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Appendix 11.

Applicability of insulation solution

In this document the insulation application and procedure optimization are described. The implementation of insulation solutions is divided into 3 different systems (external, internal and mixture), though each one is also subdivided in different categories.

Moreover, each subcategory takes into account several aspects that are explained below.

1. External

1.1 External thermally insulating cladding systems (ETICS)

The ETICS composition and scheme are shown below:

1. Base coat (adhesive mortar)
2. Insulation material
3. Facade plug anchors
4. Reinforcing mesh embedded in the base coat
5. Masonry primer
6. Top coat (mineral or, at customer's request, but vapour permeability should be checked)

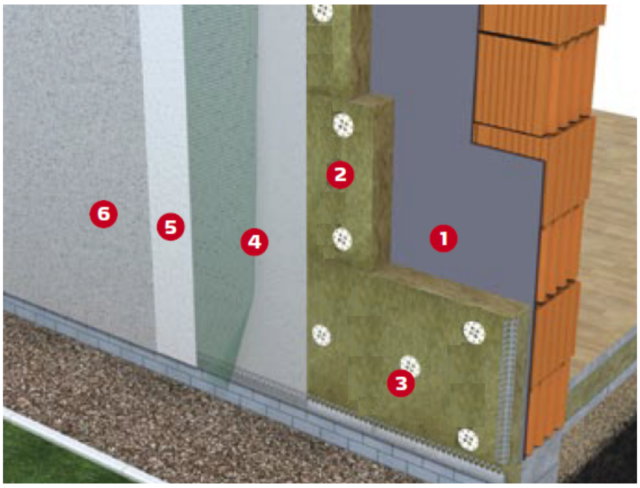


Fig 1. ETICS composition

The ETICS solution is applied following the next steps in order to overcome thermal bridges and avoid internal wall condensation and damp:

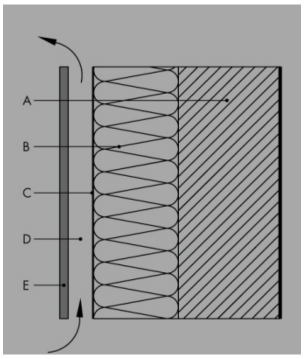
- The skirt board should be fixed level and at least 40 cm above the ground. It must be attached horizontally around the entire building.
- The insulation slabs are applied to the wall with the adhesive applied in line along the edge of the slab using the dab fixing method.
- Fixing the insulation slabs. The insulation panels are bonded to each other by being pressed against the slabs already attached.
- The insulation panels are fixed with plug anchors
- Apply external reinforced layer

- After the adhesive has dried out, apply a finishing layer of mineral or silicate mortar that could be painted in selected colour.

1.2 Ventilated façade

The implementation of a ventilated façade provides several constructive, technical and economic advantages, such as ease of installing with low maintenance, elimination of moisture condensation, reduction of outside noise, excellent thermal insulation and adaptability to replace tiles without any construction work.

A common scheme of a solid wall with a ventilated façade is shown below:



A. Load bearing wall (i.e. concrete)
B. Thermal insulation
C. Weather barrier (vapor permeable)
D. Ventilation cavity and subframe
E. Light outer leaf (i.e. ceramic tile)

Fig 2. Scheme of a ventilated facade

Its main elements from the construction point of view are:

- The light outer leaf, which is independent of the rest of the facing.
- The air chamber, which guarantees the air tightness of the system whilst enabling air circulation in its interior.
- The auxiliary substructure, which is employed to support the light outer leaf, incorporates the insulation and maintains the air chamber's dimensions.
- The insulation, which is fitted to the outer face of the inner leaf, guarantees continuity throughout the façade and avoids the appearance of the thermal bridges.

2. Internal

2.1 Flooring insulation

Insulating timber ground floors

This solution is used when the boards can be lifted without unacceptable levels of damage. If boards are to be lifted for any other reason it would normally be appropriate to take the opportunity to install insulation at the same time. Suitable materials are semi-rigid batts, boards or loose fill cellulose. If this solution causes damage, the most suitable way to insulate the floor is to access it from under the floor as explained in 3.2.

