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.

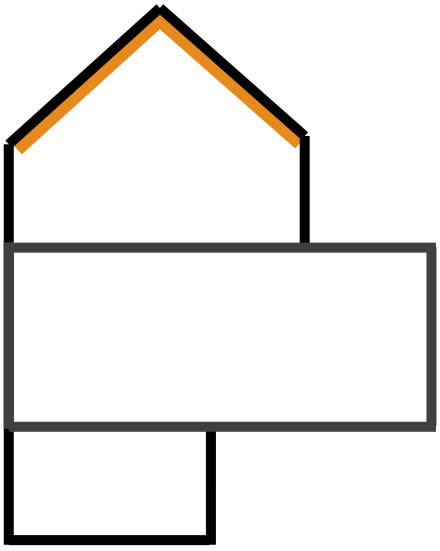
SITE 5

A COMPOSITE ROOF WITH REUSED INTERIOR INSULATION

SITUATION EXISTANT

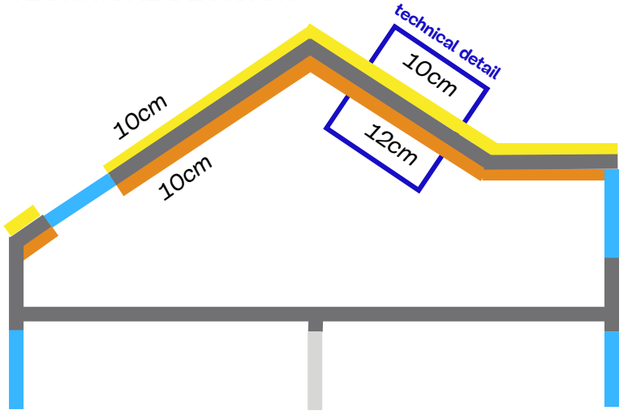
This is a house divided into two flats. Several dormer windows have been created in the existing roof. The spaces under the roof will house the kitchen and living room.

Location of intervention	*Shared house*
Affected floors	*1*
Housing units	*2*
Year of construction/major renovation	*<1930*
Type of construction	*timber frame*
Component to be insulated	*roof and dormer window*
Surface area of the envelope	*172*
Points to consider	*The beams of the wooden frame are uneven.*



Section schématique de la typologie

TECHNICAL DECISION



Schematic cross section

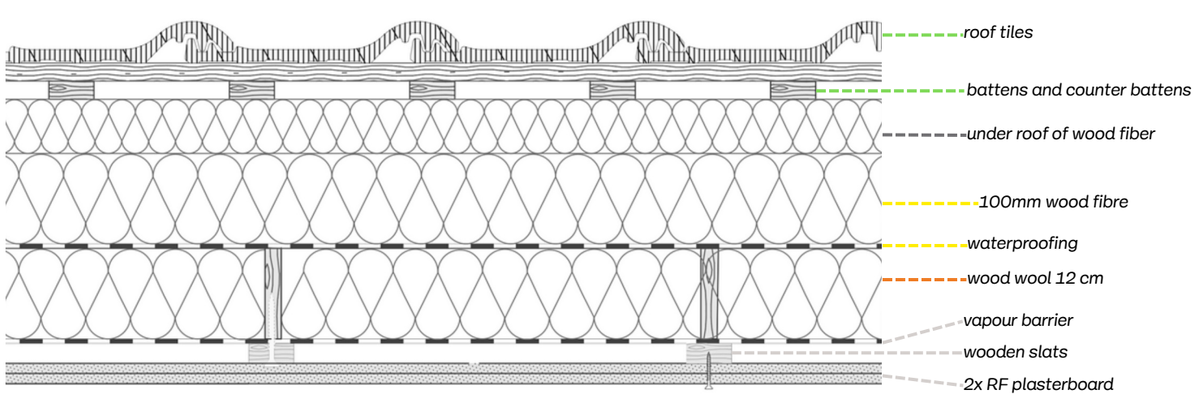
Elements to be insulated	**pitched roof**
Side of insulation	**interior (and exterior)**
Surface to be insulated	**57 m2**
Anchoring method	**stuck between the beams**
Type of insulation used	**natural wool mats**
Execution by	**Casa Blanco**

new insulation *reused insulation* *structure*

explanation of technical detail

The pitched roof was completely renovated. First, three skylights were integrated into the existing structure. The roof tiles were carefully removed, then a temporary rain screen was installed to protect the roof structure during the work. A 10 cm thick rigid wood fibre board was installed from the outside to ensure continuous insulation. A wood fibre bitumen rain screen was added to the insulation layer before the battens and counter-battens were installed.

The old tiles were then reused and replaced on the roof. Inside, flexible reused wood wool mattresses were inserted between the roof structure. These were extended using OSB panels to accommodate 10 cm of insulation on the south side and 12 cm on the north side. This difference in thickness is a consequence of the insulation available. Once airtightness was ensured, rafters were fixed in place to allow the plasterboard to be installed as the interior finish.



technical detail

REUSED INSULATION MATERIAL USED

The wood wool used on this site came from two sources. On the one hand, the insulation was recovered by Batiterre from SAAMO; on the other hand, the contractor still had surplus wood wool from previous projects. It was possible to apply insulation with a limited thickness, as it is combined with sarking insulation on the outside of the roof.

