



TECHNICAL MANUAL

VERSION 11

6: EXTERNAL WALLS

6. External Walls

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Limitations of Functional Requirements

1. These Functional Requirements do not and will not apply to create any policy liability for any remedial works carried out by the contractor or otherwise, nor to any materials used in those remedial works.
2. The guidance provided in this Section, is guidance that provides a suggested solution to meeting the Functional Requirements. If an alternative solution is selected, then this must still meet the Functional Requirements.

Workmanship

1. Evidence will be required to confirm that an 'Approved installer' for external wall cladding systems has undertaken the work if required by the terms of the manufacturer or third party certifications.
2. Any multiple occupancy building (which includes flats /apartment accommodation) must have fire stopping and cavity barriers completed by a third-party approved contractor, or have a suitable quality assurance process provided to evidence the installation of the fire stopping and cavity barriers. This is applicable to all floor levels of a building that has a floor 4.5m above the lowest external ground level.
3. All work is to be carried out by a technically competent person in a workmanlike manner.
4. Concreting shall not take place during cold weather periods where the working temperature is below 2°C or where ground conditions are frozen.

Materials

1. Steel frames and lintels should be appropriately treated to prevent corrosion.
2. All materials should be stored, installed and protected correctly in a manner that will not cause damage or deterioration of the product.
3. All materials, products and building systems shall be appropriately tested and approved for their intended purpose.
4. All load bearing structural elements providing support to the Home will have a service life of not less than 60 years, unless specifically agreed otherwise with us. All other parts of the Home will have a lesser durability and need planned maintenance, repair or replacement during that reduced period.
5. Whilst there is and can be no Policy responsibility and/or liability for any roof covering, window / door or 'Decorative external cladding' (i.e. Cladding which is decorative only and the substrate wall provides the main weather proof barrier) to achieve a performance service life of 60 years or less, such elements shall be designed and constructed so they have an intended service life of not less than where stipulated within this Manual.
6. Timber should be adequately treated or finished to resist insect attacks and be suitable for the position used within the structure. All timber treatment should be in accordance with relevant British standards and Codes of Practice.
7. Timber used in the building to provide support to the structure must be appropriately seasoned to prevent excessive shrinkage and movement.
8. All materials should be suitable for the relative exposure of the building in accordance with the relevant British Standards.
9. Reclaimed materials may only be reused with the prior agreement with the Warranty Surveyor. Independent certification and/or testing of the suitability may be required.

Design

1. External walls shall be designed and constructed so that they:
 - a. Are structurally sound;
 - b. Are durable and resistant to moisture;
 - c. Have an adequate thermal performance;
 - d. Prevent the entry of hazardous substances from the ground into the building.
2. Framed structures must be supported by structural calculations completed by an Engineer. The design and construction must meet the Building Regulations.
3. The design and specifications shall provide a clear indication of the design intent and demonstrate a satisfactory level of performance.
4. The following additional elements shall be supported by structural calculations designed by an Engineer:
 - a. Structural elements outside the parameters of Building Regulations.
 - b. Specialist structural works.
 - c. Reinforced concrete elements.
 - d. Precast structural elements.
 - e. Any engineered beams/posts manufactured off-site.
5. Projects consisting of Non-standard/Modern methods of construction must be supported with evidence of valid independent third party product conformity certification before an offer of Warranty is provided. These types of constructions must be declared before commencement.

6.

External Walls

6.1 Traditional Masonry Cavity Wall

Provision of information

A full set of design drawings and specifications shall be made available to the Warranty Provider and all other interested parties prior to the associated works starting on site. This may include:

1. Details of all proposed materials to be used in the construction of the external wall.
2. A full set of detailed drawings, including:
 - a) Plan layouts indicating dimensions, movement joints, position and size of openings, buttressing walls, etc.
 - b) Elevations with dimensions shown.
 - c) Junction details showing position of DPC's, cavity trays, other building elements such as roofs, floors, etc.
3. Engineers calculations and drawings for elements of load bearing masonry.
4. Masonry cladding and support systems. To include general arrangement drawings, sections and site specific supporting calculations (including a drawing register).