As shown in Fig 3, the insulation is supported between the floor joists and an air and vapour control layer is laid over the insulation below the floorboards. This should be fully supported and therefore used in conjunction with rigid insulation. The insulation can be supported by netting, a breather membrane or proprietary fixings depending on the type of insulation material being used.

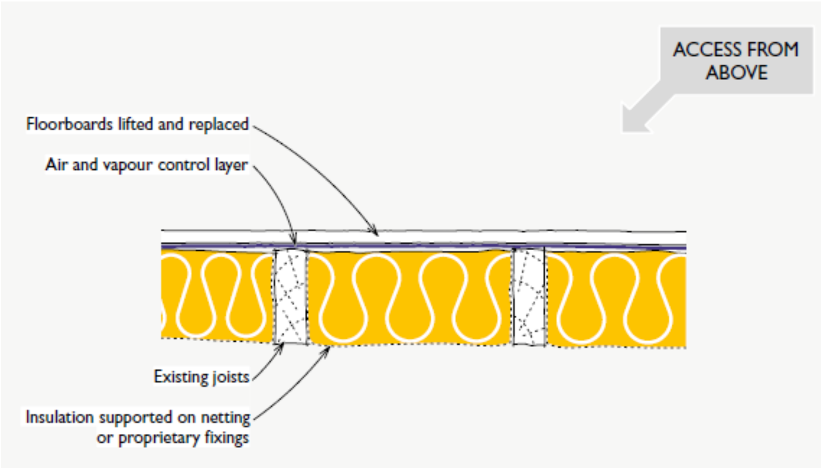


Fig 3. Fixing insulation from above floor

<u>Insulating solid ground floors</u>

The energy saving resulting from insulating solid ground floors can in many cases be of marginal benefit when the cost and disruption to the building fabric are considered. There are several risks involved with insulating solid ground floors.

2.2 Internal wall insulation

The internal wall insulation can be added in two different ways: As a composite thermal board or as a built up system using insulation behind timber battens fixed behind conventional plasterboard.

For both systems the surface of the wall must be carefully prepared and all cracked or damaged plaster must be either repaired or removed. Bare brickwork or blockwork should be pointed with mortar to eliminate air paths to the exterior.

As consideration for both systems, it has to be taken into account that it is very important to ensure that moisture cannot penetrate behind the plasterboard as condensation and dampness will result. Besides, additional insulation will be required around the sills and reveals of openings and adjacent to where internal masonry partitions meet external walls in order to prevent thermal bridging.

Below both systems are explained:

<u>Thermal boards</u>

Made of plasterboard bonded to an insulating material (e.g. polystyrene, polyurethane or mineral wool), which usually have a thickness between 25 and 50mm.This system incorporates a vapour control layer to prevent water vapour passing through the board and condensing on the cold masonry behind.

This system should be fixed to the wall using a continuous ribbon of plaster or adhesive, and not individual 'dabs' of plaster, unless the wall is particularly uneven.

Built up systems

Conventional insulation (in most cases mineral wool) is placed between vertical timber battens fixed to the wall. It is recommended to put a polythene sheet over the insulation and battens beneath the plasterboards, since it acts as the vapour control layer.

If polythene sheet is used, joint edges and services (electrical cables and wiring, which penetrate the polythene sheet) must be thoroughly sealed using tape to exclude water vapour and subsequent condensation formation behind the lining.

3. Mixture (External and/or Internal)

3.1 Cavity wall insulation

To ensure that cavity wall insulation is only installed where it is appropriate, a procedure for assessing whether the wall is suitable for the incorporation of cavity wall insulation is described below. This procedure involves:

- Determining whether the wall is in fact a masonry wall with unfilled cavities.
- Inspecting the general condition of the external wall.
- Identifying any constructional defects that first need to be remedied.
- Checking on the inside of external walls to see if there are any existing dampness problems that need to be remedied.
- Checking any penetrations of the external wall, e.g. for flues and air ventilators.
- Finding out if the cavity of a directly adjacent house has already been filled, e.g. in a terraced or semi-detached house.
- If necessary for the insulation system, checking the exposure of the wall.

