eurima

European Insulation Manufacturers Association

How to install mineral wool insulation

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1.

Insulation installation

Insulation installation

To ensure full insulation efficiency in closed constructions, mineral wool should completely fill voids so no gaps remain between the insulation and the construction. This will avoid airflow movements which can cause subsequent heat losses.

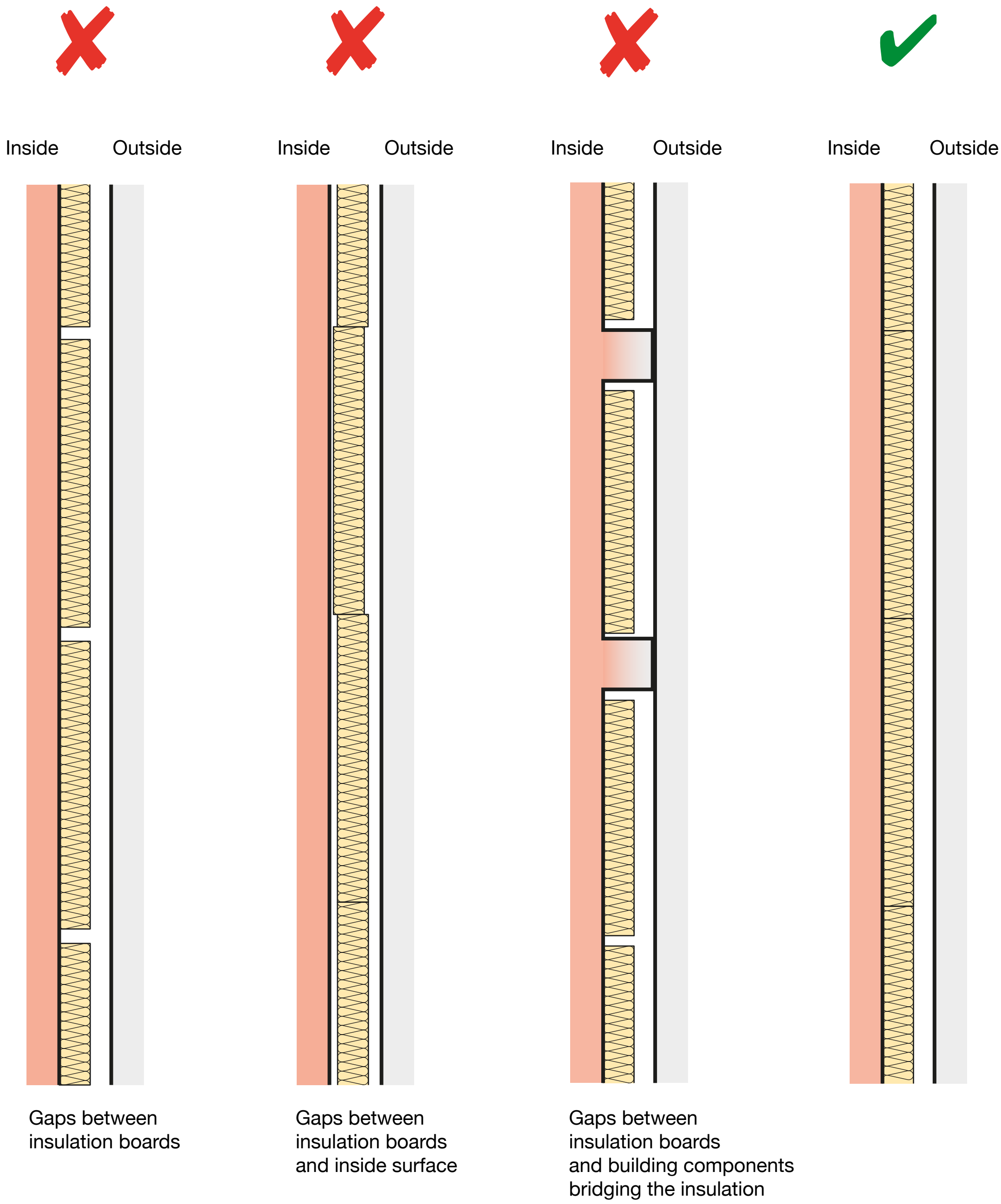


Figure 1: *Diagram representing the principles of good and bad insulation. The mineral wool needs to be installed tight against the supporting construction and tightly butted at board joints to prevent subsequent heat loss.*

2.
Wind protection

Wind protection

In ventilated attics with horizontal insulation and suspended ceilings - as well as a large ventilated volume - air speed at the exposed surface of the insulation is so low that no wind protection is needed (except at eaves).

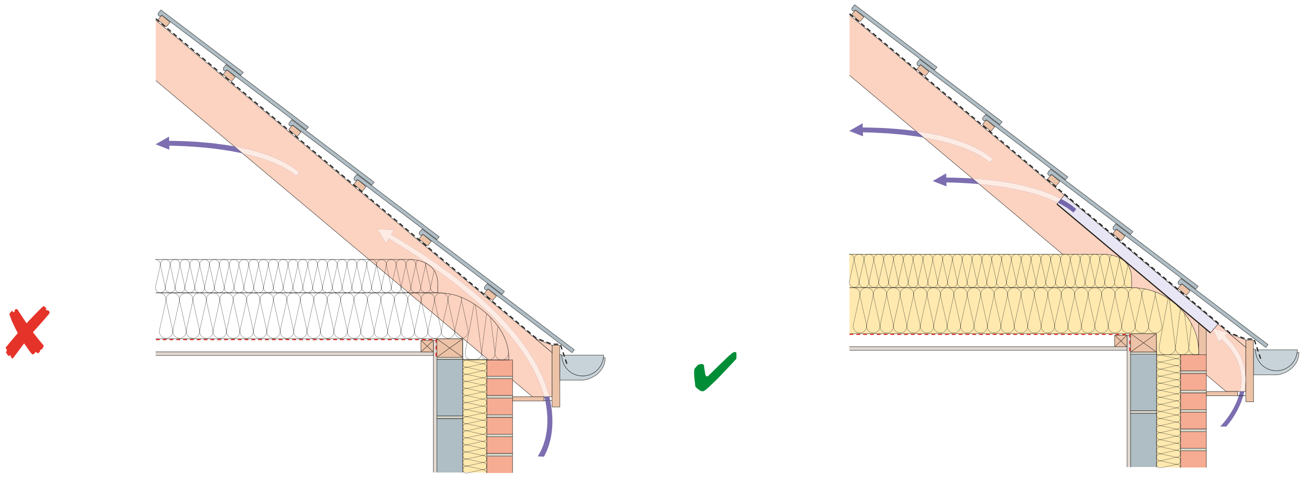


Figure 2: *Diagram showing the importance of ventilation in roofs. To prevent condensation forming in the roof space, ventilation must be provided. A ventilation tray used at eaves level, between the insulation and the roofing membrane, ensures unrestricted air flow. Best practice requires the ventilation tray to protect the exposed face of the roof insulation with an edge board. The tray should extend 200mm above the top of the insulation to prevent wind washing. The remainder of the insulation does not require this protection as the air speed in a large ventilated volume is very low.*

Wind protection

For ventilated facades (or roofs with insulation directly beneath roofing tiles), insulation efficiency can be diminished due to air infiltration or 'wind washing'. Wind protection is usually necessary in such constructions.

Factors which influence thermal degradation include:

- Insulation air permeability
- Construction exposure
- Construction geometry, including possible wind protection
- Climate

In Europe, some countries have national regulations. For example, Germany requires λ≤0.04 W/mK for a ventilated pitched roof, an indirect permeability regulation. In Denmark, there is a vague requirement that insulation needs to be protected from wind degradation.

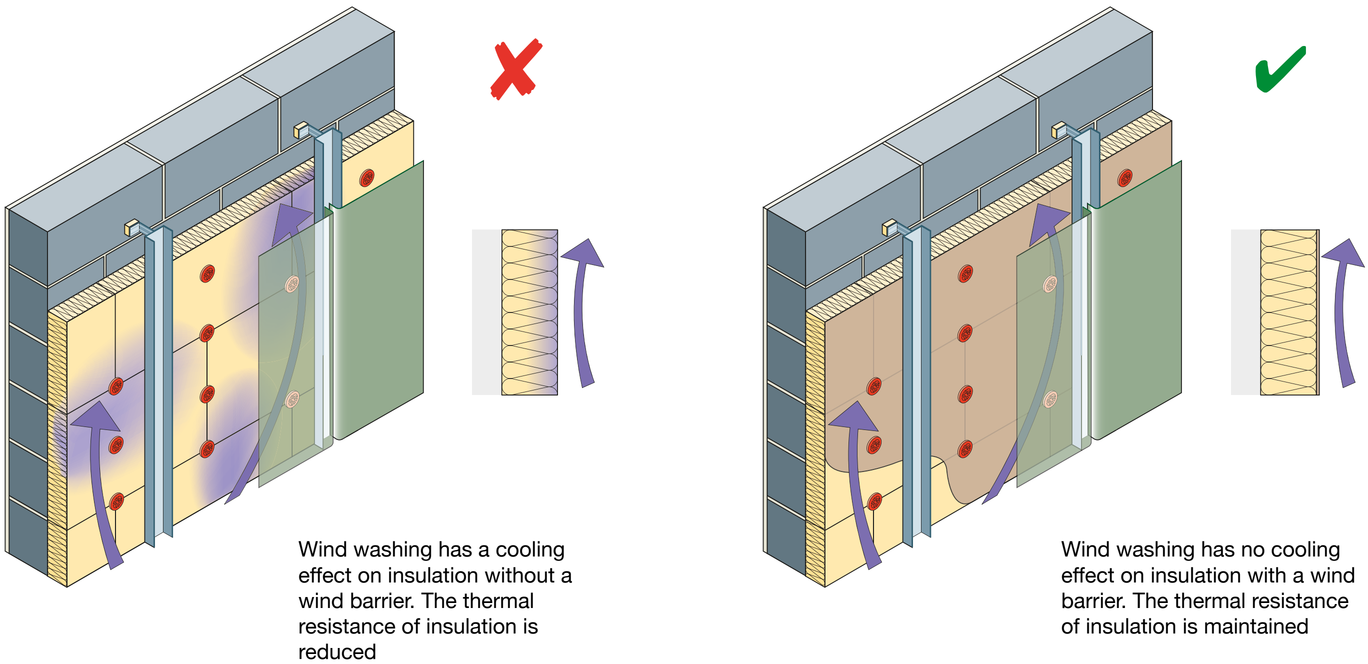


__Figure 3:__ Diagram showing the importance of adding a wind barrier to improve thermal resistance.

3.
Air tightness

Air tightness

Air tightness is needed because air exchange through the envelope increases heat loss from the building. In extreme cases, it may equal the transmission loss.

Lack of air tightness may also cause moisture damage as the heated, moist air causes condensation in the construction. Crucially, air can transport a lot more moisture into the construction than is transported by diffusion.

When high levels of airtightness are achieved, it is necessary to have a ventilation strategy for the building, to ensure good internal air quality and moisture control.

Vapour control layers and air barriers must be perfectly jointed together to achieve high levels of airtightness. Poor airtightness degrades the thermal resistance of air permeable insulation and provides a route for heat transfer by unintended ventilation.

