

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 8

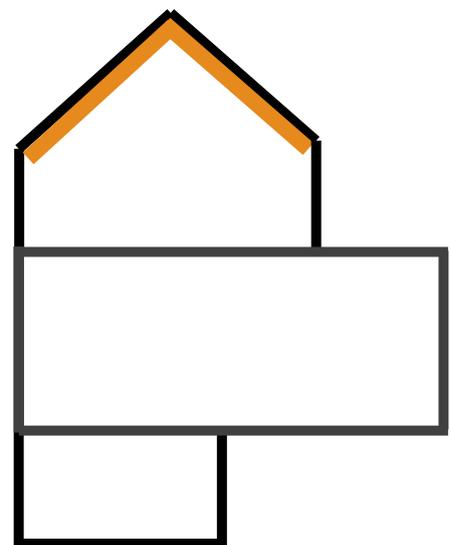
INSULATION OF ROOF FROM THE INSIDE



EXISTING SITUATION

Occupied attic space, with a bedroom and bathroom. Historic dormer window on the street side.

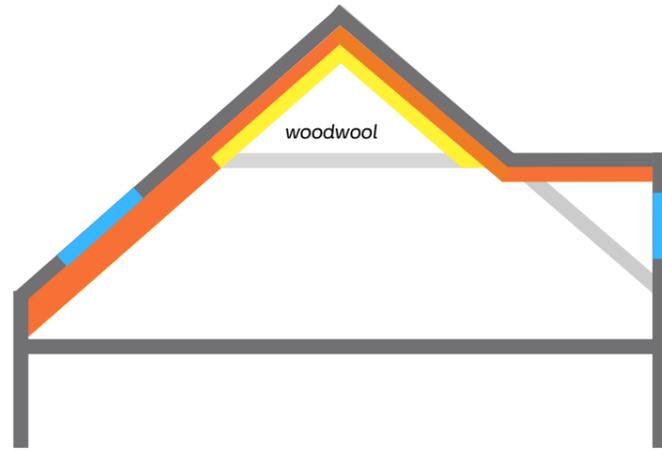
Location of intervention	single family housing
Affected floors	3
Housing units	1
Year of construction/major renovation	1898
Type of construction	timber frame
Component to be insulated	roof
Surface area of the envelope	150
Points to consider	slightly damaged roof-underlayer



Section schématique de la typologie

TECHNICAL DECISION

Elements to be insulated	roof
Side of insulation	interior
Surface to be insulated	65 m2
Anchoring method	between the beams and fixed with screws
Type of insulation used	rock wool + synthetic panels
Execution by	Self-renovation



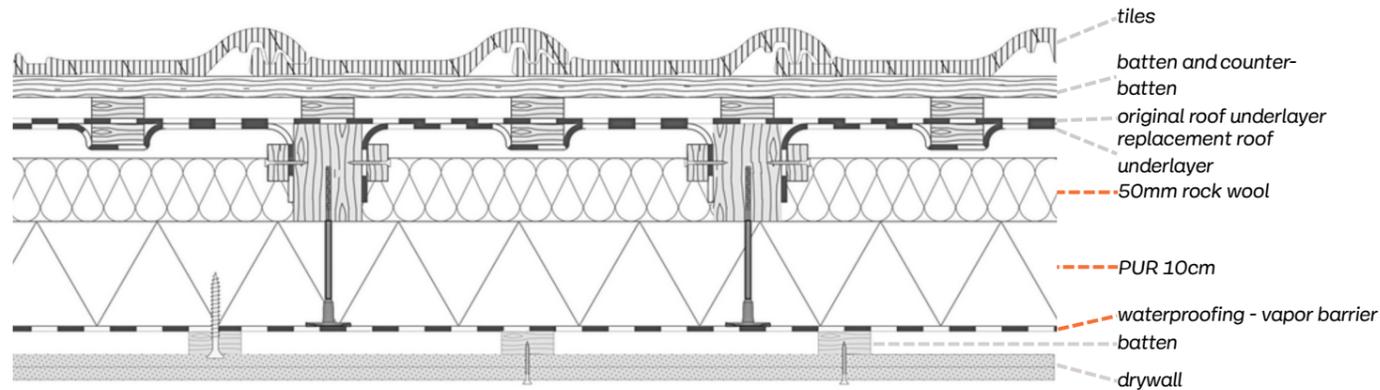
● window ● reused insulation ● new insulation ● structure