It is very important a deep inspection of the walls. All defects and dampness penetration problems must be addressed before starting the work. Walls with cavities less than 50mm wide are not suitable for insulation and any PVC covered electrical cables should have been removed.

The three most common types of cavity wall insulation used are: 1) Blown mineral fiber, 2) Polystyrene beads or granules, and 3) Urea formaldehyde foam.

The installation procedure starts drilling small holes into the mortar between the brick courses of the outer leaf at approximately one metre intervals. The insulating material is blown or injected into the cavity through these holes which are subsequently filled to leave no sign of the work that has been carried out.

If re-plastering of the internal walls is planned then it may be preferable to inject the insulation material through holes drilled in the internal walls, which are then covered when the wall is plastered.

3.2 Flat roofs / Ceiling insulation / Pitches insulation

In this section it is described the implementation of insulation material in ceiling, roofs or pitches, though it is not specified each case. The different typologies of insulation solution have been divided into 3 categories: 1) Insulation within the zone of structure, 2) Insulation above the existing structure, and 3) Insulation within the zone of structure. Within each case, it is explained several requirements (e.g. if the system can be added from indoor or outdoor side).

<u>Insulation within the zone of structure</u>

The most common location to add insulation within an existing flat roof is to install it within the existing structure zone, generally between the existing joists. This has the advantage of causing the least alteration to the existing roof by retaining the structure, its overall thickness, and the upper and lower surface finishes.

It can be installed with or without ventilation.

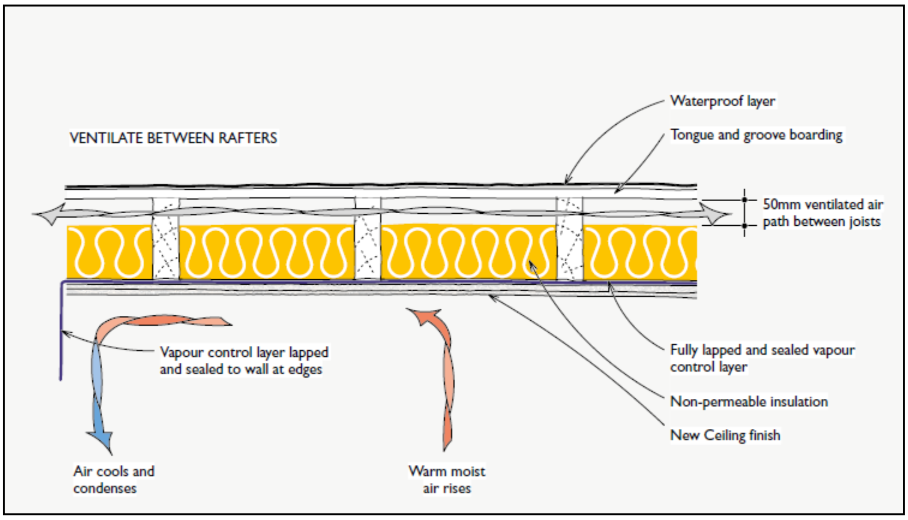


Fig 4. Ventilated cold deck using vapour permeable insulation

For the installation of insulation within the existing structural zone, the ceiling is usually removed for accessing the roof internally. Insulation is added to part of the depth of the roof joists to maintain an air-path above. A vapour control layer is shown to prevent moist air entering the roof-space and condensing.

If the implementation of insulation material is done without ventilation, it is possible to install it between joists to their full depth without allowing for ventilation. This will allow the maximum possible amount of insulation to be added without altering the appearance or thickness of the roof, but certain risks will inevitably result. Control of condensation build-up in the structure will rely entirely on the efficiency of a vapour check layer below the insulation, with all the consequent drawbacks. This layer is best installed below the joists to ensure both its durability, and to protect the structural timber, although replacement of the ceiling will therefore be necessary. Under no circumstances should unventilated insulation be used below a lead or zinc roof.

