Half-timberframed house in Alken, Belgium

Author: Nathalie Vernimme (Flanders Heritage Agency)

Wood fibre boards and internal mineral wool insulation

Walls

What is the solution?

The solution consists in insulating a timber-framed wall (wooden truss, loam and wickerwork) with a combination of wood wool fiber boards and a clay plaster finish in the framework and a retention wall with mineral wool insulation at the interior side. A pipe -service -pillar was provided on the inside. The visual perception of the wall seen from the exterior has not altered. The truss structure is not visible on the inside of the wall. The modifications made to the wall in function of energy-efficiency were approved by the conservation authority. Different scenarios where possible for the filling of the wooden truss: 1.) re-installation of the traditional wickerwork and loam, with or without extra insulation from the inside 2.) filling the compartments with wood fibre insulation boards or wood wool 3.) a filling with lime hemp blocks The first scenario was not chosen because the fear of high maintenance, concerns about insulation values and the labour-intense and therefore expensive installation. The third scenario was a plausible solution, but the architect chose the second scenario (wood fibre board is less expensive and easier to handle than hemp blocks). The steps described in the restoration file where the following: tensioning and bracing of the truss structure, after which the half timbering could be repaired, cleaned, restored and treated. For the replacements of deteriorated or damaged parts, the same type of wood (oak) in the same dimensions would be provided. After this the insulation of the truss structure

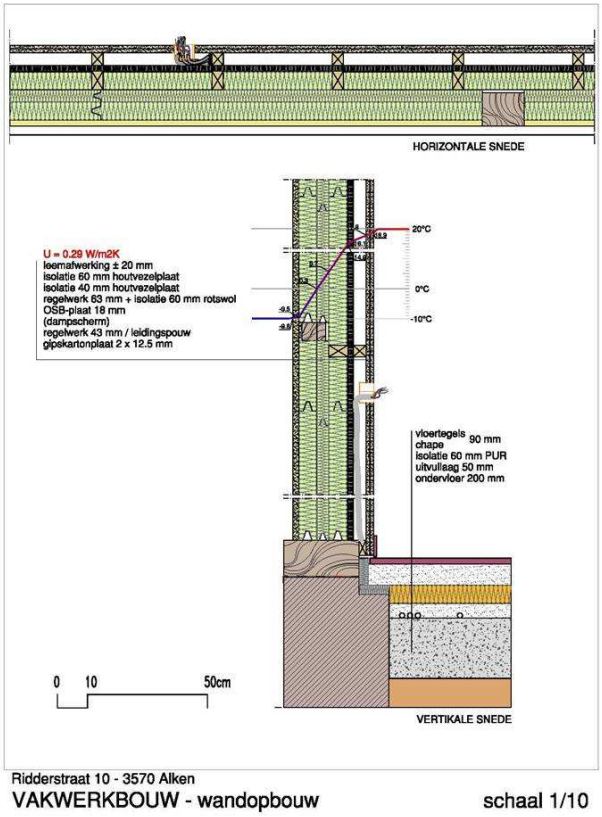
could be executed by filling in the boxes with wood fibre insulation boards, and an extra wood fibre board, to be finished with a render.

Cross section of the wall build-up, available pictures of the solution:

Details of the original wall composition with wooden fence, visible wickerwork and loam (copyright Erfgoed en Visie bvba)

Original wall build-up *(outside to inside)*	Outermost	Rendered	2-4 cm	finishing: loam
	Layer 2	Other	10-14 cm	filling of framework structure: loam + wooden fence
	Layer 3	material	thickness	
	Layer 4	material	thickness	
	Layer 5	material	thickness	
	Layer 6	material	thickness	
	Innermost	Plastered (o	2-4 cm	finishing

Original wall build-up



Cross-section for the retrofitted wall insulated with wood wool fiberboards and mineral wool

Rear wall of the half timber-framed house in Alken during intervention

Half timber-framed house in Alken before restoration in 2016

Half timber-framed house in Alken after restoration in 2016

Why does the solution work in terms of compatibility with conservation, moisture safety and energy improvement?