Schematic cross section

Explication détail technique

The existing under-roof layer was slightly damaged. These defects were first repaired, battens were installed to drain any water that might have ended up behind the original under-roof and a substitute under-roof layer was installed to protect the insulation from rain and to make the assembly fully watertight. Between the joists, 6 cm of rock wool was sandwiched. The rigid synthetic insulation panels were then fixed over

the entire surface. When combining several insulation materials, the most vapour-permeable material must be placed on the cold side. An airtightness layer must be installed over the entire surface. This barrier should not be hygrovariable when combined with an original under-roof layer. Finally the finishes were installed.



technical detail



MATÉRIAUX D'ISOLANT DE RÉEMPLOI UTILISÉ

By choosing to keep the existing roof underlayer and insulate from the inside, the risk of water penetration into the roof is significantly higher. The ceiling height was limited in certain locations. A solution that was both effective and moisture-resistant was therefore sought. Rock wool

was sandwiched between the roof-beams, which was easy to install due to the flexibility of the material. Underneath, a combination of PUR and PIR panels was picked because they were easily available and also for their high thermal resistance.



lot 1



lot 2



lot 3

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.

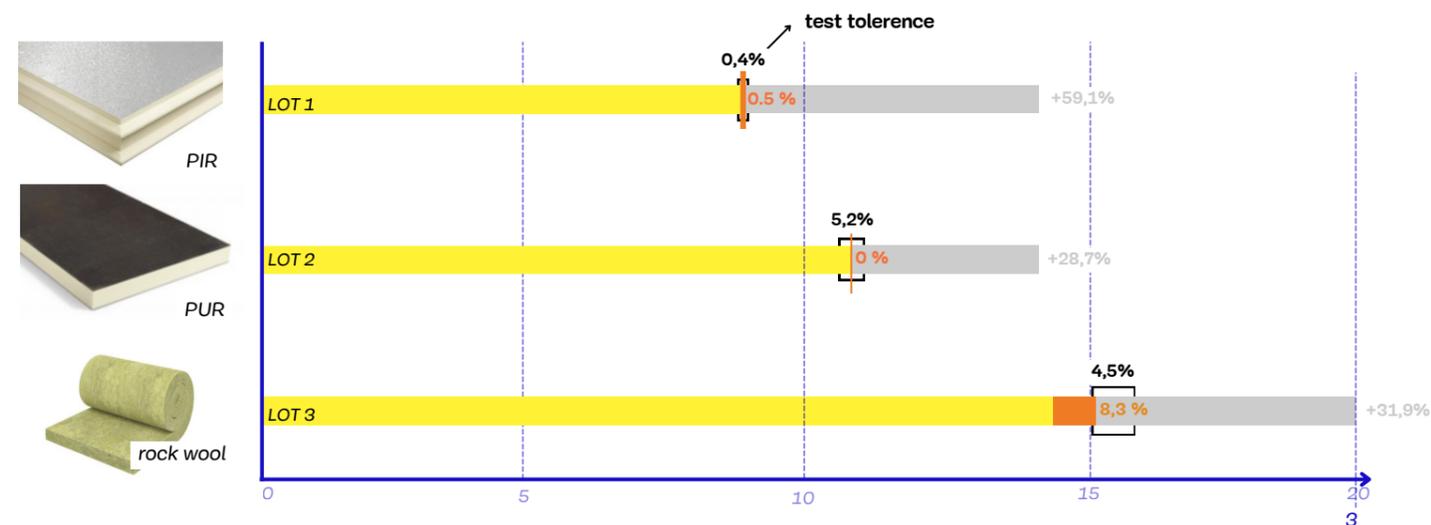
Materials	type	lot	quantity	thickness	average lambda test	new lambda	default value	supplier
PIR	synthétique	1	m2	10 cm	0,0223	0,022	0,035	Seconde Main
PUR	synthétique	2		8 cm	0,0272	0,027	0,035	Trovo
laine de roche	minérale	3		5cm	0,0379	0,038	0,050	BatiTerre