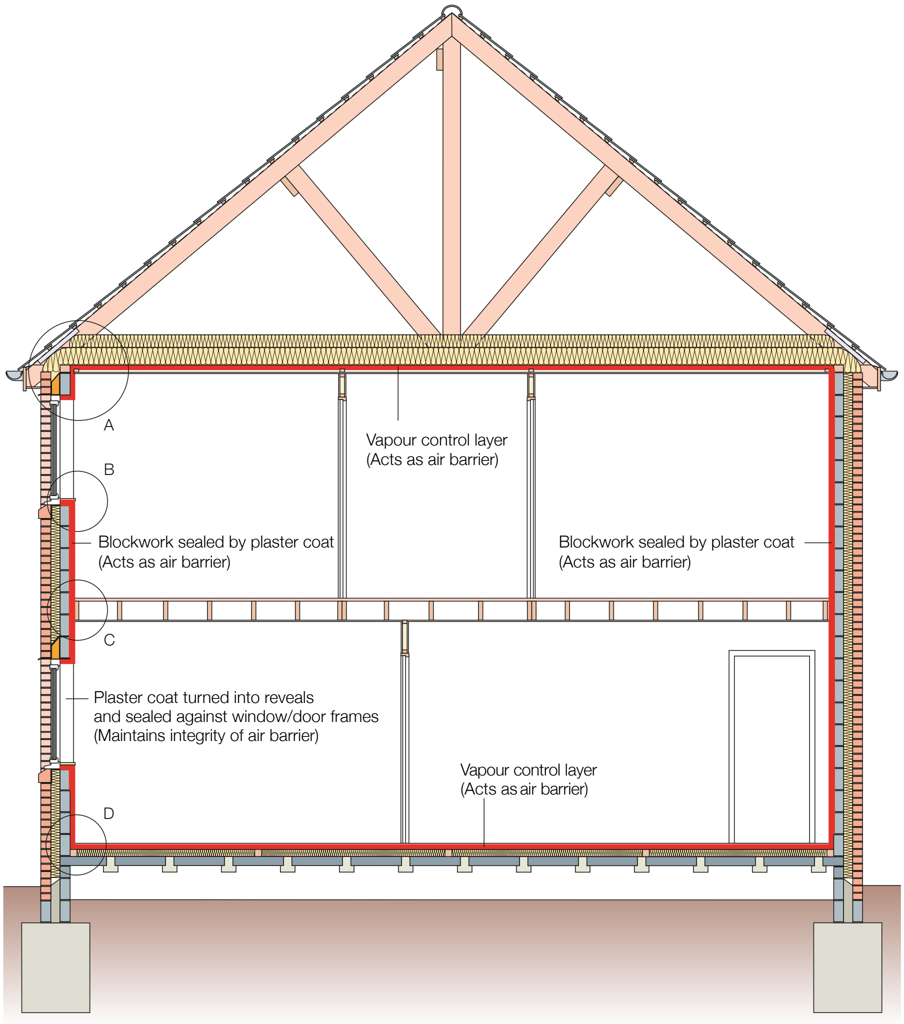


Figure 4: *Joints between different air barrier materials are at junctions A to D.*

Air tightness

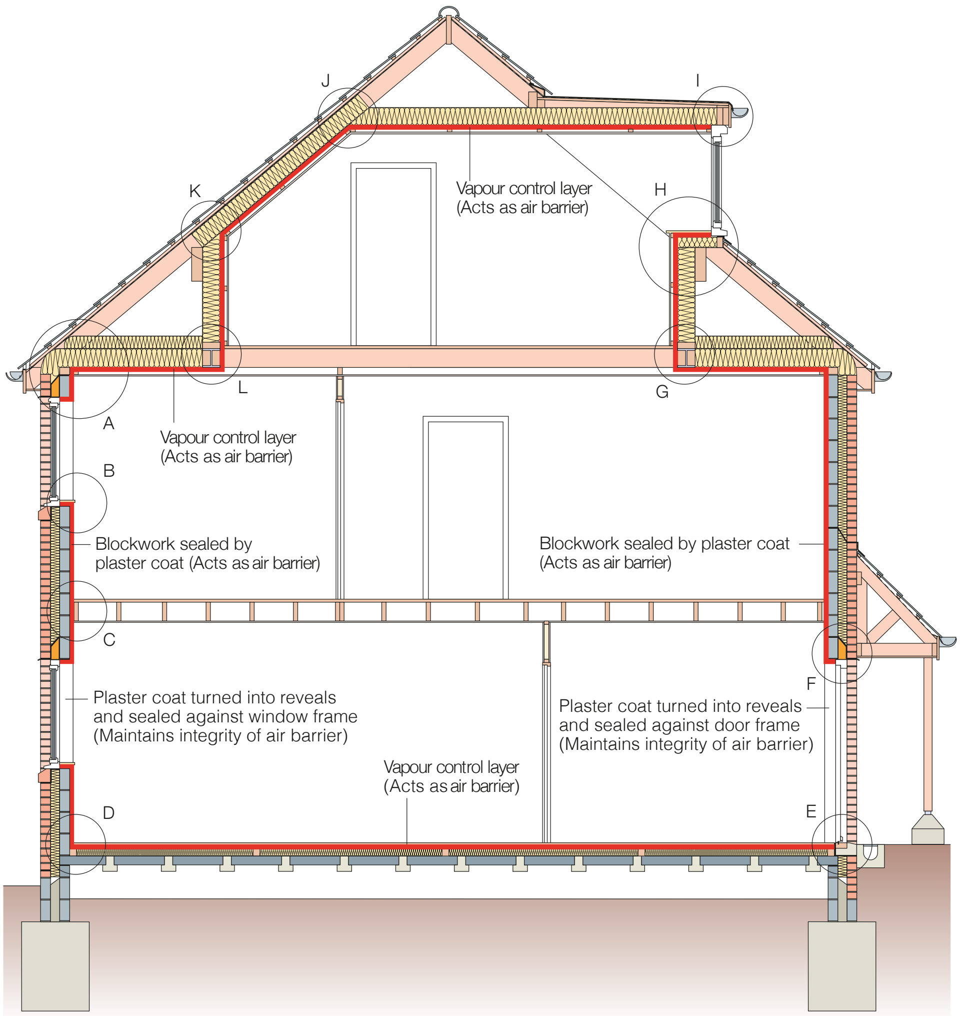


***Figure 5:** Joints between different air barrier materials are at junctions A to L.*

Air infiltration degrades the thermal resistance insulation products which are air permeable, such as mineral wool.

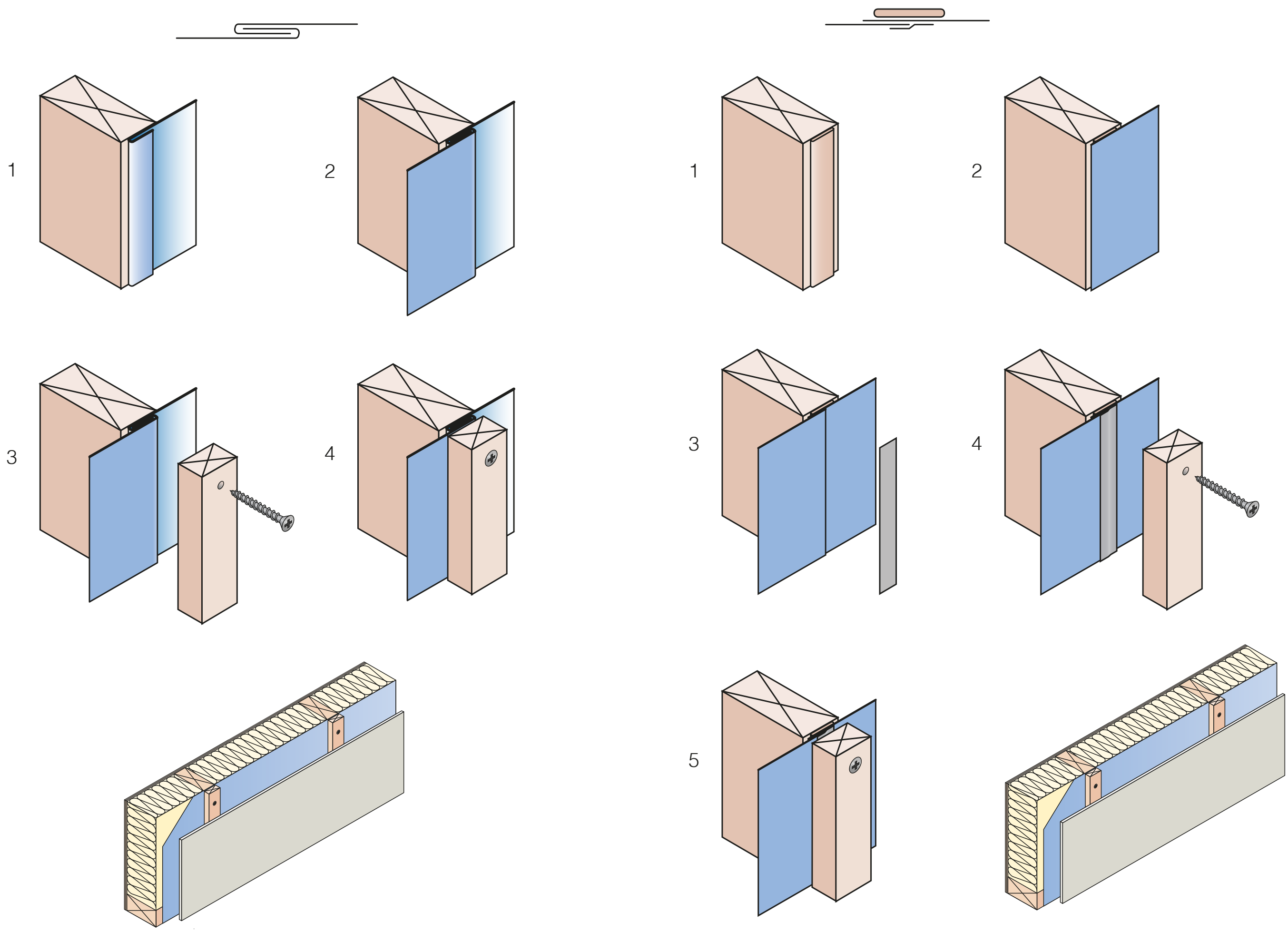
Air tightness is generally ensured by the water vapour membrane for timber frame constructions.

However, difficulties arise when trying to achieve perfect sealing of joints and connections between membranes in different components and penetrations from services.

Joints are susceptible to leakage and the linear metres of joints need to be kept to a minimum. This can be achieved by using a separate water vapour membrane from rolls as wide as possible. Joints need to have sufficient overlap, must be welted and then fixed by mouldings nailed or screwed to the construction.

Air tightness

Products with integrated water vapour membrane and stapling strips are obsolete due to an excessive number of joints - and stapling is an inadequate method to maintain air tightness. Using adhesive tapes for securing joints should be seriously considered, but it is important to be aware that the durability of tapes has to equal the lifetime of the building, as repairs are very difficult.



Figures 6a and 6b: *Air tightness, required to maintain thermal resistance of air permeable insulation, is achieved using a vapour barrier with perfectly sealed joints. Joints must be welted and then fixed either by moulding with nails (6a) or screwed to the construction (6b).*

Air tightness

Penetrations from services need to be mechanically sealed and the number of penetrations reduced by moving installations to interior walls as far as possible.

Another possibility is to place the water vapour membrane inside the insulation – a rule of thumb is to allow the membrane to be moved to one third of total insulation thickness from the warm side. Services can then be run on the warm side of the membrane, thereby avoiding penetrations.

