8 Retrofitting thermal insulation in old buildings

There are two basic reasons to modernize an old building in energy terms:

- the fact that components have to be repaired in routine maintenance work in any case
- the higher level of living comfort

and these result in an increase in the overall value of a property.

Living comfort means comfortable temperatures throughout the house, neither too hot nor too cold.

The Energy Saving Regulation places requirements on the limited life of components and thus on the need to carry out routine maintenance on a building and to repair components (see Chapter 6, page 39). Accordingly, the Energy Saving Regulation requires that components are provided with appropriate thermal insulation when necessary repairs are carried out on them.

8.1 Polyurethane rigid foam insulation solutions

8.1.1 Roof repairs and roof extensions

Pitched roofs:

Over-rafter insulation: the optimum in roof renovation

If the roof requires renovation or improved thermal insulation is to be retrofitted in an extended roof, over-rafter insulation is recommended in the first instance. In this way, the rafters can remain visible from the inside. The advantages of this method of insulation are that there is no loss of space, no damage to the interior of the house, no noise and no dirt. Existing installations need not be removed and the overall internal construction need not be altered.

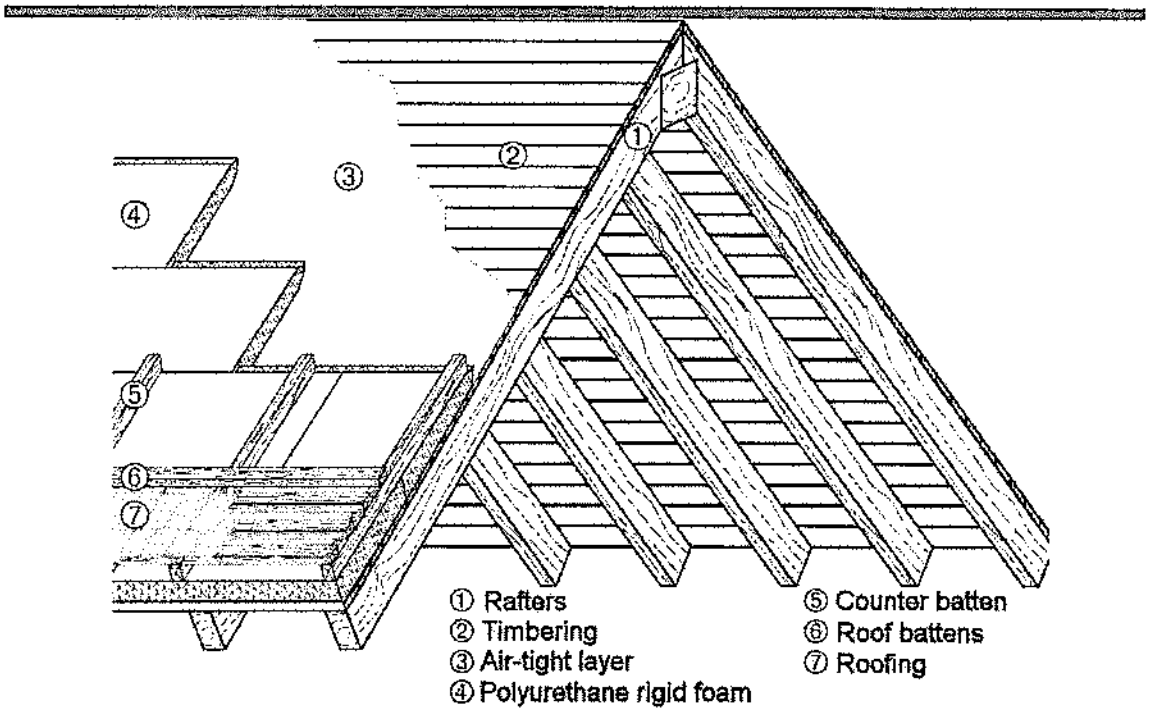

Fig. 35: Over-rafter insulation with polyurethane rigid foam insulating boards

In over-rafter insulation, the entire surface of the construction as a whole is clad with polyurethane insulation. This protects the roof construction from the effects of temperature and moreover has the advantage that the rafters do not act as thermal bridges. Self-adhesive overlaps in polyurethane rigid foam insulating elements ensure a tight seal all round.

Under-rafter insulation: when the roofing is intact

If pitched roof insulation over the rafters is not possible, insulation can be provided under the rafters. In all cases, it is a prerequisite for this insulating system that the roofing should be intact. With under-rafter insulation, too, the rafters do not form thermal bridges. However, because it is positioned above the insulation, the woodwork is constantly exposed to the effects of temperature. Moreover, the available space is reduced considerably by this form of insulation, and thermal bridges are also produced in the region of the wall joints. The advantage of polyurethane rigid foam in under-rafter insulation is that the loss of space is kept as low as possible, because of the small thickness of polyurethane rigid foam insulating boards in comparison with other insulating materials.