*1

*2

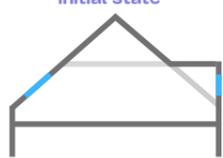
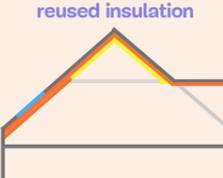
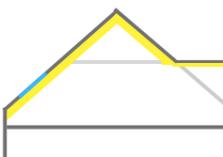
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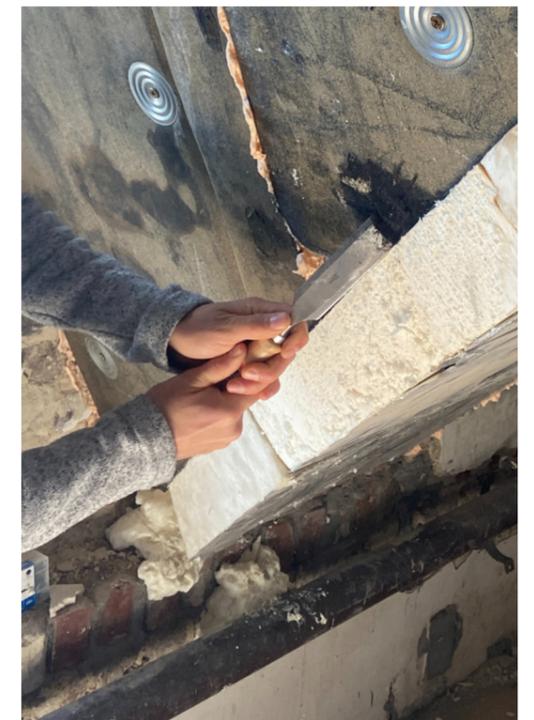
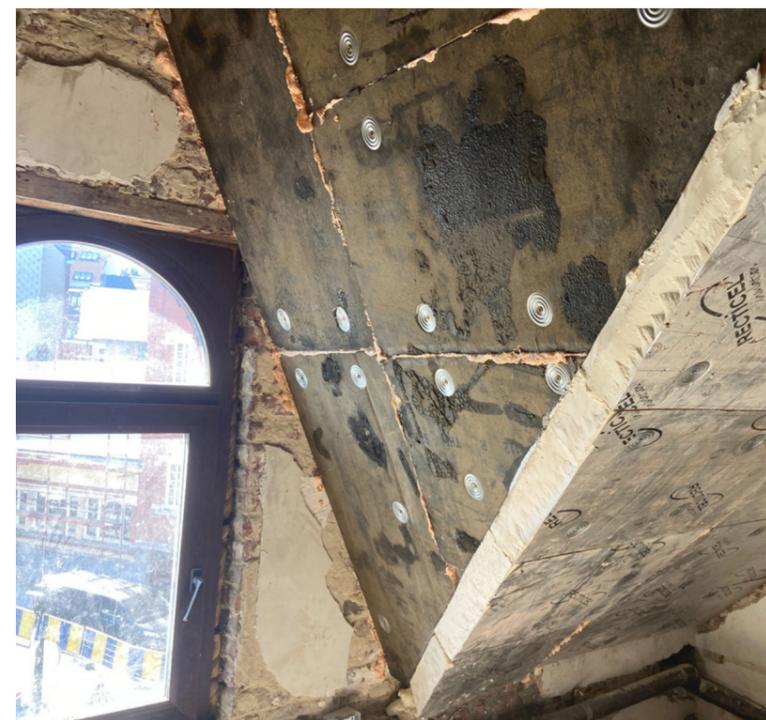
Insulation thickness in cm to achieve a thermal resistance of R: 4 m²-K/W



