synthetic plates precisely proved to be complex.

évolution



stable

The thermal coefficient of the insulation deteriorated only very slightly compared to the same type of new material. The test results gave the same value as for new materials, with a tolerance of 5%.

défaut value

average

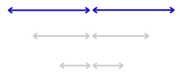
The default value applied results in an increase of approximately 30% in the thickness calculated on the basis of the actual lambda value of the insulation in question. A reference number is printed on the plate, which can be used to trace the product.

deformation

little

The panels had numerous dents and cracks, and the corners were often damaged. In addition, a large number of small holes were visible on the surface of the insulation.

variations market



average

There is a significant difference in the lambda value of PUR boards between different manufacturers and models. These values have also improved over recent years, often making older insulation less effective.

Based on all the feedback received, this implementation has been rated relatively positively.

- *The **design** of the exterior insulation system for flat roofs limits the risk of condensation and integrates well with the façade insulation, although caution is required in the absence of mechanical ventilation. Fixing with PU foam makes reuse difficult at a later date. Protection against summer heat remains limited.*
- *The **installation** was complex because of the poor condition and limited size of the panels, often requiring a double layer to be installed, which increased costs despite the reduced purchase price. The configuration of the roof, with its many obstacles, required precise adjustments to ensure thermal continuity.*
- *The **thermal conductivity** of reused panels remains stable, with performance close to that of new materials despite slight deformation and ageing.*

CONCLUSION

The installation of the reused PIR panels was similar to the installation of new insulation of the same type. The material has a stable thermal conductivity and good performance. The simultaneous insulation of the entire façade facilitates good continuity with the insulation of the roofs. However, their degraded condition and irregularities complicated the installation, requiring a double layer and increasing costs. Fixing with PU foam ensures watertightness but makes future reuse difficult. The protection against summer heat remains limited. with synthetic PU panels.

ISOL'UTION

UTILISONS DU RÉEMPLOI

ISOL'ution is a collaboration between the ATM department of the ULB, La Rue asbl, Casa Blanco and Batiterre. The project aims to test the reuse of insulation materials in energetic renovation projects in Brussels. Insulation materials are recovered, sorted, tested (mainly on their thermal conductivity) and reinstalled in homes.

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RENOLUTION .brussels

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