

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 2

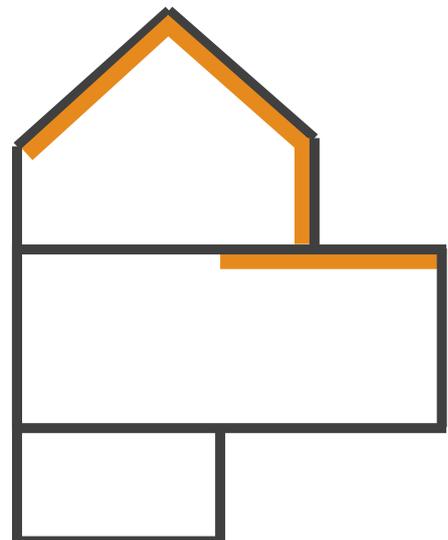
ISOLATION OF A PITCHED ROOF



EXISTING SITUATION

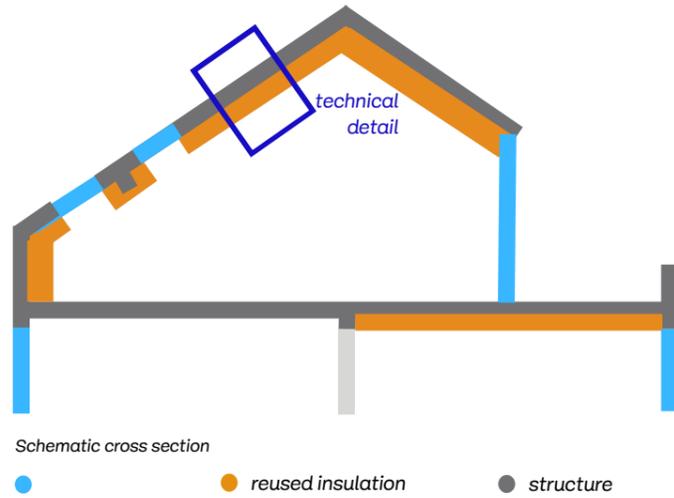
Duplex located on the top two floors of a jointly owned property. The owners favor natural insulation materials for the roof.

Location of intervention	house divided into several units, with shop on the ground floor
Affected floors	2
Housing units	3
Year of construction/major renovation	1930
Type of construction	Original timber structure
Component to be insulated	pitched and flat roof
Surface area of the envelope	200 m ²
Points to consider	the irregularity of the existing structure



Section schématique de la typologie

TECHNICAL DECISION

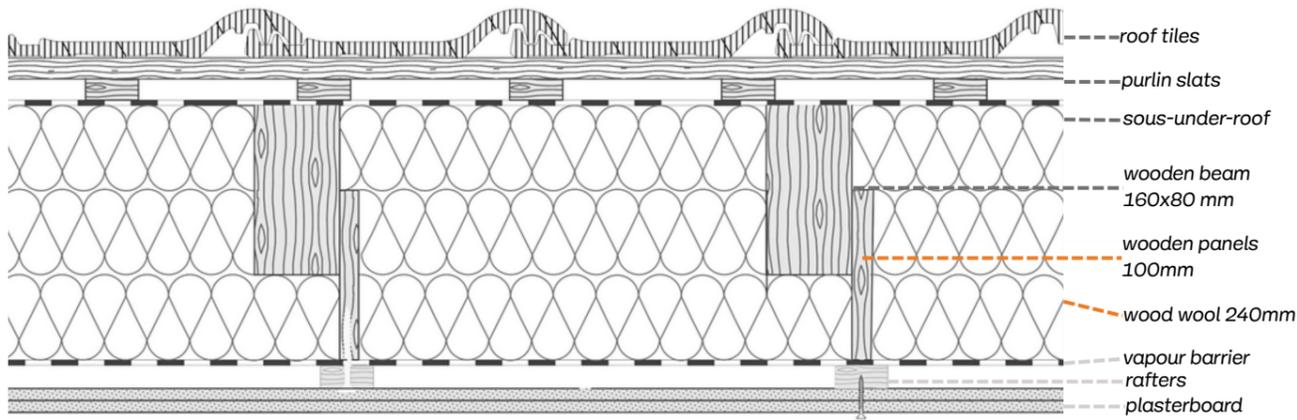


Elements to be insulated	pitched and flat roof
Side of insulation	interior
Surface to be insulated	78 + 20 m ²
Anchoring method	stuck between wooden beams
Type of insulation material	natural wood and grass wool insulation
Execution by	Casa Blanco