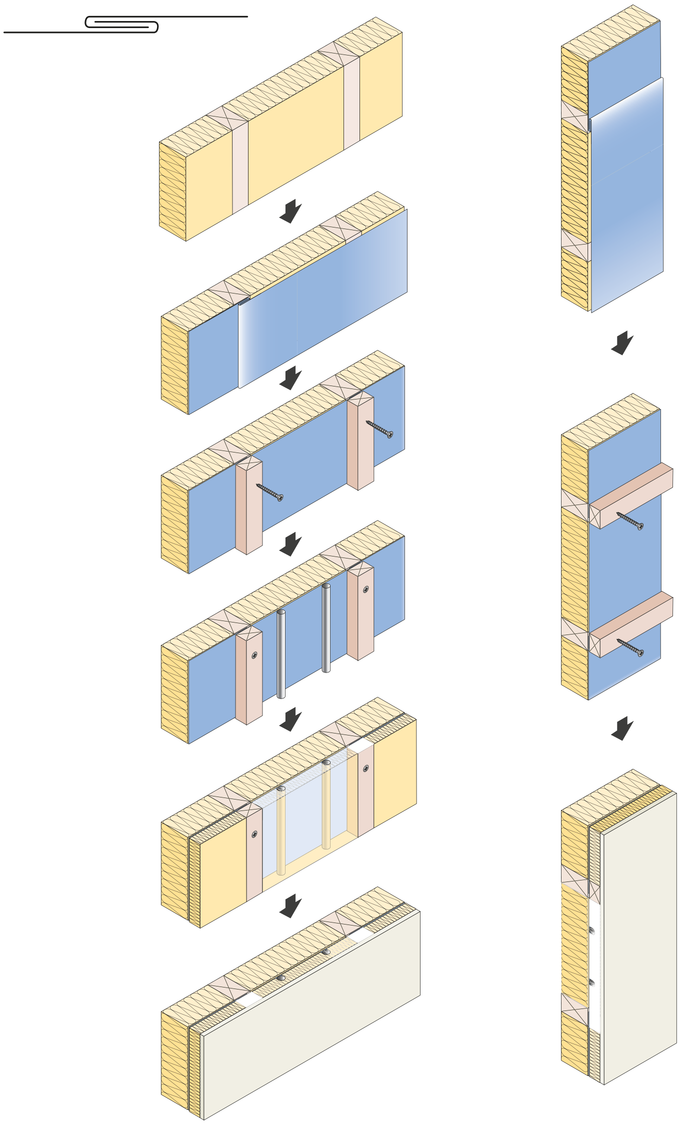


Figure 7: *Vapour barrier positioned at one third thickness of insulation from warm side, allowing services to be installed without penetrating the vapour barrier.*

4.

Thermal bridges

Thermal bridges

Thermal bridges increase heat energy transmission by providing shortcuts through the insulated structure, causing reduced indoor comfort and increased energy consumption. Thermal bridges may also cause condensation, leading to mould growth which results in construction decay and health risks.

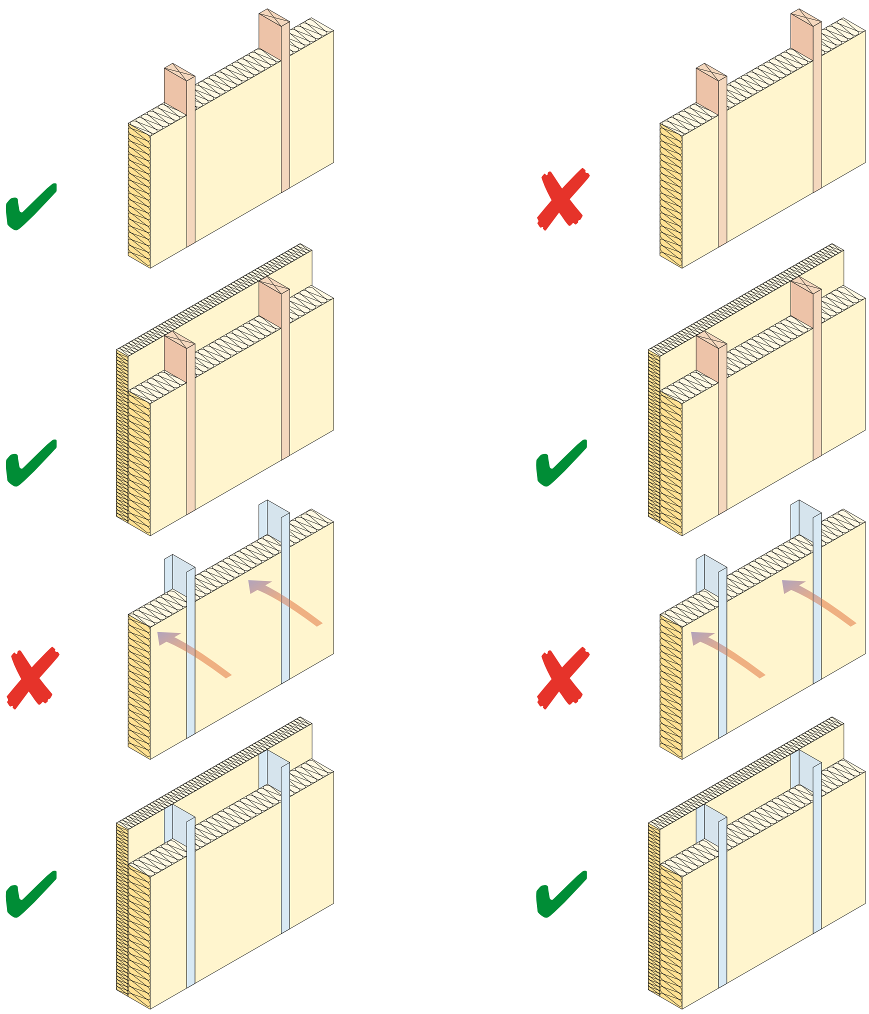
This can be reduced by placing the insulation on the outside of constructions, or dividing it into multiple insulated layers, reducing the area of highly conductive structural elements spanning the full thickness of the construction.

Figure 8: *Thermal bridging will reduce the thermal performance of the construction and lead to loss of indoor comfort, as well as increased energy consumption.*

(To demonstrate this principle, the constructions are shown without the vapour barrier, sheathing and sheathing felt).

Low thermal performance constructions:
For timber frames, insulation between studs is acceptable. For light steel frames, insulation must also be placed across studs to prevent thermal bridging.

High thermal performance constructions:
For timber frames and light steel frames, insulation must be placed across studs to prevent thermal bridging.



Thermal bridges

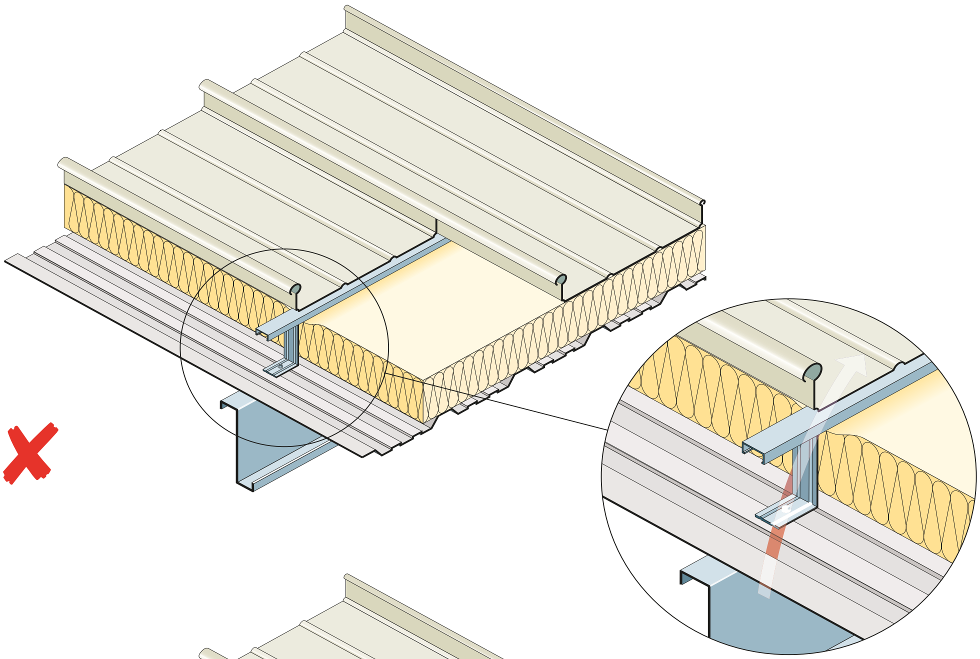
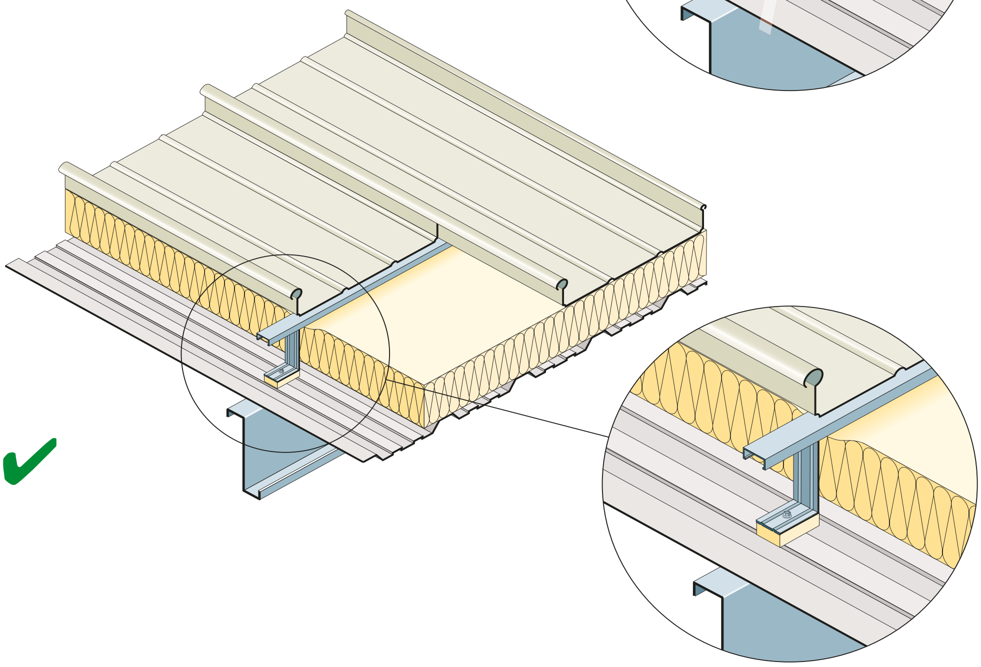


__Figure 9:__ To avoid thermal bridging and main the roof construction's thermal performance, the rail and bracket spacer system should incorporate a thermal break.

(The air and vapour barrier is omitted for clarity and should be installed below the insulation).



All thermal bridges formed from high conductivity material - no matter how the small the surface area - should be avoided.

Where insulation is either missing or merely compressed also represents a thermal 'weakness' and should always be avoided.