The Warranty Surveyor, at their discretion, may also request supporting information that demonstrates suitability for use of any materials or systems contained within the above.

Structural design of walls

A method of meeting the requirements of the Warranty is to design and construct walls to the relevant Building Regulations depending on the region. For example, in England and Wales, the masonry units should be built in accordance with Approved Document A (Structure). Alternatively, justification of design by an Engineer can be used as a solution.

Dealing with areas of high exposure to frost and wind-driven rain

The design and construction of masonry cavity walls should be suitable for the site specific exposure location. For further information on determining the exposure for the site location please see BS 8104 and BR 262 for further guidance.

The suitability of full fill cavity insulation in exposure locations

The following table outlines the minimum cavity widths for full fill insulation types in varying exposure locations. Full fill cavity wall insulation with only fair faced masonry is not suitable for very severe exposure zones as detailed in the table.

Suitable cavity wall construction depending on exposure, for use with full fill cavity insulation

Exposure category	Suitable wall construction (max 12m in height)	Minimum insulation thickness (mm)		
		Built-in insulation	Retro-fill (other than UF foam) - Blown in mineral wool, polystyrene beads etc.	Urea Formaldehyde Foam - UF foam
Very Severe (Exposure zone 4)	Any wall with impervious cladding	50	50	50
	Fair-faced masonry with impervious cladding to all walls above ground storey	100	100	Not permitted
	Any wall fully rendered ⁽²⁾	75	75	Not permitted
	Fair-faced masonry ⁽¹⁾	Not permitted		
Severe (Exposure zone 3)	Any wall with impervious cladding or render ⁽²⁾	50	50	50
	Fair-faced masonry with impervious cladding or render ⁽²⁾ to all walls above ground storey	50	75	50
	Fair-faced masonry ⁽¹⁾	75	75	Not permitted
Moderate (Exposure zone 2)	Any wall with impervious cladding or render ⁽²⁾	50	50	50
	Fair-faced masonry with impervious cladding or render ⁽²⁾ to all walls above ground storey	50	50	50
	Fair-faced masonry	50	75	75
Sheltered (Exposure zone 1)	Any wall with impervious cladding or render.	50	50	50
	Fair-faced masonry with impervious cladding or render to all walls above ground storey	50	50	50
	Fair-faced masonry	50	50	50

Notes:

(1) In very severe exposure locations, fair-faced masonry with full fill cavity insulation is not permitted.
 (2) Render on an external leaf of clay bricks (F2, S1 or F1, S1 designation bricks BS EN 771) in severe or very severe exposures is not permitted where the cavity is to be fully filled with insulation.

- This table covers walls where the external leaf does not exceed 12m in height.
- The exposure category of the building is determined by its location on the map showing categories of exposure to wind-driven rain (see the 'External Walls – Claddings' section and also BRE Report 262).
- Fair-faced masonry includes clay, calcium silicate and concrete bricks and blocks and dressed natural stone laid in an appropriate mortar, preferably with struck, weathered or bucket handle joints. Cavity walls of random rubble or random natural stone should not be fully filled.
- Recessed mortar joints should not be used.

Additional requirements in a coastal location

Where developments are within a coastal location additional Warranty requirements should be met.

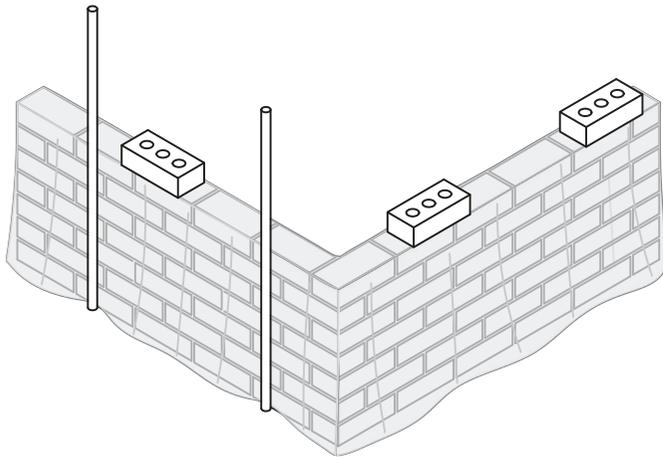
For the purpose of this Technical Manual we are considering sites within 5km inland from the shore line or sites located in 'tidal' estuarine areas where they are within 5km of the general shoreline.