Explanation of technical details

The project involves the conversion of a duplex apartment located on the top two floors of a co-owned building. The owners are particularly concerned about indoor air quality and the environmental performance of the project. With this in mind, they have opted for natural insulation materials, which guarantee both low CO₂ emissions and good thermal phase shift, which is advantageous for summer comfort in living spaces under the roof.

The existing wooden frame was partially extended in order to achieve sufficient room for the insulation. Bio-based insulation mats are inserted between the beams. The creation of a terrace within the roof volume requires particular attention to the connection between the insulation. In order to ensure the continuity of the thermal envelope and avoid thermal bridges, the insulation overlaps by at least 1 metre on the ceiling of the lower level.



technical detail



flat roof insulation



insulation of pitched roofs

REUSED INSULATION MATERIAL USED

This project required a significant amount of insulation material, partly due to the large surface area of the roof and partly due to the high thermal performance demands: a thermal resistance (R) of 6.5 was achieved, requiring a minimum insulation thickness of 26 cm.

The reused insulation materials come from three different sources. A combination of wood wool and grass wool mattresses was used. These two types of materials have compatible characteristics and can be combined without compromising the overall performance of the insulation system.



lot 1



lot 2



lot 3

Test results of the thermal conductivity

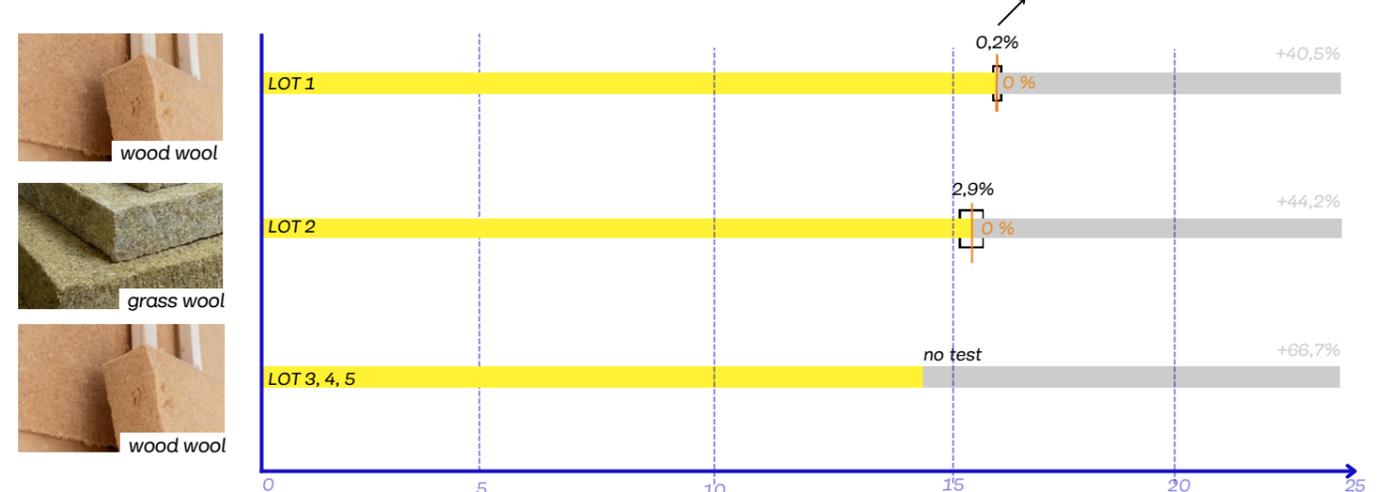
The table below consists of two parts. First, it lists the materials used and their technical characteristics. Secondly, their thermal resistance is compared using different lambda (thermal conductivity) values and different thicknesses. The thickness of the insulation panels is calculated based on the 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
wood wool	natural	1	34 m ²	14cm	0,042	0,042	0,060	BatiTerre
grass wool	natural	2	57 m ²	18 cm	0,041	0,041	0,060	Natura Mater
wood wool	natural	3	17 m ²	8 cm	/	0,036	0,060	Colisuem, surplus from the building site, still packaged
		4	16 m ²	14 cm	/	0,036	0,060	
		5	13 m ²	22 cm	/	0,036	0,060	