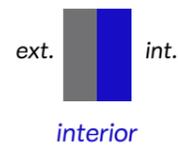
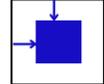
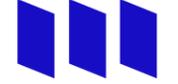
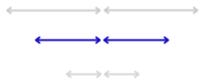
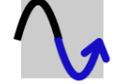
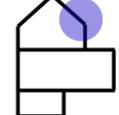
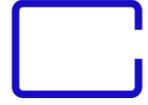
RENOVATION SCENARIOS

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)	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)
<p>initial state</p> 	Roof with wooden structure Damaged roof underlayer	0m2				<p>materials 0,29</p> <p>energy 187,13</p> <p>187,42</p>	3834.7 kgCO ₂ eq/m ²	7.14 W/m ² .K
<p>reused insulation</p> 	INSIDE replacement roof underlayer + 6 cm rock wool + 8 cm PUR + vapor barrier	65 m2	lambda: 0,0379 (laine) 0,0272 (PUR) R: 4,77	PRICE: 38,8€/m2: 2523€ I: 4,6€/m2: 299€ M: 36,6€/m2: 2379€ L: 0€/m: 0€ transport: 150€	<p>production 2,7</p> <p>energy 5,39</p> <p>maintenance 0,7</p> <p>waste 0,7</p>	<p>materials 1.69</p> <p>energy 5,39</p> <p>insulation 0.38</p> <p>7,06</p>	132.4 kgCO ₂ eq/m ²	0.21 W/m ² .K
<p>new insulation</p> 	INSIDE replacement roof underlayer + 6 cm rock wool + 8 cm PUR + vapor barrier	65 m2	lambda: 0,038 (laine) 0,027 (PUR) R: 4,54	PRICE: 44€/m2 2860€ I: 12€/m2: 780€ M: 44 €/m2: 2860€ L: 0€/m: 0€	<p>production 2,7</p> <p>energy 5,39</p> <p>maintenance 0,7</p> <p>waste 0,7</p>	<p>materials 4,37</p> <p>energy 5,39</p> <p>insulation 3.06</p> <p>9,76</p>	151.6 kgCO ₂ eq/m ²	0.21 W/m ² .K