Further information on Warranty requirements within a coastal location can be found in 'Appendix B - Coastal Locations'.

Protection of masonry

All new masonry work should be protected during construction by covering it to ensure that walls are not allowed to become saturated by rainwater, dry out too quickly in hot weather, are protected against frost attack, the risk of efflorescence and line staining and movement problems are reduced.

Any temporary cover should not disturb the new masonry.



Working in adverse weather

Precautions should be taken when necessary to maintain the temperature of bricks, blocks and mortar above 2°C. The use of anti-freeze as a frost resistant additive in mortar is not permitted. Please refer to 'Appendix C - Material, Products, and Building Systems' for further guidance.

During prolonged periods of hot weather, when masonry units can become very dry, absorbent clay bricks may be wetted to reduce suction. Low absorption bricks, i.e. engineering bricks, should not be wetted. For calcium silicate and concrete units, the mortar specification may need to be changed in order to incorporate an admixture.

Brick and block suitability

Bricks and blocks should:

- Be capable of supporting proposed loads.
- Comply with BS EN771 and PD 6697.
- Have appropriate compressive strength in accordance with the Building Regulations.

Exposure

Facing bricks must have a suitable level of durability and particular attention should be paid to the brick's resistance to frost and moisture. Further information can be found in 'Appendix C - Material, Products, and Building Systems'.

Colour variation of bricks

There is usually a variation in the colour of bricks of the same style. To prevent patching of colour, it is recommended that at least three packs of bricks are opened at any one time and mixed randomly to ensure that the wall is of an even colour.

Frogs and perforations

Frogged bricks have a depression in the face of the brick. Normally, they should be laid with the major depression, or frog, facing up so that it is fully filled with mortar during laying. This ensures optimum strength, helps to increase the mass of the wall (to give good sound insulation) and prevents the possibility of standing water within the structure, which could freeze. Bricks with a directional surface texture are intended to be laid frog up.

Care should be taken with the use of perforated bricks where the exposure rating of the wall is high, as water retention/collection has been found to exist in the perforations.

Efflorescence

Efflorescence is a white deposit on the face of masonry brought about by water moving through the wall, dissolving soluble salts and depositing them when the water evaporates during drying out.

Efflorescence is best prevented by:

- Keeping all units dry prior to use.
- Protecting the head of newly constructed work with some form of cover to prevent saturation.

Frost attack

Frost attack can occur through the repeated action of rain water freezing and thawing. When water turns into ice, there is increase in volume which can eventually cause stresses to masonry units and lead to spalling. This can be avoided by specifying freeze/thaw resistant bricks in areas that are prone to prolonged periods of saturation.

Common influences which can lead to frost attack include:

- The freeze/thaw resistance of the masonry units.
- Saturation of the masonry.
- Degree of exposure to wind driven rain.
- Localised protection from other buildings, topography, roof overhangs, coping or capping.

The following details can reduce persistent wetting and lessen the risk of frost attack:

- Parapet walls should have a coping or capping (for further guidance on parapet walls, see 'External Walls - Parapets').
- Sills and coping should have a weathered upper surface.
- Paths around the building should drain away from walls to avoid saturating brickwork.
- Masonry and mortar specification should be in accordance with PD 6697
- As a quick guide, Freeze/thaw resistant masonry units should be selected using the recommendations in the following table.