Thermal bridges

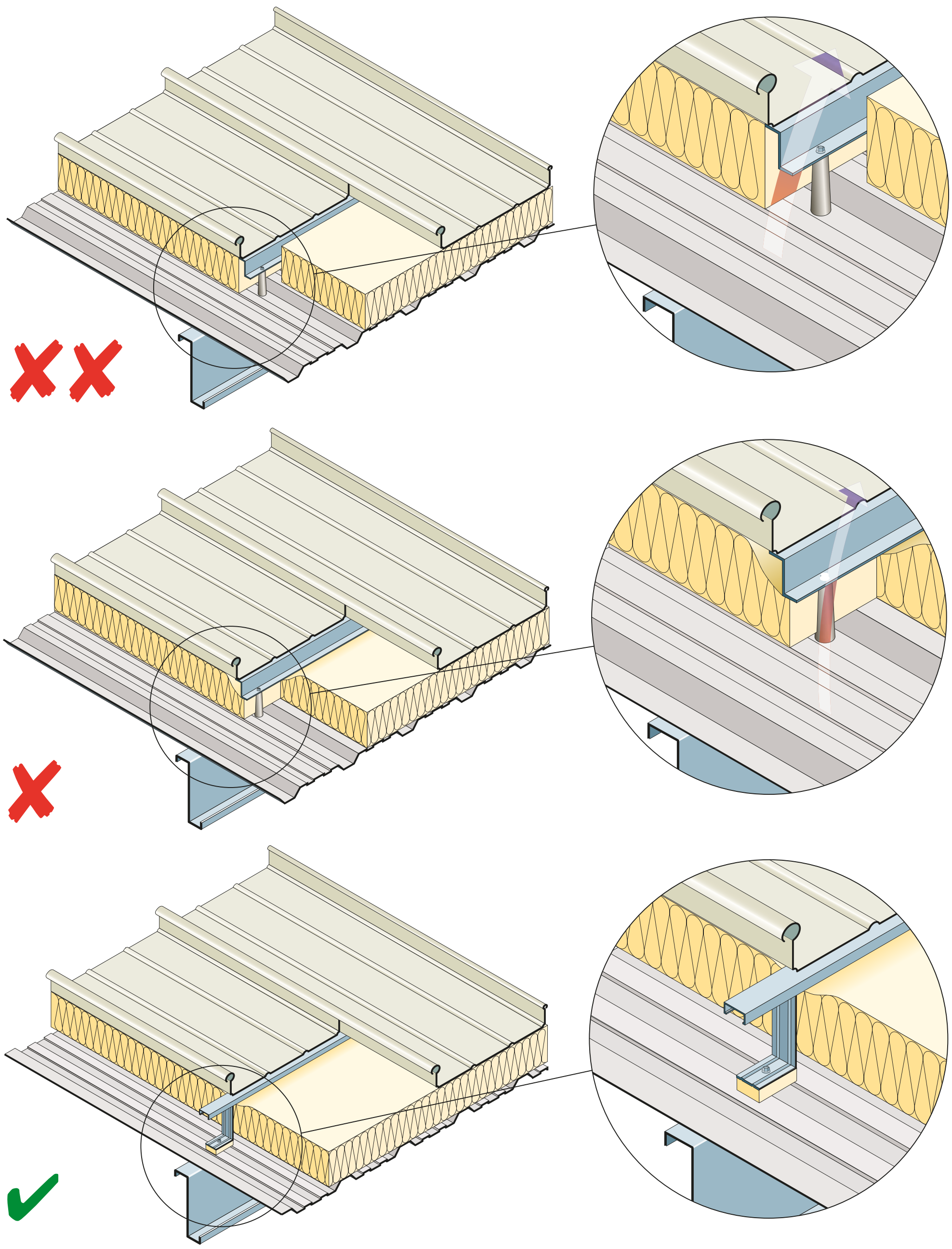


__Figure 10:__ A rail and bracket spacer system incorporating a thermal break will avoid thermal bridging and maintain the thermal performance of the roof construction. Using a zed spacer bar system - which incorporates nylon ferrures - will create a substantial reduction in insulation thickness along the length of each zed spacer and therefore a consequent loss of thermal performance in the roof construction. If the insulation is cut and Figure 10 stopped at the zed bar with a gap left underneath, an even greater heat loss will occur.

5.

How to install in walls

How to install in walls

5.1 Single Leaf Masonry Construction (Internal Insulation)

Masonry construction happens when small masonry units are jointed together with mortar. A masonry unit can be made from:

- Natural stone, which can be completely or partially dressed for squareness
- Solid or cellular brick or block
- Clay, concrete or calcium silicate

The wall may be an integral part of the structure of the building or infilling within a structural frame.

Figure 11 shows the insulation glued to the masonry. It could also be fixed with pins. An internal finish, commonly plasterboard or cement fibre board, is also required. This is supported by the insulation itself, which must provide the necessary mechanical and compressive strength.

Internal insulation generally requires a water vapour membrane to be placed on the warm side of the insulation to prevent a build up of condensation on the inside of the masonry. Figure **12** shows the use of vapour-check plasterboard as an alternative – this must be effectively taped at each board joint.

The air barrier must also be continuous with other building elements and joints properly sealed (see Figures **4**, **5**, **6a**, **6b** and **7**). If a service void is placed between the internal lining board and the water vapour membrane (or vapour-check plasterboard) to minimise penetrations, then the building air tightness strategy must recognise that the air barrier in this wall element is the water vapour membrane and the air barrier in other adjoining elements must be joined to this.

In cases where the insulation is fixed directly to the wall, there should be no gaps in the insulation layer.

In some circumstances, it may not be permitted or possible to place the insulation in direct contact with the inside of the masonry. In these cases, it is critical to ensure that the cavities behind the insulation:

- Do not communicate with the exterior or an unheated space
- Do not communicate with gaps that partially or fully penetrate the insulation system

How to install in walls

If the above does occur, the insulation system could be partially or completely bypassed and be largely ineffective.

When insulating a wall internally, it is important to note that building elements which join with the wall can introduce floors, as well as partition significant non-repeating thermal bridges. This includes intermediate floors, and partition and party walls. Steps should be taken to eliminate or reduce these thermal bridges to a minimum.

If the insulation is fixed to the exterior it will require some form of rain protection – please refer to Figures **18** and **19**.

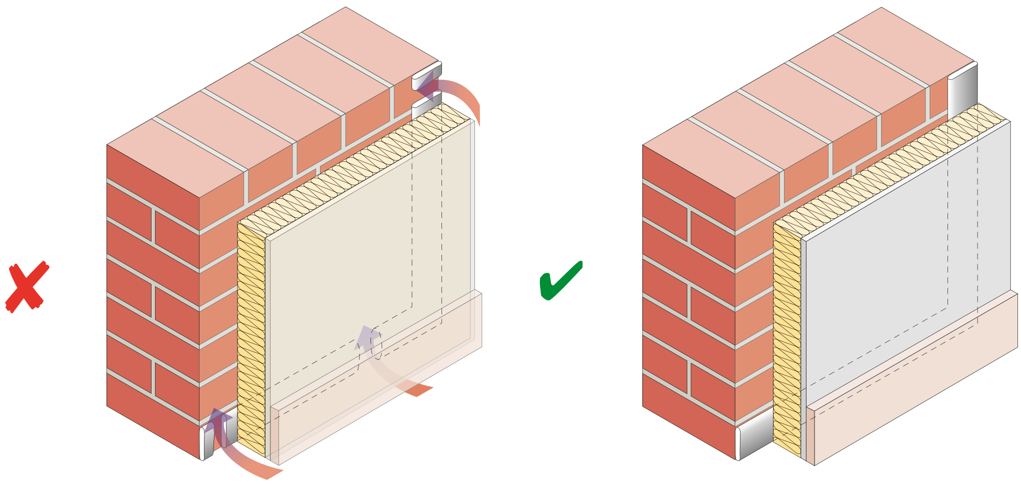


Figure 11: *The laminated thermal wall panel – comprised of mineral wool insulation board bonded to tapered edge, vapour-check plasterboard – must be continuously sealed at all perimeter edges against the external wall to eliminate air infiltration between the panel and external wall. This applies to panels fitted directly to external wall with adhesive and/or mechanical fixings.*

Air movement in an unsealed gap will degrade the thermal resistance of the panel insulation and result in heat loss through the external wall.

How to install in walls

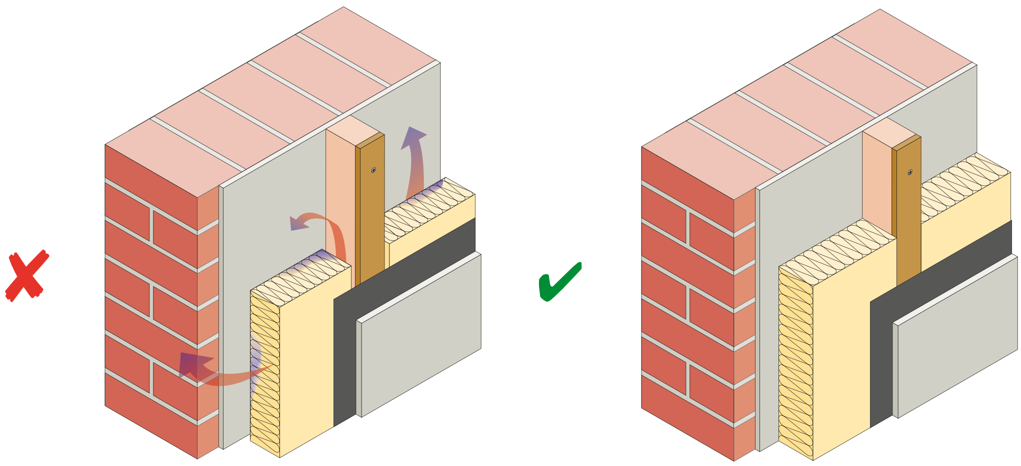


Figure 12: *Insulation boards must fit tightly against the wall finish and between the insulated battens. Gaps create air movement that degrade thermal resistance of insulation and heat is lost through external wall.*

To maintain integrity of the vapour control membrane, clamped joints must be used to achieve perfect sealing.

How to install in walls

5.2 Two Leaf Masonry Cavity Wall Construction (Full Fill Insulation)

This methodology creates an outer leaf of decorative masonry which acts as a rain screen and an inner leaf of structural masonry. The two leaves are usually tied together with metal wall ties and the minimum cavity width is usually 50mm.

In nearly all new build projects, the insulation will be placed in the cavity between the two leaves of masonry. The cavity width will almost always need to be greater than 50mm to accommodate insulation thickness which enables the wall to provide the thermal performance level required by building regulations, standards and codes.

In Figure 13, the insulation fully fills the cavity and is in intimate contact with the masonry on both sides of the cavity.

The insulation can also partially fill the cavity, but should only be in contact with the inner leaf, leaving a small residual airspace (see Figure **14**).

When insulation fully fills the cavity, the material should be water-resistant so it does not absorb water from the outer leaf, which would destroy its thermal value. The insulation can be built-in during wall construction in the form of slabs, or formed in-situ when injected into the cavity after the wall has been built. In all cases, there should be no gaps between built-in slab insulation, or voids within injected insulation. When installed, the product should be in intimate contact with the inner leaf of masonry to ensure full contact and there should be no cavities between the masonry and the insulation to avoid air circulation degrading the thermal resistance.

When placing insulation external to a masonry cavity wall, it is important to note that the cavity between the leaves must be effectively sealed, so that it cannot communicate with the external air or another unheated space. If not effectively sealed, there is a substantial risk that the insulation will be bypassed and not be effective. Fully filling in the cavity is an important step to enable sealing as it reduces free airspace and makes effective sealing at the perimeter much more likely.

If the insulation is fixed to the exterior it will require some form of rain protection (please refer to Figures **18** and **19**).