Between-rafter insulation: thin but effective insulation with polyurethane rigid foam

If over-rafter and under-rafter insulation are not possible, insulation may be fitted between the rafters. The disadvantage of between-rafter insulation is that because the rafters in older buildings are often only of the structurally required height, correspondingly less material can be used if WLG 040 insulating materials and higher are employed, resulting in a worse U-value (cf. Energy Saving Regulation, Appendix 3, Table 1). Polyurethane rigid foam insulating boards are the exception.

Even at a thickness of just 100 mm, using WLG 030 polyurethane insulating boards or insulating elements leads to the U-value of 0.30 W/(m^2·K) required according to the Energy Saving Regulation. Since the rafter height in old buildings is generally at least 12 cm, expensive additional under-rafter insulation can thus be dispensed with.

Top floor ceiling:

Simple and cost-effective, even with accessible lofts

According to the Energy Saving Regulation, inaccessible top floor ceilings of heated rooms must be insulated by December 31, 2006 in such a way that the U-value of the top floor ceiling will not exceed 0.30 W/(m^2·K). A simple and cost-effective solution for meeting this requirement is to lay 100 mm thick WLG 030 polyurethane rigid foam insulating boards or 80 mm of WLG 025. In this case, polyurethane rigid foam provides excellent insulating efficiency at a low, space-saving insulating material thickness. To prevent thermal bridges, these panels should be provided with a stepped rebate.

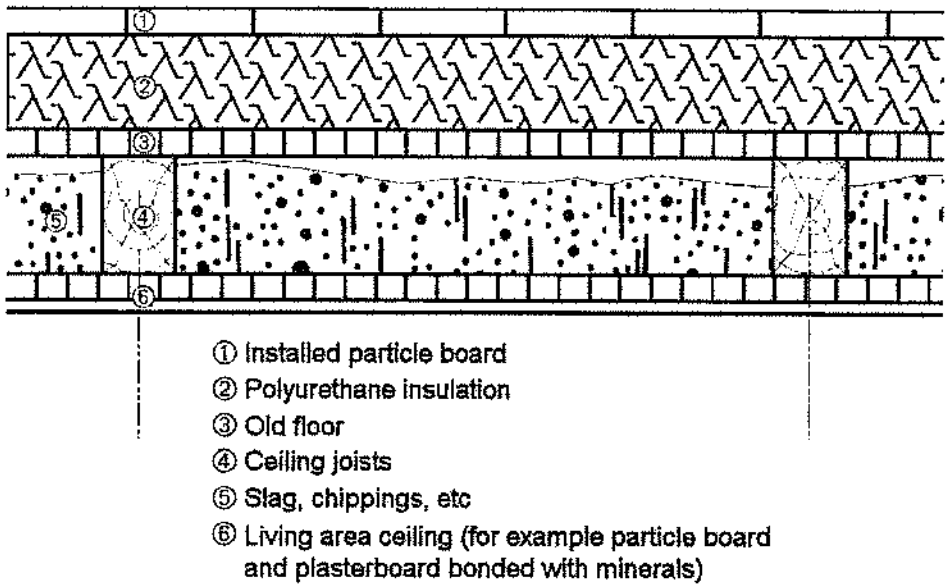

Fig. 36: Retrofitted insulation of the top floor ceiling with polyurethane rigid foam

If the design includes an accessible loft, it is sufficient to completely cover the insulating boards, for example with particle boards. The low construction height also ensures that as much as possible of the original room height is maintained in the region of the loft.

Flat roofs:

Effective insulation and high compressive strength

Polyurethane rigid foam insulating boards have been used for approximately 40 years for the thermal insulation of flat roofs and have proved to be extremely effective in this application. The Energy Saving Regulation flat roof requirements can be met in old buildings even with small insulating material thicknesses. The U-value of 0.25 W/(m^2·K) required under the Energy Saving Regulation is achieved using 120 mm thick WLG 030 polyurethane rigid foam panels or 100 mm thick WLG 025 panels.

Polyurethane rigid foam flat roof insulating boards are highly compression-resistant; they can be used under a gravel load, under terrace coverings laid over the whole area, and under green roofs. With special polyurethane rigid foam tapered panels, a roof gradient that carries

off water can also be produced. Heat-insulated roof gullies may also be provided to remove water and air from the roof.