Freeze/thaw resistance categories:

Freeze/thaw resistance category	Possible use case*
F2 – Severe exposure to freeze/thaw	Can be used in normal building situations and all exposures to wind driven rain. F2 rated masonry units should be used: <ul style="list-style-type: none"> • Below DPC • Brickwork plinths • Chimneys • Capping, coping and sills
F1- Moderate exposure to freeze/thaw	Provides a moderate freeze/thaw resistance and in general F1 rated masonry units can be used between DPC and eaves. However they should not be used in areas of severe or very severe exposure to wind driven rain or elevated sites.
F0 – Passive exposure to freeze/thaw	Not freeze/thaw resistant – should not be used externally unless completely protected by impermeable cladding

Please note, the possible use cases are not an exhaustive list. In all situations, confirmation of suitability of the masonry unit for the intended use must be confirmed by the manufacturer of the masonry units and reference to PD 6697.

The following should also be considered in relation to the freeze/thaw of brickwork:

- External painted finishes on brickwork has the potential to trap moisture and as such the manufacturer should be consulted to ensure the decorative finish will not have a detrimental impact on brickwork durability.
- Masonry units with low soluble salts should be specified where there is a risk of brickwork being persistently wet.
- Most concrete bricks have a strength of 22N/mm² and are durable in most situations and are equivalent to frost resistance class F2 for clay bricks. For copings and sills, bricks with a compressive strength of 36N/mm² should be used.
- Concrete blocks used in the outer leaf without protective cladding or render must have a compressive strength greater than 7.3N/mm² or have a density of at least 1,500kg/m³.
- In Scotland, all clay bricks used externally should be frost-resistant, F2, S2 or F2, S1 to BS EN 771-1 and all concrete bricks used as facings should be 22 N/mm² to BS EN 771-3.
- In areas of severe and very severe exposure to wind driven rain, the following should be specified:
 - Clay facing bricks which are frost-resistant F2, S2 or F2,S1 to BS EN 771-1.
 - Concrete bricks with a minimum strength of 22N/mm² to BS EN 771-3.
 - Concrete blocks with a minimum density of 1,500kg/m³ or compressive strength greater than 7.3N/mm².
 - Calcium silicate masonry units must be confirmed to be F2 rated to BS EN 771-2 by the manufacturer
 - Most types of aircrete blocks with render.

If there are any doubts about the suitability of facing bricks in areas of severe frost exposure, written clarification by the brick manufacturer confirming the suitability of the brick should be provided.

Reclaimed bricks

Due to difficulties in testing the durability of the exact batch proposed to be used, reclaimed bricks should not be used for Warranty purposes.

Mortar

General

A mortar type above DPC should be chosen in accordance with the guidance given in the 'External Walls' and 'Appendix C - Material, Products, and Building Systems' sections, or as recommended by the brick or block manufacturer. To ensure adequate durability, strength and workability, lime and/or air entraining plasticisers may be added to cement in accordance with the manufacturer's recommendations. Cement and sand alone should not be used unless a strong mix is specifically required by the design.

Batching

Keep batching and mixing equipment clean to avoid contamination with materials used previously.

Mixing

Our preference is, that mortar should be mixed by machine, or use ready mixed rendered mortars. Mortar should be carefully and consistently proportioned and then thoroughly mixed using a mechanical mixer, except for very small quantities. Quality control procedures must be in place where non-ready mixed mortars are used.

Stability during construction

Gable walls should be appropriately propped prior to the construction of any roof. When a floor or roof slab of a building is used for the temporary storage of building materials, the loading should not exceed the design loading for the element.

Key points: Construction below DPC

1. Brickwork and blockwork must be selected to have suitable durability for its use in the wall construction in accordance with BS EN 771-1 and PD 6697.
2. Mortars below DPC are exposed to higher levels of saturation and therefore require higher durability classification (see BS EN 998-2).
3. Cavities below ground should be filled with concrete ensuring there is a minimum gap of 225mm between DPC and the top of concrete.
4. Concrete for cavities should be GEN 1 grade and a consistence class S3.
5. External ground levels should be a minimum of 150mm below DPC.
6. The compressive strength of the masonry units must meet the requirements of the Building Regulations.