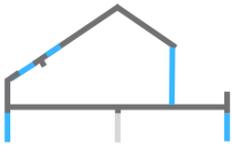
*1 *2 *3

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



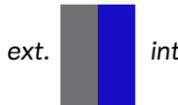
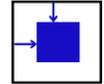
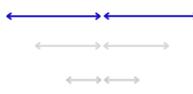
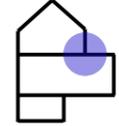
RENOVATION SCENARIOS

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 (m ²)	Thermal resistance of insulation R (m ² ·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/m ² ·K)
<p>initial state</p> 	Wooden frame structure	0m ²				<p>materials 0,3</p> <p>energy 187,1</p> <p>187,4</p>	3834kgCO ₂ eq/m ²	7,14 W/m ² ·K
<p>reused insulation</p> 	ON THE INSIDE + woodwool and grass wool insulation +vapor barrier	98 m ²	lambda: 0,0396 R: 6,55	PRICE: 84€/m ² : 8139,8€ I: 19€/m ² : 1843€ M: 44€/m ² : 4 268,00€ L: 57,6€/m ² : 3 541,8€ transport 330€	<p>maintenance 0,7</p> <p>waste 1,32</p> <p>production 0,14</p> <p>energy 4,9</p>	<p>materials 1,9</p> <p>energy 4,9</p> <p>insulation 0,22</p> <p>7,06</p>	121,83 kgCO ₂ eq/m ²	0,19 W/m ² ·K
<p>new insulation</p> 	ON THE INSIDE + woodwool and grass wool insulation +vapor barrier	98 m ²	lambda: 0,038 R: 6,84	PRICE: 83,6€/m ² : 9078,50€ I: 32€/m ² : 3136€ M: 57€/m ² : 5529€ L: 41 €/m: 4018€	<p>maintenance 0,7</p> <p>waste 1,32</p> <p>production 0,8</p> <p>energy 4,9</p>	<p>materials 2,82</p> <p>energy 4,9</p> <p>insulation 0,88</p> <p>7,72</p>	126,94 kgCO ₂ eq/m ²	0,19 W/m ² ·K