It was easier to recover a sufficient quantity of insulation material with a reduced thickness. The fact that the batches are 10 and 12 cm thick does not really pose a problem in terms of application, as they can be used on both sides of the roof (north and south).

lot 1

lot 2 et 3

lot 4

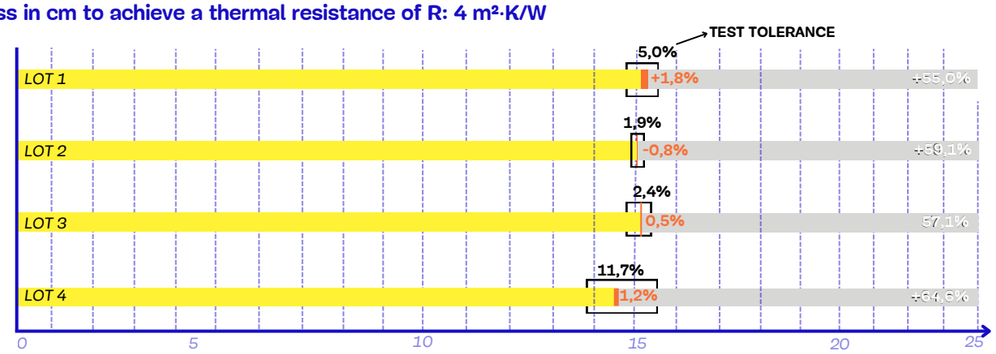
Test results of the thermal conductivity

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
Wood wool	*Natural*	*1*	*23 m2*	*10 cm*	*0,0387*	*0,038*	*0,060*	*BatiTerre*
		2	*10 m2*	*12 cm*	*0,0377*	*0,038*	*0,060*	*BatiTerre*
		3	*11 m2*	*12 cm*	*0,0382*	*0,038*	*0,060*	*BatiTerre*
		4	*10 m2*	*12 cm*	*0,0364*	*0,036*	*0,060*	*Casa Blanco*
					**1*	**2*	**3*	

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

natural wool



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.

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.

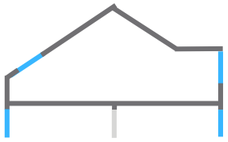
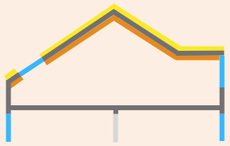
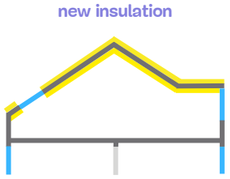
Cost comparison
This section is broken down into several sub-elements: the insulation material (I), all materials (M), labour (L) and additional costs. The price is first expressed per square meter, then as the total cost for the entire project. This allows for a clear comparison between the different 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_2 eq./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.

roof	Element composition	Area to be insulated (m²)	Thermal resistance of insulation R (m²·K/W)	Cost comparison	Environmental impact per life cycle stage (mPt/FU)	Impact per component (mPt/FU)		Impact on climate change (kg CO_2 eq./FE)	Thermal performance (W/m²·K)
initial state 	*Pitched roof with wooden structure*	*0m2*				materials **1,15** energy **187,15** **189,6**		*3856 kgCO2 eq/m2*	**7,14** *W/m2.K*
reused insulation 	*INSIDE* *+ 10 cm reused woodwool insulation* *+ vapour barrier*	*57 m2*	*lambda: 0,038* **R: 2,6** *woodfiber on the outside + 2,7*	*PRI: 109,5€/m2:* **6 241,5€** **I: 12,5€/m2: 712,5€** *M: 44,5€/m2:* **2536,5€** **L**: *65€/m:* **3705€**	maintenance *0,63* waste *1* production *1,81* energy **5,03**	materials **3,36** energy **5,11** insulation **0,09**	**8,47**	*139,8 kgCO2 eq/m2*	**0,20** *W/m2.K*
new insulation 	*INSIDE* *+ 10 cm new woodwool insulation* *+ vapour barrier*	*57 m2*	*lambda: 0,036* **R: 2,8** *woodfiber on the outside + 2,7*	*PRI: 117€/m2* **6669€** **I: 20€/m2: 1140€** *M: 52 €/m2:* **2964€** *L: 65€/m:* **3705€**	maintenance *0,63* waste *1* production *2* energy **5,03**	materials **3,63** energy **5,03** insulation **0,36**	**8,66**	*140,2 kgCO2 eq/m2*	**0,19** *W/m2.K*

FEEDBACK

Design

side insulation

composed

The roof was insulated from the inside and outside, ensuring a continuous thermal envelope. This approach also facilitates connection with the interior insulation of the façades and optimises the space between the beams. Composite insulation offers real technical advantages, its execution is relatively expensive .