Special case:
From a flat roof to a pitched roof

When a leaky or insufficiently insulated flat roof is renovated, a common choice nowadays is to convert the existing roof construction into a pitched roof. Because a measure of this type involves complete reconstruction of the roof structure, the insulation is applied above the rafters, since this is the most expedient solution and also the cheapest if polyurethane rigid foam insulating boards are used. This type of conversion must be authorized by the responsible building inspectorate.

8.1.2 External walls and façades

Composite thermal insulation system:
Slim construction, good styling

According to the Energy Saving Regulation, if the design includes replastering of an external wall, this refurbishing measure must be combined with thermal insulation.

Insulating boards consisting of polyurethane rigid foam may, depending on the substrate, be dowelled and glued or just glued. A plaster undercoat with fabric reinforcement is initially applied to the insulating boards, followed by a visible final rendering. All parts of the system (insulating material, adhesive, dowels, fabric reinforcement, plasters etc.) must be adapted to one another and be tested as an overall package.

According to the requirements of the Energy Saving Regulation, a U-value of 0.35 W/(m^2·K) should be achieved in old buildings, i.e. the WLG 030 polyurethane insulating boards used must be at least 80 mm thick.

The "slim" construction of the system, due to the small thickness of polyurethane rigid foam insulating material, facilitates the construction of the joints and makes it possible to maintain the esthetic quality of the façade.

Internal insulation:

Composite panels found to be effective, even with an integrated vapor barrier

On buildings with visible masonry, framework, or structured façades that is worthy of conservation under a preservation order, external insulation is not possible due to the expense, a preservation order or urban conservation. In this case, internal insulation is a possibility. According to the provisions of the Energy Saving Regulation, a U-value of 0.35 W/(m²·K) is to be achieved in old buildings. Composite panels of plasterboard or plaster fiberboard with 80 mm WLG 030 polyurethane rigid foam (which may also be provided with an integrated vapor barrier) have been found to make excellent insulating elements. Polyurethane rigid foam, the "slim" insulating material, promotes optimum use of the internal space in this case.

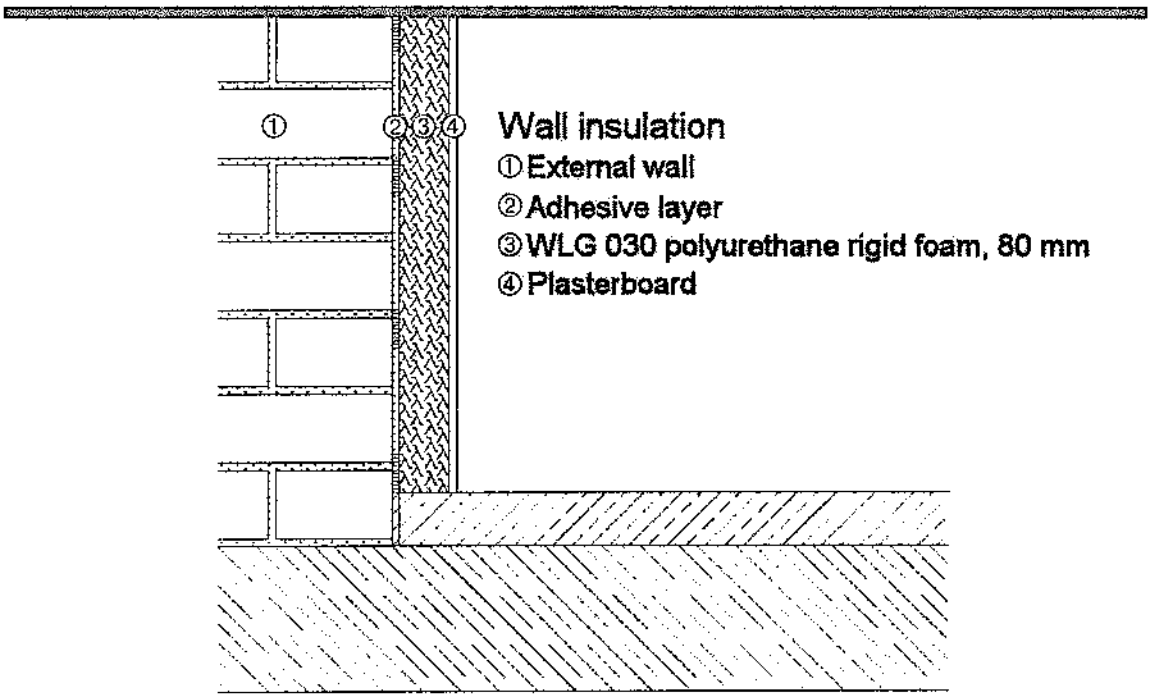

Fig. 37: Internal insulation with polyurethane rigid foam

8.1.3 Floors and basements

Floor and basement ceilings:

Small panel thickness, low construction heights

Professional thermal insulation in the floor saves heating energy and increases the living comfort . Polyurethane rigid foam insulating boards can be used for all thermal insulation tasks that occur in the floor region, i.e.