How to install in walls

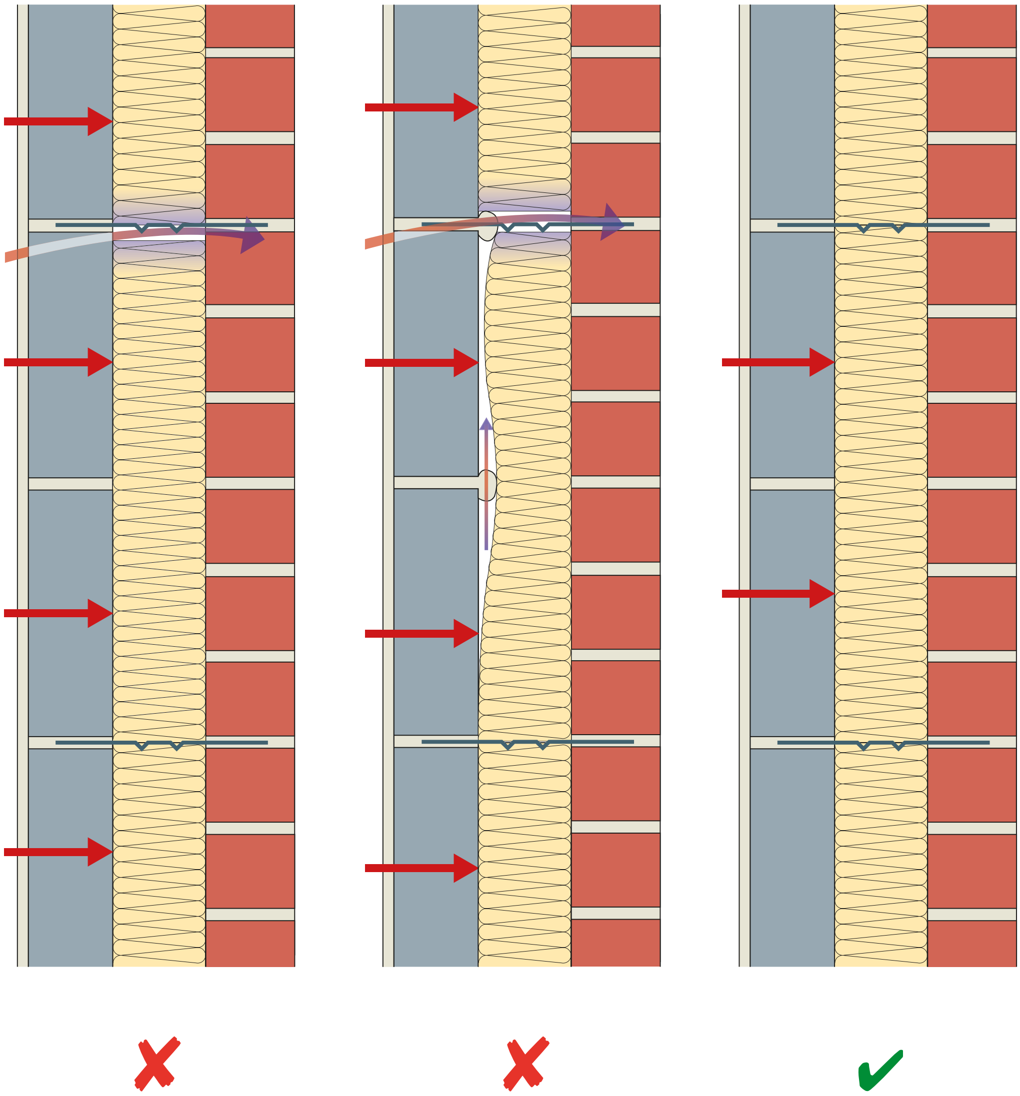


__Figure 13:__ Insulation boards must be in full contact with the supporting inner leaf and tightly fitted at joints. Gaps create air circulation which will degrade thermal resistance of insulation.

5.3 Two Leaf Masonry Cavity Wall Construction (Partial Fill Insulation)

In Figure 14, the slab insulation partially fills the cavity, leaving a small residual airspace between the outer leaf and the insulation. However, it must be be in full contact with the inner leaf to avoid air circulation degrading the thermal resistance. The insulation is supported on the metal wall ties and is held back to the inner leaf with clips. There should be no gaps in the insulation layer between slabs.

The possibility of air circulation is higher in partial fill than in full fill because there is a free airspace in the residual cavity.

Insulation is only likely to be fitted outside the the cavity during a thermal upgrade to an existing building. In this case, insulation can be placed either inside the inner leaf or outside the outer leaf. If the cavity was not already filled this would be a sensible first step, but this is not likely to provide sufficient thermal performance as standards improve, so it will be necessary to take additional insulation measures. It is also important to ensure no possibility of harmful condensation forming in the construction when placing insulation in two separate planes of a cavity wall construction.

When placing insulation external to a masonry cavity wall, It is important to note that the cavity between the leaves must be effectively sealed so that it cannot communicate with the external air or another unheated space. If not effectively sealed, there is a substantial risk the insulation will be bypassed and not be effective. Fully filling the cavity with mineral wool is an important step to enable the sealing of the cavity because it effectively reduces the free airspace of the cavity and makes effective sealing at the perimeter much more likely.

If the insulation is fixed to the exterior it will require some form of rain protection (please refer to Figures **18** and **19**).

How to install in walls

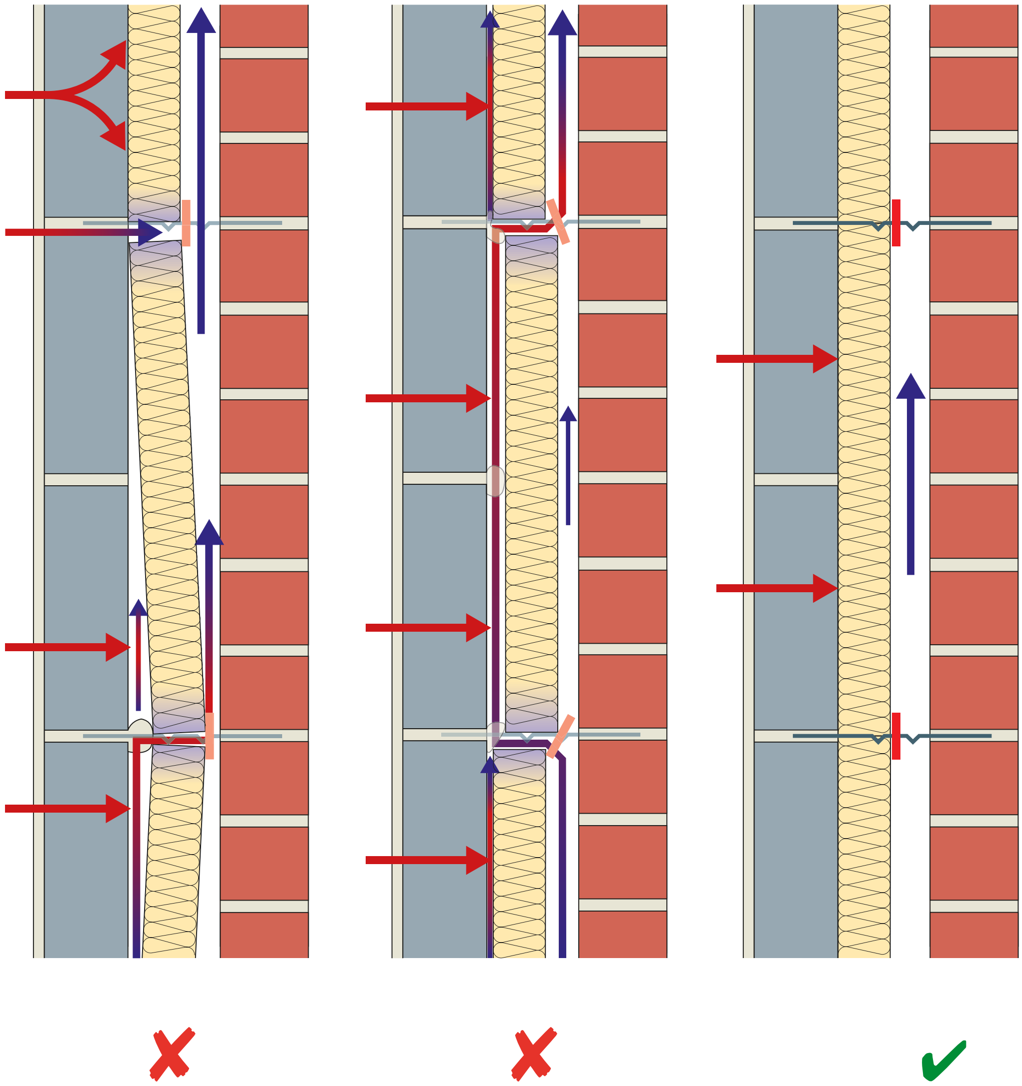


__Figure 14:__ Insulation boards must be in full contact with the supporting inner leaf and tightly fitted at joints. Gaps create air circulation that degrades thermal resistance of insulation.

5.4 Lightweight Frame Construction

Frame construction describes lightweight frames made from timber with associated linings. These individual wall elements may be either structural or purely infill between a more massive structural frame.

In frame construction, a water vapour membrane is usually necessary and will normally also provide the air barrier. The air barrier should be contiguous with the insulation as well as other building elements. Joints must also be properly sealed (See Figures **4**, **5**, **6a**, **6b** and **7**).

Insulation is usually placed between studs in a timber frame but may also be placed between and across the studs in timber frames where high levels of thermal performance are required. In all cases insulation should be contiguous with the air barrier and ideally completely fill void depths to restrict free airspaces.

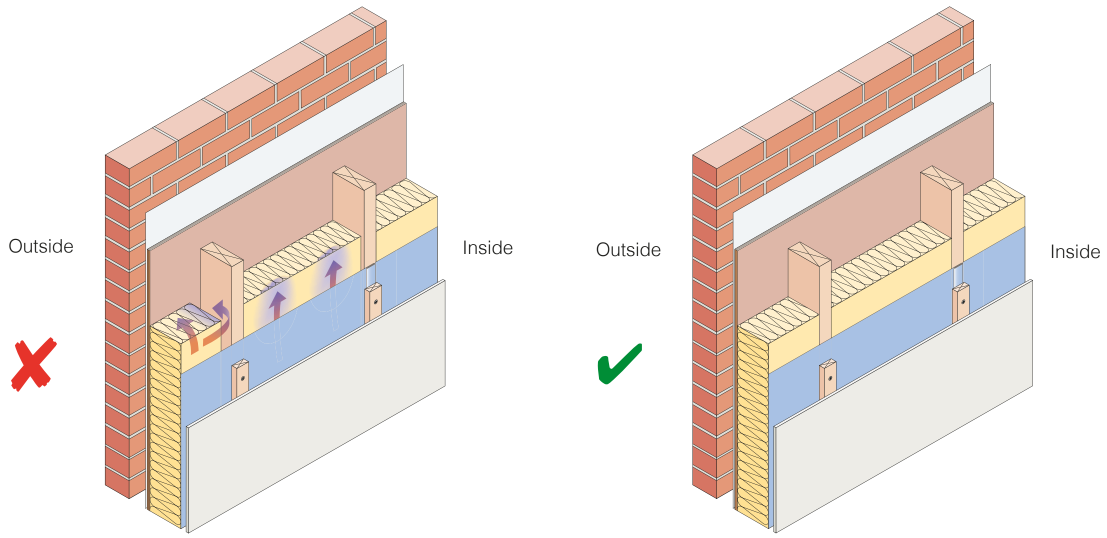


Figure 15: *Air tightness of the timber frame is required to maintain thermal resistance of air permeable insulation. It is achieved using a vapour barrier with perfectly sealed joints formed against the studs and contiguous with insulation, to avoid gaps that create air movement and subsequent heat loss (See Figure **6** for more details on the sealed joint method). Similarly, insulation should be the full thickness of studs and fit tightly between them.*

Where insulation is separated from the vapour barrier and gaps occur between insulation boards – or the insulation is not tight to the timber framing – the heat losses will considerably increase.