<u>Insulation above the existing structure</u>

Where it is feasible to raise the level of the roof covering without compromising the character of the building, new insulation can be installed above the decking. There are two systems named 1) Warm deck system, and 2) Inverted system

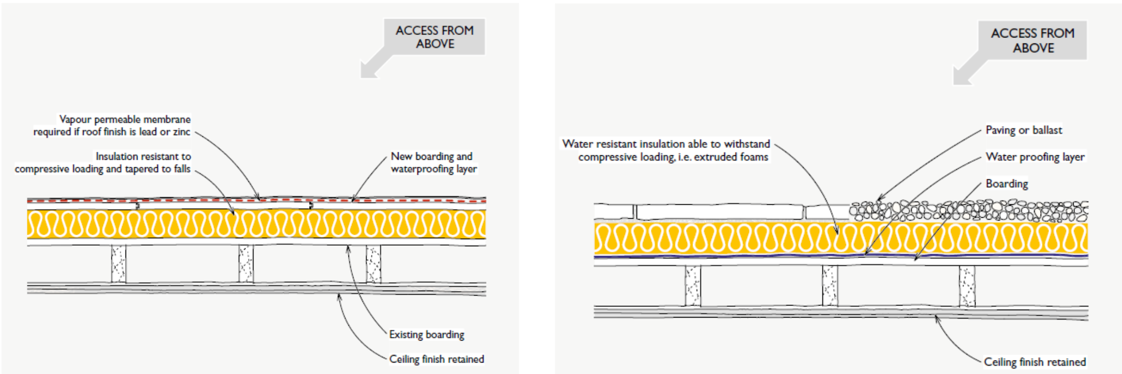


Fig 5. Warm deck system and Inverted system

Where the existing flat roof covering is being replaced or repaired it can provide the opportunity to add insulation above the existing roof deck tapered to provide a fall. The existing roof covering could also be retained providing a partial vapour check. As there is no ventilation between the insulation and the underside of the roof covering then this detail would be most suited to finishes such as asphalt, stainless steel and copper.

This will require either the use of insulation boards which can resist a compressive load, or the addition of deep firings or in order to carry a raised deck above the existing one. If rigid insulation is used, a new roof covering can be directly installed with a corrosion-resistant metal such as stainless steel or copper, or a continuous covering such as asphalt can be used.

The inverted roof is a modified version of a warm deck roof where insulation is applied above a continuous waterproofing layer. Rainwater is allowed to percolate through the joints in the insulation and drain away via the waterproof layer below. In this case, the insulation is placed above the waterproof layer and is protected and held down by paving or ballast. The insulation needs to be able to withstand compressive loading. This detail is particularly suited to asphalted roofs. The roof space is unventilated.

<u>Insulation beneath the existing structure</u>

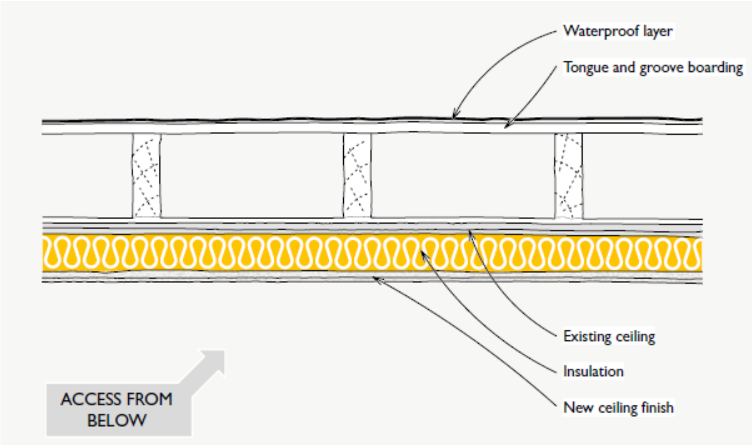


Fig 6. Insulation added below roof structure

As shown in the Fig 6 the existing lime plaster ceiling is retained and insulation is added below with a new ceiling under. A new ceiling can easily be added below an existing ceiling using shallow joists.