fixation

between rafters

The insulation was wedged between the roof beams, which were extended using OSB panels to achieve a thickness of 10 cm and 12 cm. Once the airtight seal had been achieved, battens were laid to hold the insulation in place and secure the finishing panels.

humidity

low

Thanks to continuous sarking insulation, advanced airtightness and the implementation of a ventilation system, the risk of moisture problems is limited.

choice of materials

natural

Wood wool was chosen for its positive environmental impact, its moisture regulation capabilities and its high inertia.

availability

low

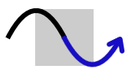
Natural insulation materials are not frequently available on the reused materials market. However, only a thin layer of insulation was needed on the inside in this project, which made it easier to find the appropriate insulation materials.

price

high

Natural insulation materials are more expensive than other types of materials. The demand for these materials is quite high. They were recently introduced to the market, so their condition remains very similar to that of new materials. These factors explain why the price of reused materials is often close to that of new insulation materials.

phase shift



high

This design, with continuous sarking insulation and interrupted natural wool insulation on the inside, offers exceptional heat control, with a phase shift of 14.5 hours. This is thanks to the high density of the materials used.

thermal bridge

resolved

Wood fibre panels were installed continuously across the entire structure. In addition, the wood wool used on the interior can be more easily connected to the façade insulation (also from the inside) to ensure a continuous insulation without thermal bridges.

Installation

state of the insulation

high

The insulation materials are still in very good condition. This is largely explained by the fact that wood wool is quite recently produced.

dimensions

divers

The recovered insulation is 10 and 12 cm thick. The roof was thus insulated 2 cm thicker on the north side than the south side, as heat loss is greater there.

material handling

average

The insulating mattresses were cut to a size slightly larger than the width available between the beams and then inserted between them. The flexibility of wood wool makes it easy to handle, unlike rigid wood fibre panels, for example.

installation

simple

Wood wool is very easy to install in a wooden structure because the distance between the beams of the frame is not too wide. The mattresses are therefore easily held in place.

nuisance

low

Handling reclaimed insulation mats produces slightly more dust than handling new insulation. It is therefore important to avoid breathing in the dust and to protect workers' eyes. The impact of installing natural insulation on workers' health is significantly lower than that of mineral insulation.

logistics

average

The insulation came from two sources located close to each other. The logistics for this project were therefore not very complex. The materials were supplied well in advance to ensure the necessary quantity of this relatively rare type of insulation. They therefore had to be stored for a long period of time.

building irregularities

average

Except that the old beams of the roof structure were quite deformed by time, this building is relatively uniform and easy to insulate.

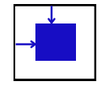
continuity insulation

very continuous

Roof insulation can easily be connected to the insulation of the façade (on the inside), as the roof is insulated on both sides. The continuity of the insulation is guaranteed by the continuous wood fibre board on the outside of the structure.

Thermal conductivity

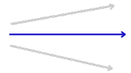
sample preparation



simple

The samples were cut fairly easily to the exact dimensions required to perform a thermal conductivity test.

évolution



very stable

The thermal coefficient of the insulation is very stable over time compared to new insulation of the same type. On average, performance has deteriorated by only 1%. This can be explained by the recent nature of these materials.

défault value

bug different

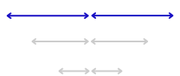
The additional thickness based on the default lambda value is high for wood wool. In this case, an additional thickness of 55 to 65% should be added if the thickness is calculated based on the default lambda value. There is a wide variety of natural insulation materials available on the market.

deformation

average

Despite the good condition of this material, the corners are slightly damaged and the material has lost some of its thickness in the middle.

variations market



large

The market offers a wide variety of natural insulation materials. These materials differ greatly in terms of binder type, characteristics, density, recognition, etc.

Based on feedback from all experiments, this implementation has received an overall positive evaluation.

- The **design** *and choice of insulation applied both inside and outside the structure offer several advantages: easier interior installation, good continuity of the thermal envelope with minimal thermal bridging, effective protection against summer heat, and a limited risk of moisture-related issues. Although this type of insulation is uncommon in the reuse market, the low thickness required made it straightforward to source the necessary quantity.*

- **Installation** *proceeded smoothly due to the high quality and dimensional consistency of the recovered materials. Their natural composition also minimizes discomfort for the workers handling the materials.*

- The **thermal conductivity** *of the material remained stable. However, the default thermal conductivity value used in the absence of precise data remains a limitation, as it does not reflect the performance differences among the various types of bio-based insulation materials available.*

CONCLUSION

The pitched roof was insulated both on the inside and outside, ensuring excellent thermal continuity and good protection against summer heat. Despite the higher cost of this approach, installation was facilitated by the quality and uniformity of the reused materials.

Site logistics were facilitated the locally sourced materials. The thermal performance of the wood wool insulation remained stable, although the default values applied to this type of material are not representative of its actual qualities.

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.

This project is funded by Bruxelles Environnement under the RENOLAB.ID call. This report was translated as part of the Circular Building Coalition 2025 Open Call. The Circular Building Coalition is supported by the Laudes Foundation.

RENOLUTION .brussels

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