How to install in walls

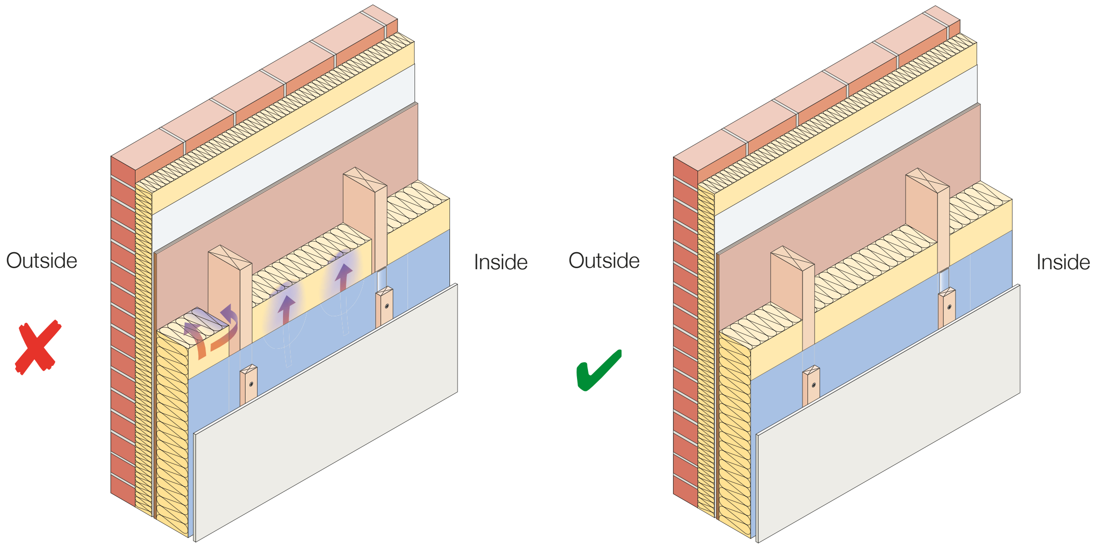


Figure 16: *Air tightness in timber frames is required to maintain thermal resistance of air permeable insulation. It is achieved using a vapour barrier with perfectly sealed joints formed against studs and contiguous with insulation, to avoid gaps that create air movement and subsequent heat loss (See Figure **6** for more details on the sealed joint method). Similarly, insulation should be the full thickness of studs and fit tightly between them.*

Where internal insulation is separated from the vapour barrier and gaps occur between insulation boards - or the insulation is not tight on the timber framing - and the heat losses will considerably increase.

Insulation positioned over studs will result in a construction with substantially reduced thermal bridging and lower heat loss.

How to install in walls

In light metal frames, insulation should always be placed across the frame to reduce the thermal bridging effect. If the insulation is placed wholly outside the frame then the air barrier must be located at that position, otherwise the air in the cavities behind the insulation is very free and there is a high risk a thermal bypass will render the insulation ineffective.

If the void inside the frame contains insulation, this will reduce the chance of a thermal bypass. However, it will be necessary to check that there is no risk from condensation forming on the outer sheathing of the frame. If insulation is placed on the inside of the frame, the risk of thermal bypass is equally reduced.

The air barrier should be contiguous with the insulation. The air barrier must also be continuous with other building elements, and joints properly sealed (See Figures **4**, **5**, **6a**, **6b** and **7**).

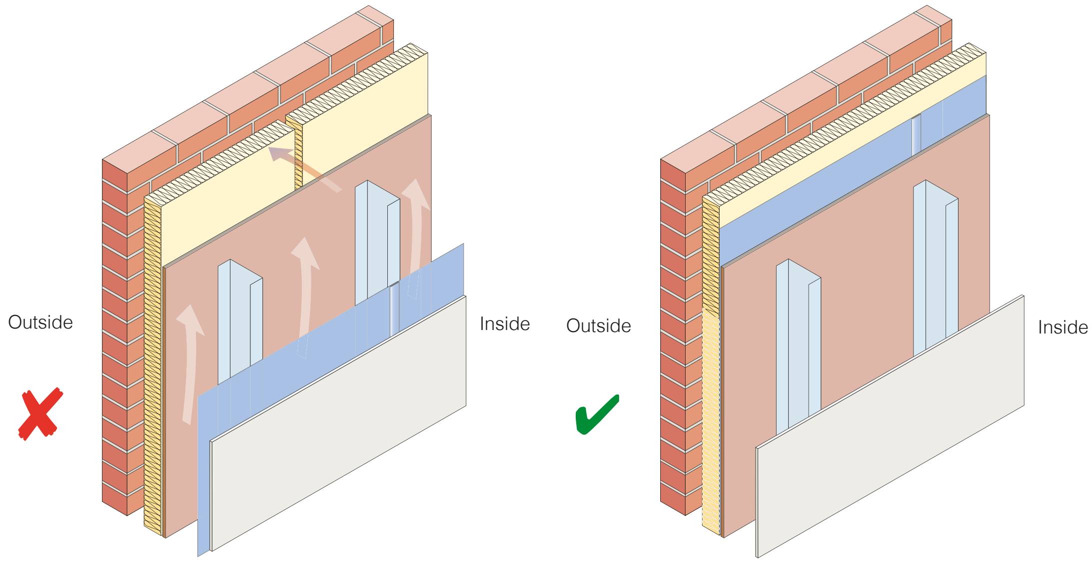


Figure 17: *The air barrier must be contiguous with insulation, and therefore positioned outside of the frame. If the air barrier is placed on the inside face of the frame, air and heat movement within the frame void could bypass the insulation, at weak points in the insulation layer.*

5.5 Concrete or Masonry Single Leaf Construction (External Insulation)

The concrete may be dense, lightweight or contain aggregates. The masonry may be brickwork or blockwork.

Figure 18 shows the insulation fixed with plastic pins or glued to a masonry wall before the exterior render is applied. The masonry surface should be flat and smooth to ensure full contact and there should be no cavities between the masonry and the insulation to avoid air circulation degrading the thermal resistance.

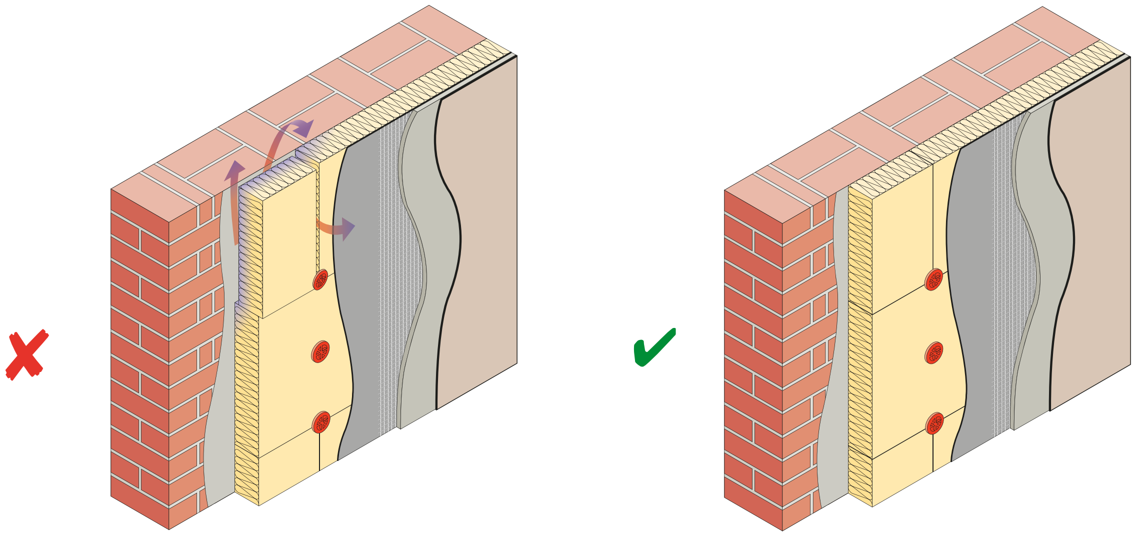
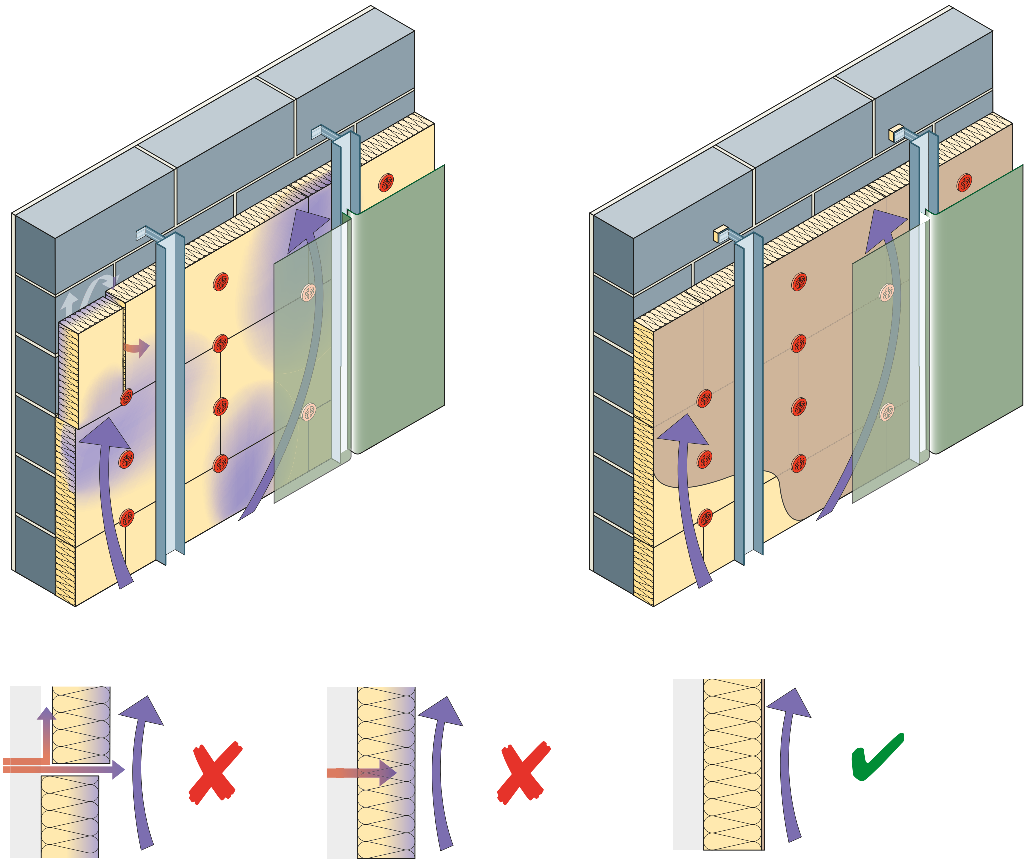


Figure 18: *Insulation boards must be in full contact with the wall and tightly fitted at joints. Any protuberance from the substrate that causes misalignment of the insulation boards is a potential source of heat loss. Gaps create air movement that degrades thermal resistance of insulation and heat is lost through external wall.*

How to install in walls

Figure 19 shows the insulation is fixed with pins or glued to a masonry wall before the exterior rain screen is fixed to its supporting brackets. The masonry surface should be flat and smooth to ensure full contact and no cavities between the masonry and the insulation to avoid air circulation degrading the thermal resistance. Gaps in the insulation can increase thermal transmissions up to 50%.



Insulation boards not in full contact with the wall and gaps between joints, result in heat loss.

Wind washing has a cooling effect on insulation without a membrane or other impervious facing. Thermal resistance of the insulation is reduced.

Wind washing has no cooling effect on insulation if a membrane or a dense glass is used. Insulation in full contact with wall and tightly fitted at joints. Thermal resistance of insulation is maintained.