FEEDBACK

Design	Installation	Thermal conductivity
<p>side insulation</p>  <p>interior</p> <p>Insulation along the interior surface requires special attention to airtightness, which is why a vapour barrier was necessary. Nevertheless, insulation on the interior side is easy to install, particularly if the ceiling height is high. This application helps to preserve the roof tiles, provided they are still in good condition.</p>	<p>state of the insulation</p>  <p>high</p> <p>The natural wool was still in very good condition. The material had not lost much of its quality during its first use. The material is not very old.</p>	<p>preparing samples</p>  <p>average</p> <p>Natural insulation mattresses are much easier to handle in order to obtain a sample of the right size than with sheet material.</p>
<p>fixation</p>  <p>between structure</p> <p>The insulation is inserted between the structural beams of the roof, which have been extended using OSB panels to achieve a thickness of 24 cm. Once the airtight seal has been achieved, battens are installed to hold the insulation in place and secure the finishing panels.</p>	<p>measurements</p>  <p>average</p> <p>Many insulation materials of different sizes were recovered. However, this is not a significant problem as the mattresses are easy to handle and cut in both directions.</p>	<p>evolution</p>  <p>very stable</p> <p>Reused natural insulation mattresses retain their lambda value very well. However, it should be noted that these products have not been on the market for very long and they are therefore not very old.</p>
<p>humidity</p>  <p>average</p> <p>The kitchen is located directly under the roof. A good moisture control system is therefore necessary. In this case, this includes a hydro-variable vapour barrier, an air extraction system and ventilation grilles in the new windows.</p>	<p>material handling</p>  <p>average</p> <p>Reused mattresses are often more flexible and tear more easily when sawing. This complicates handling them and increases the time needed to work with them. However, during this project, it caused only minor disruption.</p>	<p>default value</p>  <p>high</p> <p>The default value applied in cases where the brand/model is unknown is very penalising in the case of natural insulation materials.</p>
<p>choice of materials</p>  <p>natural</p> <p>The choice of natural wool insulation was in line with the owner's ecological convictions and desire to ensure good indoor air quality, regulate humidity and provide effective protection against summer heat. In this case, a combination of wood wool and grass wool was used.</p>	<p>installation</p>  <p>average</p> <p>Recovered mattresses sometimes need to be cut horizontally to achieve the required dimensions, which is more complicated than cutting vertically.</p>	<p>deformation</p>  <p>low</p> <p>Apart from slight deformation at the corners, the insulating mattresses retained a very stable shape during installation.</p>
<p>availability</p>  <p>low</p> <p>A large quantity of materials was required, which was not obvious, as natural wool is not widely available on the reuse market. The insulation materials for this project came from three different sources. Finding these materials required a lot of work.</p>	<p>nuisances</p>  <p>low</p> <p>Handling reused insulation produces slightly more dust than new insulation. As with new insulation, it is important not to breathe in the dust and to protect your eyes. The impact of installing natural insulation on workers' health is significantly less than that of mineral insulation.</p>	<p>market variation</p>  <p>average</p> <p>There is a significant difference in lambda value between different manufacturers and models of natural insulation materials.</p>
<p>price</p>  <p>high price</p> <p>Natural insulation materials are more expensive. These materials are not very old, so their condition when reused is very similar to that of new materials. The initial price of natural insulation is quite high and demand for these materials is high. These factors explain why the price of reuse is often close to that of new insulation materials.</p>	<p>logistics</p>  <p>high</p> <p>The insulation came from three different sites, including one outside the Brussels region. This dispersion led to logistical challenges and additional transport costs. Due to the scarcity of this material on the reuse market, its early acquisition and prolonged storage also generated additional costs.</p>	<p>Based on all the observations from these experiences, this implementation has received an overall positive assessment.</p> <ul style="list-style-type: none"> The interior design with vapour barrier ensures good airtightness and preserves the existing elements, while limiting thermal bridges by raising the rafters with OSB panels. The natural insulation materials chosen offer good hygrothermal comfort and effective phase shift against summer heat. Natural insulation materials are more expensive and have limited availability on the circular materials market, mainly due to the very large amount of insulation required for this project. The installation was facilitated by the relatively good condition of the reused materials and their flexible format, although cutting the materials horizontally and the deformation of the beams complicated the work. Handling generates a little more dust, but without any major impact. The thermal conductivity remained stable, although performance was slightly lower than that of new mattresses, mainly due to the diversity of the materials' origins.
<p>phase shift</p>  <p>large</p> <p>The natural insulating materials used have a high thermal phase shift. This is very beneficial against overheating in summer.</p>	<p>building irregularities</p>  <p>high</p> <p>The old beams of the roof that were integrated in the roof complex, are very irregular, making it difficult to achieve a flat surface during finishing. This resulted in a significant variation in insulation thickness, ranging from 32 to 24 cm, thus requiring more materials to achieve the minimum thickness required.</p>	
<p>thermal bridge</p>  <p>solved</p> <p>When creating a terrace in a building (where external insulation is not possible), it is essential to overlap the insulation of the ceiling of the lower floor by at least 1 meter. The elements used to extend the beams must be thin in order to avoid thermal bridges.</p>	<p>insulation continuity</p>  <p>relatively continuous</p> <p>The insulation was placed between the wooden rafters, which creates a slight thermal bridge. However, raising the rafters with thin OSB boards limits these losses, and the thick layer of insulation effectively compensates for them.</p>	

CONCLUSION

The thermal conductivity of the natural insulation remained stable, reflecting the quality and recent production moment of these materials. The installation was similar to that of new insulation, ensuring a good thermal performance. However, limited availability on the

reuse market made collecting the materials a long and complex process, requiring prolonged storage and generating high transport costs. Despite this, the use of these natural insulation materials improves the building's hygrothermal performance and durability.



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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