FEEDBACK

Conception	Mise en œuvre	Conductivité thermique
<p>side insulation</p>  <p>interior</p> <p>To save money and preserve the existing roof tiles, the roof was insulated from the inside. Great care must be taken to ensure airtightness and proper connections between the different layers.</p>	<p>state of the insulation</p>  <p>average</p> <p>The rock wool and PIR panels were in very good condition. The PIR panels even still had their tongue and groove. The PUR panels, on the other hand, were in poorer condition. They still contained bitumen residues, which had to be removed.</p>	<p>sample preparation</p>  <p>high</p> <p>Due to the variety of the materials, the testing process became much more complex. This was also a consequence of the two relatively small batches of synthetic boards.</p>
<p>fixation</p>  <p>sandwiched</p> <p>The rock wool was simply inserted between the wooden beams of the roof. The PUR boards were fixed with screws using a thermal break system. Both applications are easily reversible and allow for potential future reuse.</p>	<p>dimensions</p>  <p>uniform</p> <p>The PUR and PIR panels had different thicknesses, but since they were used on other parts of the roof, this did not really pose an issue. Rock wool, on the other hand, has very uniform dimensions.</p>	<p>évolution</p>  <p>stable</p> <p>The different insulation materials had a thermal conductivity very similar to that of equivalent new materials.</p>
<p>humidity</p>  <p>high risk</p> <p>This application presented a high risk of moisture-related problems. The original under-roof layer was damaged, and a bathroom is present in the attic. PUR and PIR panels, when combined with a highly performant airtightness layer, can avoid moisture penetrating the complex, if they are installed in a completely airtight manner.</p>	<p>material handling</p>  <p>average</p> <p>Due to the regular structure, the materials only had to be modified to a limited extent.</p>	<p>défaut value</p>  <p>average</p> <p>PIR panels are a highly efficient insulation material. Consequently, the drawback of using the default value is very high (almost 60%), but this material has surface markings that indicate the exact type. For the other materials, the effect of applying the default value is similar to that of most materials.</p>
<p>choice of materials</p>  <p>synthetic + mineral</p> <p>Rock wool was chosen mainly because it could be easily installed between the roof structure. PUR boards were selected for their high resistance to moisture and their high thermal performance.</p>	<p>installation</p>  <p>simple</p> <p>Installing these materials is very easy. Simply place the rock wool between the structure and screw in the synthetic sheets. The owner, who has no special technical training, carried out this work himself.</p>	<p>deformation</p>  <p>average</p> <p>The rock wool and PIR panels are in very good condition and therefore only slightly deformed. The PUR panels, on the other hand, were in poorer condition and more deformed along the edges, with some of the thickness lost due to the continuous weight applied on the surface.</p>
<p>availability</p>  <p>very available</p> <p>Rock wool is widely available on the reuse materials market, particularly in smaller thicknesses, as was the case for this project where the insulation was inserted between the 8 cm roof structures. PUR boards are also widely available, although they are not always in very good condition.</p>	<p>nuisance</p>  <p>average</p> <p>A small amount of dust was released during the installation of the rock wool, and the bitumen residues also caused a nuisance (especially in terms of odor).</p>	<p>variations market</p>  <p>little</p> <p>Between the different types of rock wool, the thermal conductivity and properties vary little. The properties of synthetic boards, on the other hand, vary much more.</p>
<p>price</p>  <p>cheap</p> <p>The materials were recovered at a reduced price. Since the owner carried out the works himself, the additional work required due to irregularities in the insulation materials did not result in extra costs.</p>	<p>logistics</p>  <p>low</p> <p>The PIR and PUR panels had been in storage for some time, which were surplus from another construction site. The rock wool came from BatiTerre, located in the same building as the rest of the storage. Having all the materials in one place greatly simplified the logistics of the construction site.</p>	<p>Based on all the feedback, this implementation can be given an overall positive assessment.</p> <ul style="list-style-type: none"> • The design, with rock wool inserted between the joists and synthetic boards (PUR/PIR) placed underneath, provides good insulation continuity and material reversibility, despite a significant moisture-related risk, particularly due to the damaged under-roof layer and the presence of a bathroom in the attic. • The installation was relatively straightforward thanks to materials that were generally in good condition, had regular dimensions, and a fairly simple roof geometry, although some inconveniences (dust, bitumen residues) were observed. • The thermal conductivity of the tested materials is close to that of new products, with good thermal stability. The variety of materials, however, made the testing process more complex.
<p>phase shift</p>  <p>little</p> <p>Rock wool and PUR provide less effective protection against summer heat. On the upper part of the roof, wood fibre insulation is used instead of PUR to improve summer comfort and because the available height allowed for it.</p>	<p>building irregularities</p>  <p>low</p> <p>The shape of this building is relatively regular. The beams are spaced at very regular intervals. The pointed dormer window had a rather specific shape, which complicated the insulation of the interior of the dormer window.</p>	
<p>thermal bridge</p>  <p>présent</p> <p>The facade insulation was also applied from the inside and could therefore be easily connected to the roof insulation. The roof contains a large-sized beam, wider than the insulation layer, thus forming a thermal bridge with the rest of the structure. The party walls are not yet insulated, which results in a temperature difference between these two surfaces.</p>	<p>continuity insulation</p>  <p>continue</p> <p>The insulation was applied continuously. It was interrupted only at the level of the roof's load-bearing beam.</p>	

CONCLUSION

The insulation of the roof from the inside was relatively straightforward thanks to the regular shape of the roof. The existing, slightly damaged roofing was retained and reinforced, allowing the tiles to remain in place. This reinforcement of the under-roof layer is, however, a temporary solution and will need to be replaced in the

future when the roof finish is renewed from the outside. The reused materials, particularly the rock wool and PIR, were in good condition and easy to install. As a result, the works could be self-executed by the owner. The thermal performance of the reused materials is comparable to that of new products.



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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