Figure 19

5.6 Openings in External Walls

Openings should not be a source of uncomfortable, internal thermal conditions and consideration must be given to the thermal performance of frames and gazing. The air barrier must also be properly sealed to the frames and be continuous with other building elements. (See Figures **5**, **6a** and **6b**). This can be achieved using special tapes or glue following the advice of specific manufacturers.

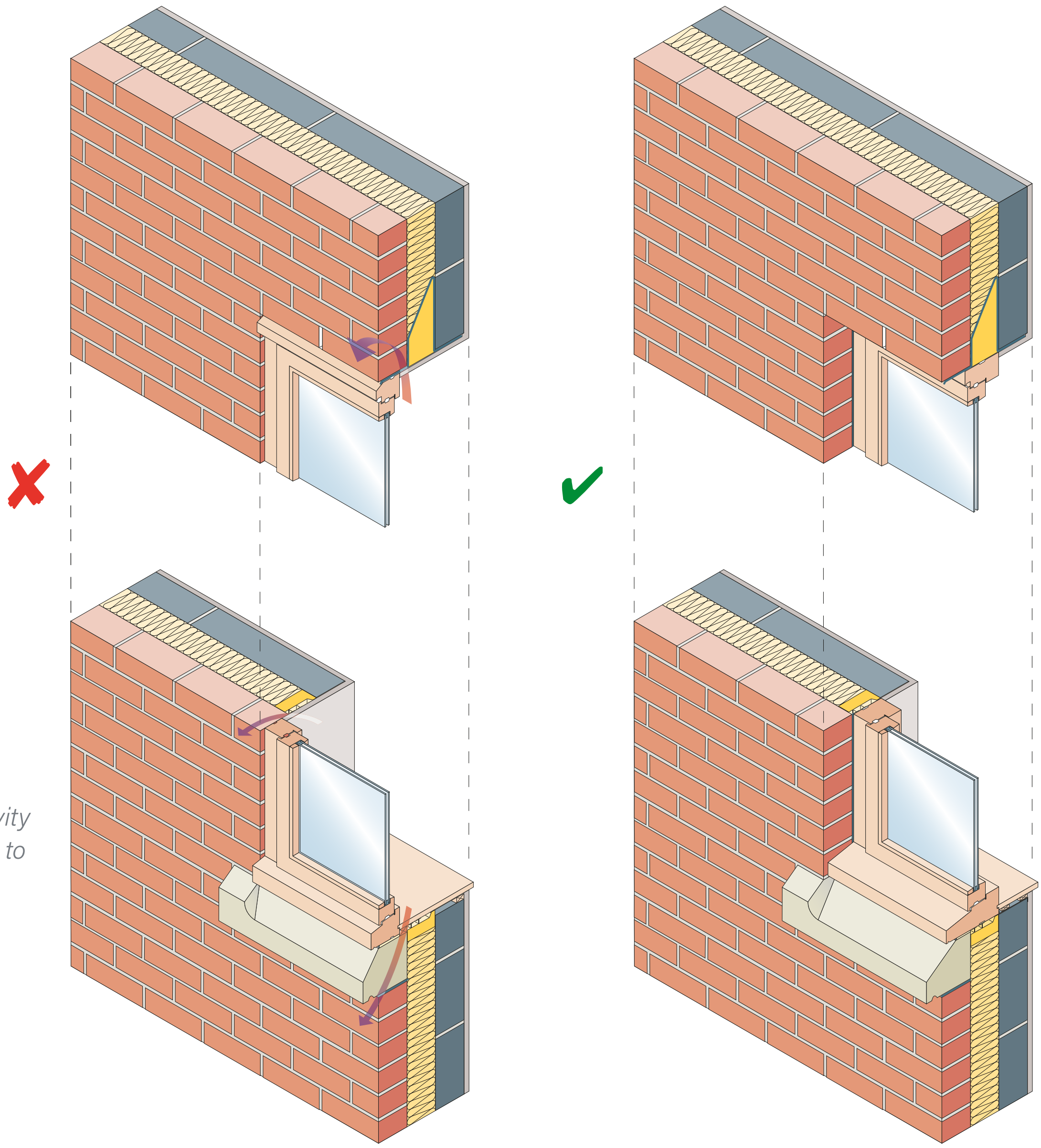


Figure 20: *To avoid thermal bridging, the cavity insulation must be taken to the back of the frame.*

To ensure airtightness at openings, the vapour control layer/air barrier must be sealed to the frame.

6.

How to install in roofs

How to install in roofs

6.1 Ventilated Pitch Roofs - New Build

If possible, a wind protection membrane should be installed. Otherwise, the manufacturer can indicate the most appropriate product depending on the climate and local rules. Insulation is generally placed between the rafters. It should also be placed between and across the rafters to reduce thermal bridges. The insulation should be contiguous with the air barrier. It should fill the void depth to restrict free airspaces.

A water vapour membrane is necessary and will normally also act as the air barrier.

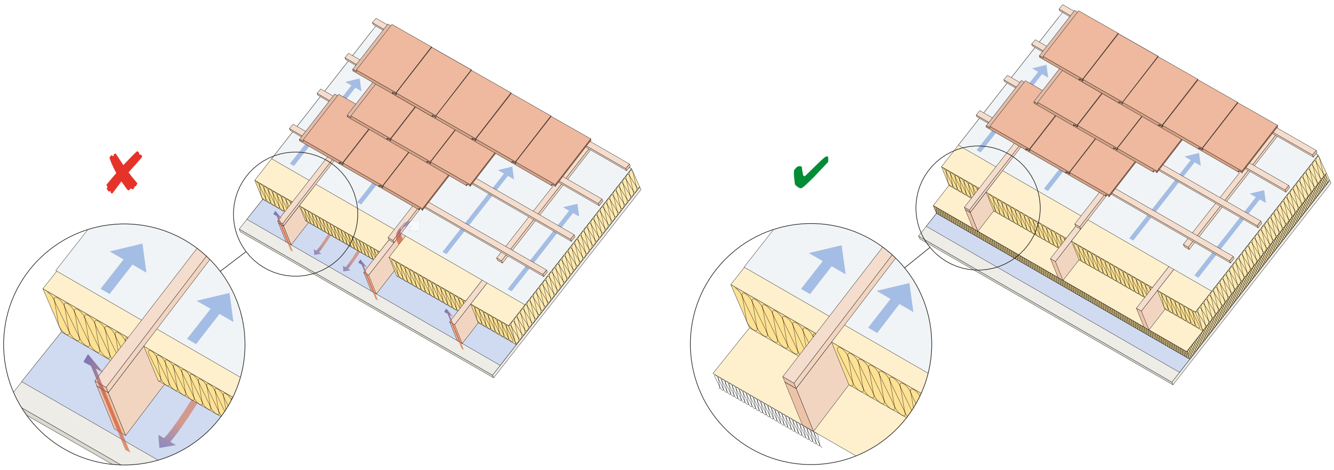


Figure 21: *A low vapour-resistant roof tile underlay allows water vapour to continuously escape into the ventilated space created by the counter battens. It also acts as a windproof layer to protect against loss of thermal performance of the insulation.*

Air tightness of the roof is required to maintain thermal resistance of air-permeable insulation, achieved using a vapour barrier with perfectly sealed joints, contiguous with the insulation to avoid gaps that create air movement and subsequent heat loss. See Figure ***6*** *for details of sealed joint method. For similar reasons, the insulation should be the full thickness of rafters and fit tightly between them. To avoid thermal bridging, additional insulation should be placed across the rafters.*

6.2 Ventilated Pitch Roofs - Renovation Solution

Insulation is generally placed between the rafters. It should also be placed between and across the rafters to reduce thermal bridges. The insulation should be contiguous with the air barrier. It should fill the void depth to restrict free airspaces.

A water vapour membrane is necessary and will normally also act as the air barrier.

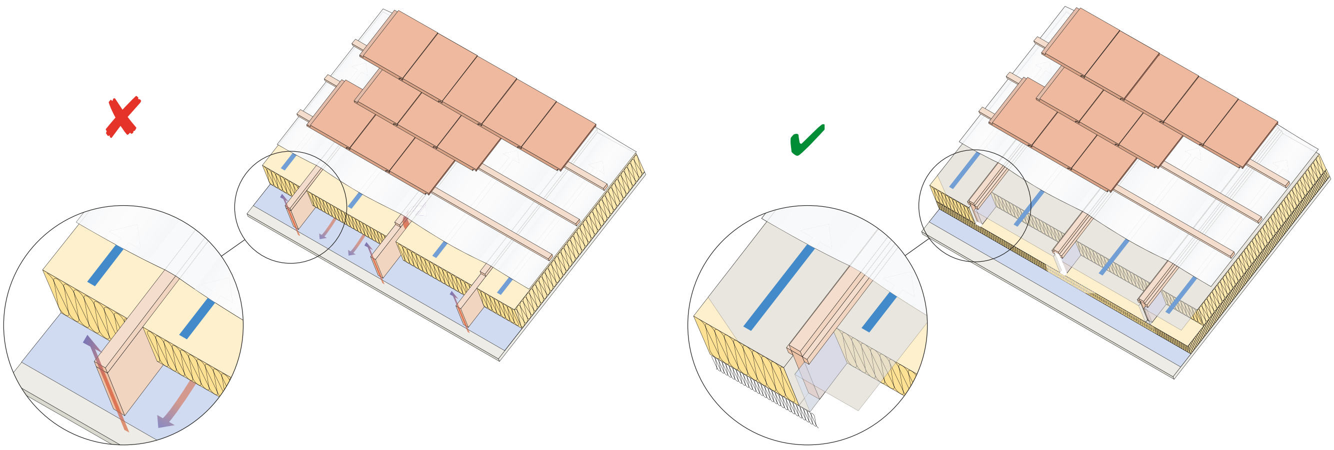


Figure 22: Where a roof is being upgraded without removing the roof covering, it is necessary to maintain a ventilation path. If the insulation is not protected, it could be subjected to wind washing. This can be avoided by installing a low vapour resistance membrane above the insulation (as shown) whilst maintaining the ventilation space.

The roof's air tightness is required to maintain thermal resistance of air-permeable insulation, achieved using a vapour barrier with perfectly sealed joints, contiguous with the insulation to avoid gaps that create air movement and subsequent heat loss. See Figure ***6*** *for details of sealed joint method. For similar reasons, the insulation should be full thickness of rafters and fit tightly between them. To avoid thermal bridging, additional insulation should be placed across the rafters.*

6.3 Flat or Low Pitched Roofs

To avoid gaps between boards reducing the thermal resistance of the roof insulation, dimensional tolerances should be less than 5mm on flat or low pitched roofs with insulation on top of a concrete roof construction.

This construction leads to excellent thermal efficiency, with almost no thermal bridges and enables a nearly foolproof installation.

The insulation boards are fixed by hot bitumen or mechanical means (screws, anchors etc). This is due to corrugated metal being deformed by the weight of the workmen when installing the insulation, where the bond is broken before the bitumen sets.