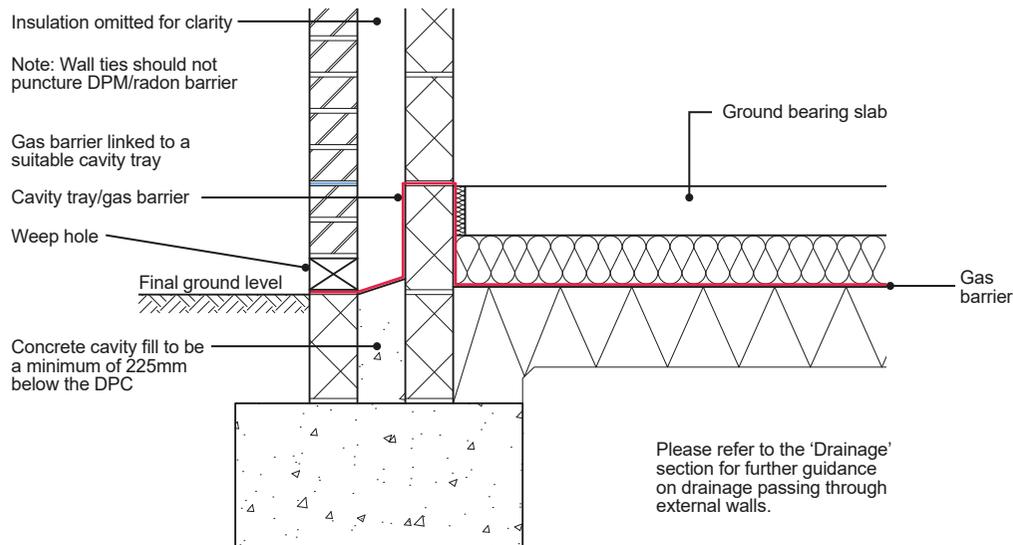
Damp proof courses (DPC)

1. DPC's should be of a flexible material, be suitable for the intended use, the DPC should have appropriate 3rd party certification. The installation specification of DPC's should follow good design practice in accordance with BS 8215.
2. Blue bricks or slate will not be accepted as a DPC.
3. DPC's should be laid on a mortar bed and correctly lapped at junction and corners. The depth of the lap should be the same width as the DPC.
4. The DPC should not bridge any cavity unless it is acting as a cavity tray where a cavity is required (e.g. over a telescopic floor vent).
5. Damp proof membranes should be lapped with the DPC a minimum overlap of 100mm. DPM's should be at least a minimum 1200 gauge thickness.

Rendering below DPC

1. Rendering below DPC should only be carried out using a specialist render manufacturer's specification. No render system should bridge the DPC and a proprietary uPVC bead or stainless steel bead should be used above and below where the renders meet at the DPC.
2. DPC should extend through the rendering system in between the bellcast beads or render stop system.
3. For bellcasts, uPVC beads or stainless steel beads are acceptable.