The natural structure of the fiberboard insulation and the clay plaster, with its humidity regulation properties, ensures a stable moisture balance and vapor tension regulation of the wall. Water vapour can get in and it can just as easily get out. This makes it well adapted to the hygrothermal behavior of heritage buildings. The wood fiber boards are used to create a weather tight shell that keeps the building warm in winter but, as importantly, cool in summer. The moisture can be managed with a vapour (internal sheet of OSB) control layer to avoid internal condensation. As it is crucial when retrofitting to have an airtight building envelope, this kind of insulation technique has to come with an airtightness barrier. The main purpose of the retention wall, filled with rock wool insulation at the interior side of the wall was extra acoustic insulation.

Description of the context:

This half timber-framed, rendered vernacular detached building with late 17th century core is situated in the village centre of Alken. Alken is a small village with 11.500 inhabitants situated in the fruit region Haspengouw in the province of Limburg in Flanders, Belgium. The village was first mentioned in documents in 1066. It developed in the valley of the river Herk. The type of architecture is a double house with an increased ground floor. It consists of 8 bays and one building layer. The half-timbered construction was once typical and characteristic for the entire building territory of Alken. The building is one of the only 3 remaining half timber-framed houses in Alken. The building was out of use and in a very bad state at the moment of renovation. It was almost completely stripped down to the bearing structure. The purpose of the total building renovation (including improvement of energy performance and comfort) was residential reuse. From a heritage point of view the renovation of

the walls had to be performed with artisanal techniques and materials of the same kind and dimensions, the restoration of the structure - where needed - and the preservation (as much as possible) of the wooden style and framework of the outer walls.

Pros and cons of the solution:

The pros for this solution are: the wood fiber insulation boards are a natural product, and have a good Life Cycle Assessment over the whole life time, have a good fire resistance and excellent hygroscopic properties, so the risk of damage to the building envelope is reduced. The wood fiber insulation boards have a high thermal performance and offer acoustic insulation. The boards ensure an easy and safe installation. They can be cut to shape without producing irritating fibers and don't need extra support, the boards won't fall or sag. The rock wool is made for 70-90% % out of recycled material, acts as a sound insulator, has a good fire-resistance, is mildew resistant, is moisture resistant and vapor permeable and is easy to install. The characteristic timber framework remains visible in the exterior of the walls. The original 17th-century appearance has not been changed and it is not even visible that there is any isolation between the style and framework. The hygrothermal behavior is adapted to heritage buildings and a good airtightness can be achieved when the solution is installed with an airtight barrier. The cons for this solution are: The wood fibre insulation boards are not the cheapest insulation material on the market and the rock wool is non-biodegradable. By installing the retention wall with rockwool at the inside of the wall the truss is not visible from the interior. Another point is the need to be sure that the insulating system is enough airtight.

Type of data available (level of information, simulation):

This solution is well-known and documented. Wood fibre boards are used across Europe as cavity insulation in timber frame applications. Additional Information: Best practice example "Half-timber-framed house in Alken, Belgium": Half-timberframed house in Alken, Belgium (hiberatlas.com)

Additional Information:

During execution the restoration plans where changed. The wood fibre insulation board that was provided on the inside was replaced by a retention wall, filled with rock wool insulation. The main purpose of the change of the intervention was extra acoustic insulation. As a result the thickness of the façade package has increased considerably and the truss structure is no longer

visible on the inside. This is acceptable from a heritage point of view, since the insides of vernacular half-timbered buildings used to be often thickly draped, limed or papered. A better option would have been though to provide a clay plaster as interior finishing layer. Such a finish would have reflected more with the 17th-century look. The build-up of the retrofitted wall was the following: 20 mm clay plaster, 60 mm wood fibre insulation board, 40 mm wood fiber insulation board, battens + 63 mm+ 60 mm rock wool insulation, 18 mm OSB board vapor control layer, framework, 43 mm pipe (service) cavity and 2X12,5 mm plasterboard The facade insulation resulted in limited energy savings on primary energy consumption of approximately 5% or 8,077 kWh / year or approximately 485 EUR / year, which yielded an E-level gain of 16 E points.

Link to best practice example (Hiberatlas):

https://www.hiberatlas.com/en/half-timberframed-house-in-alken-belgium--2-58.html