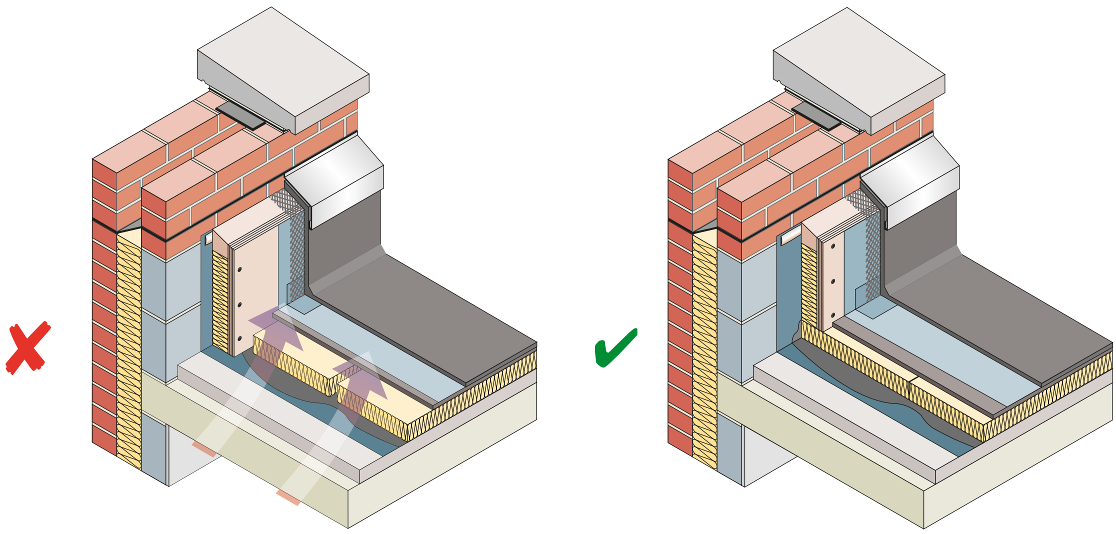


Figure 23: *To avoid heat loss via the roof construction, ensure the deck insulation boards are tightly butted together and also sealed at the junction with perimeter upstand.*

How to install in roofs

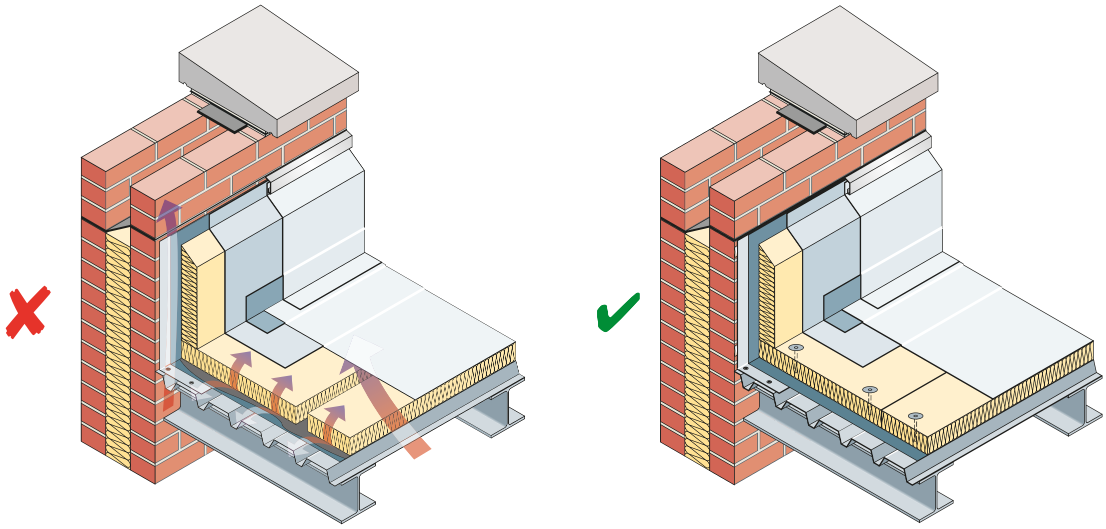


Figure 24: *To avoid heat losses via the roof construction, ensure the deck insulation boards are tightly butted together and preferably mechanically fixed. The perimeter metal should also be sealed to the perimeter wall to prevent ingress at the rear.*

Hot bitumen bonding of the insulation to corrugated decking often results in adhesion loss due to deformation of corrugated decking by the workmen during installation, before setting occurs. This can lead to air movement at interface and degrading of thermal resistance, as well as wind uplift.

7.

How to install in floors

How to install in floors

7.1 Suspended Timber Floors

For suspended timber floors, insulation is generally placed between the floor joists. In this case, the insulation should be placed in full contact with the underside of the floor deck and fit tightly to the sides of the rafters. The insulation should be supported at the design depth to prevent slumping. The air barrier must also be continuous with other building elements and joints properly sealed (See Figures **4**, **5**, **6a**, **6b** and **7**).

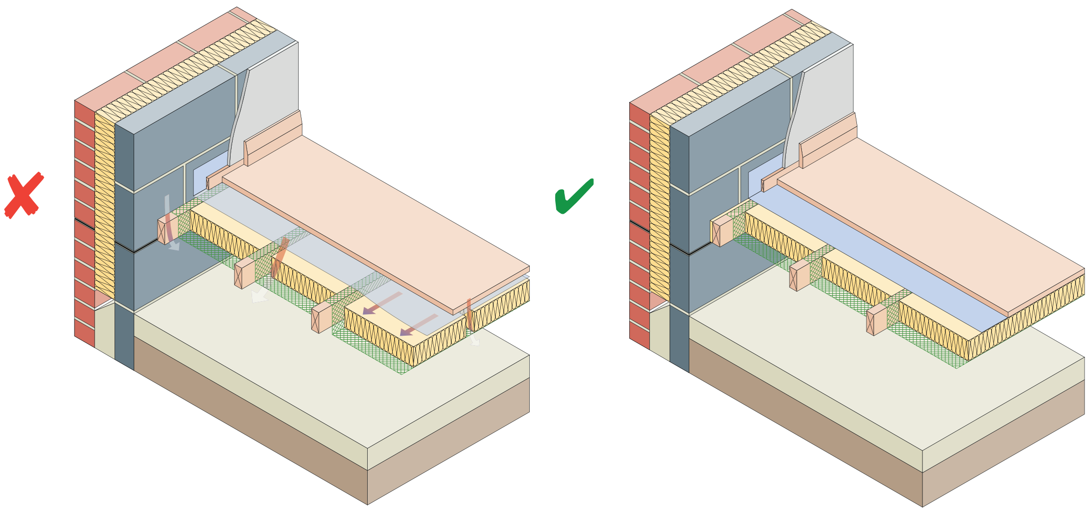


Figure 25: *To avoid heat losses through the vented, suspended timber floor construction, ensure the insulation is tightly fitted between the floor joists and is in full contact with the underside of the floor deck. The perimeter joists should be sealed to the perimeter wall to prevent air ingress and subsequent heat loss. To ensure continuity of the building's airtightness, the air barrier should be turned up at the perimeter wall and overlapped by the plaster finish.*

How to install in floors

7.2 Suspended Concrete Floors

For suspended concrete floors, the insulation should be placed in full contact with the underside of the floor deck and fit tightly to the sides of the floor battens. The air barrier must also be continuous with other building elements and joints properly sealed (See Figures **4**, **5**, **6a**, **6b** and **7**).

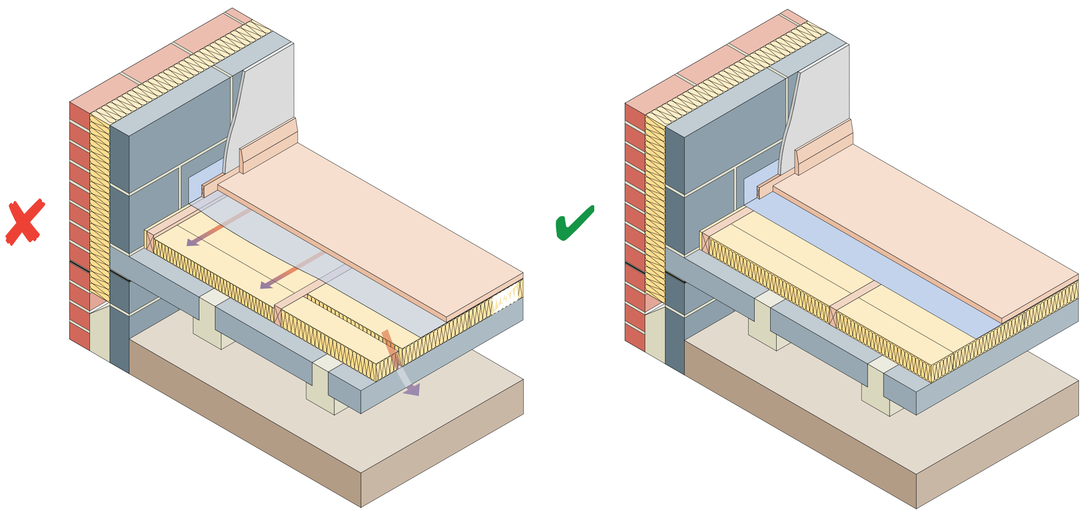


Figure 26: *To avoid heat losses through the vented, suspended beam and block floor construction, ensure the insulation is in full contact with the underside of the floor deck and insulation boards are tightly butted together. The perimeter deck fixing battens should preferably be insulated to enhance thermal performance of the floor. To ensure continuity of the building's airtightness, the air barrier should be turned up at the perimeter wall and overlapped by the plaster finish.*

How to install in floors

7.3 Groundbearing Concrete Floors

The insulation is placed on top of the dpm and the concrete is poured on top of the insulation. Care is needed to keep all joints between insulation boards tight.

It is important to consider insulation's compressive creep. There are examples where low quality products have lost significant thickness, and consequently, resulted in reduced thermal performance.

The air barrier must also be continuous with other building elements, and joints properly sealed (See Figures **4**, **5**, **6a**, **6b** and **7**).

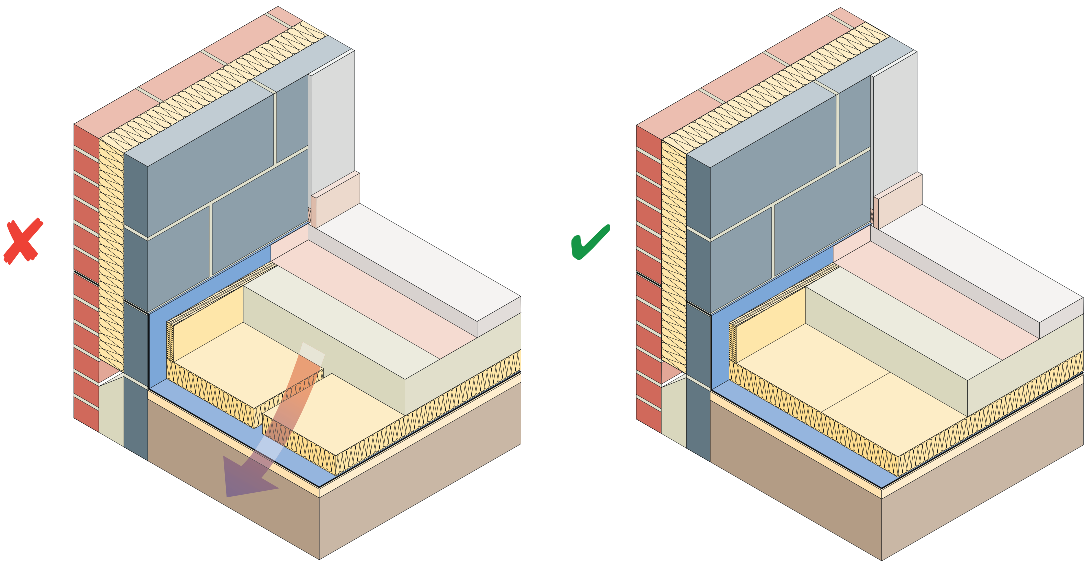


Figure 27: *Ground floor in-situ concrete slab. Ensure insulation boards are tightly butted together to avoid heat loss to ground.the air barrier should be turned up at the perimeter wall and overlapped by the plaster finish.*