- above unheated basement spaces
- on floors directly adjacent to the ground
- on floors above open passages.

Polyurethane rigid foam ensures optimum thermal insulation with a small panel thickness and thus provides favorable building conditions for achieving low construction heights. In old buildings, the U-value according to the Energy Saving Regulation is 0.40 W/(m²·K). In this case, 60 mm thick WLG 025 polyurethane panels or 80 mm of WLG 030 already meet the requirements.

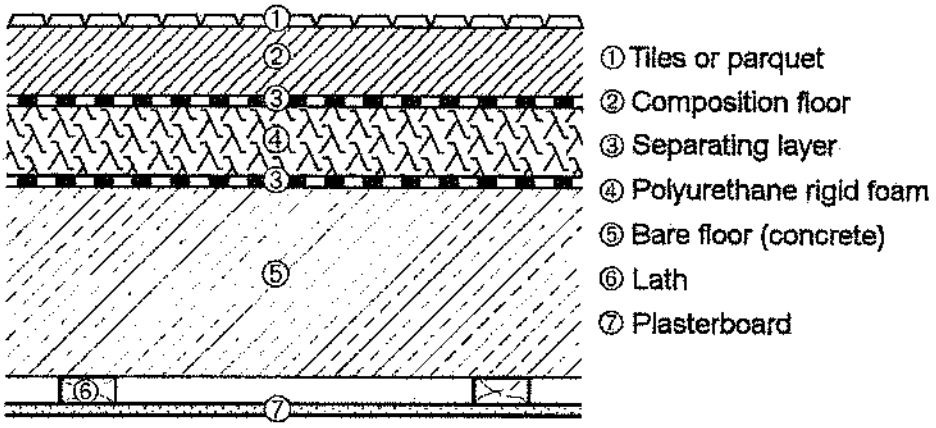

Fig. 38: Insulation of the basement ceiling with polyurethane rigid foam

If upper floor insulation cannot be installed during refurbishment measures, the basement ceiling is insulated from below. Since the ceiling height in old buildings is generally low, polyurethane insulating boards are also especially suitable in this case. The extremely low thermal conductivity of this material means that the heat losses through the basement ceiling can be reduced even with extremely thin panels. In this case too, the Energy Saving

Regulation requirements of the thermal insulation of basement ceilings (U-value 0.40 W/(m^2·K)) are met by 60 mm thick WLG 025 polyurethane panels or 80 mm thick WLG 030 panels.

In unheated spaces, only the basement ceiling has to be insulated. For heated basement spaces, used for parties, hobbies or exercising for example, an additional internal insulation of the walls and the floor is required to prevent uncomfortably cold wall surfaces and floors.

External basement walls (perimeter insulation):
Tight, effective insulation, dry and warm

Buildings that are more than 50 years old, but also newer buildings, often have damp ground floors, basements and cellars. Rain, splashes of water, and lateral or rising damp and leakage water result in large heat and energy losses in damp, uninsulated basements. The best solution is external refurbishment with a seal in accordance with DIN 18195-1 "Building seals; principles, definitions, attribution of water-proofing types" and subsequent polyurethane perimeter insulation.

The energy losses through the external walls of the basement space are reduced considerably by perimeter insulation. Perimeter insulation provides a pleasant room climate in inhabited basement spaces, such as self-contained apartments.

Polyurethane rigid foam is a particularly suitable insulating material for perimeter insulation. Polyurethane perimeter insulating boards do not decompose, are resistant to mildew and rot, and have an excellent mechanical strength. Because of their resistance to solvents, polyurethane perimeter insulating boards can readily be glued onto the seal in the wall region.

Mineral-mat-laminated WLG 030 polyurethane rigid foam panels are used for perimeter insulation. 80 mm thick polyurethane rigid foam panels are used for insulation to achieve the U-value of 0.40 W/(m^2·K) prescribed in the Energy Saving Regulation.

There is building inspectorate approval for the application of polyurethane rigid foam insulating boards as perimeter insulation (Z-23.33-1259). This approval also covers the thermal insulation of structurally non-load-bearing floor panels.