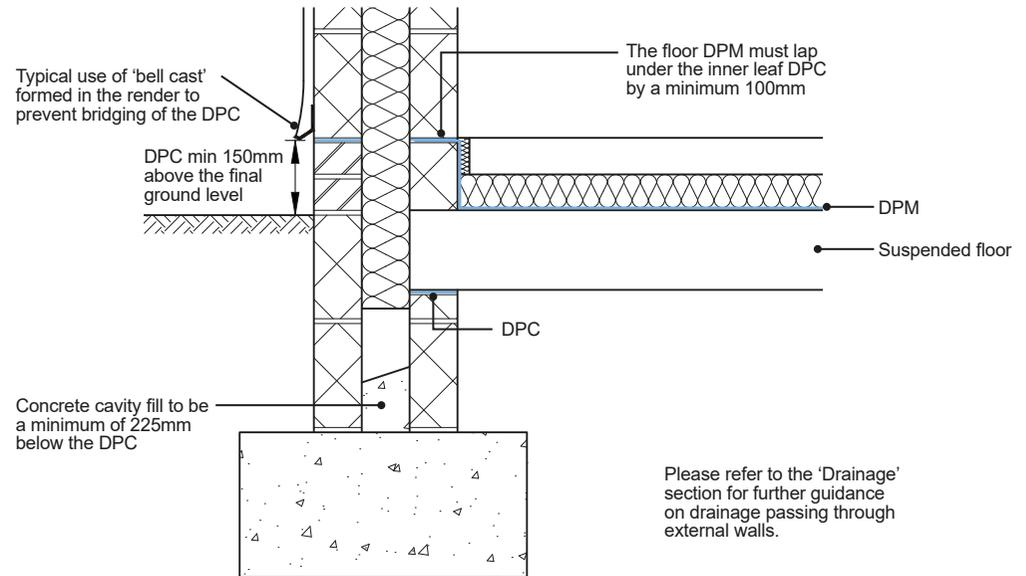
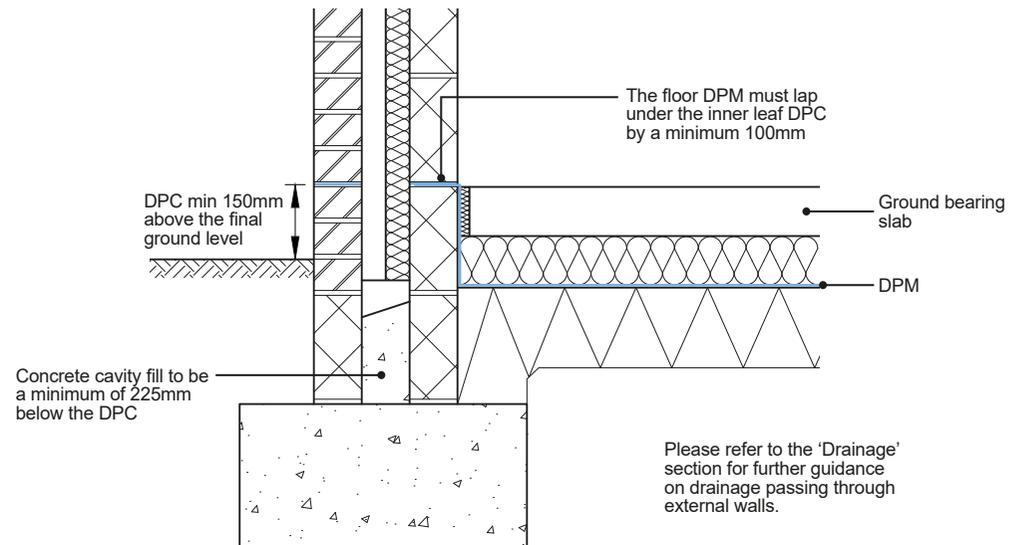
Note: For further guidance on the application of render please refer to the 'External Walls - Render' section.

Typical gas barrier arrangement: Traditional ground bearing slab

All of the drawings shown in this sub-section are strictly in relation to our Warranty requirements. Please refer to the Building Control Body to ensure the detailing achieves compliance with relevant Building Regulations in respect of thermal and fire requirements.

DPC and DPM arrangement: Suspended floor

Example shown with a rendered wall

**DPC and DPM arrangement: Traditional ground bearing slab**

Cavities

A traditional masonry wall should be constructed using an inner and outer leaf, and a cavity should be provided between them, which meet the following provisions:

- The cavity should have a minimum width of 50mm.
- It is to be kept clear from mortar spouts to ensure the cavity is not bridged.
- The two leaves should be appropriately tied.
- The cavity can be fully or partially insulated, depending on exposure to wind driven rain. For partial fill insulation, a minimum clear residual cavity of 50mm should always be provided. Further information can be found in BS 8104.
- A 75mm minimum residual cavity will be required to partial fill insulated cavities in very severe exposure locations.
- For very severe exposure locations, fair faced masonry with a full fill cavity insulation is not permitted. A partial fill insulation will be necessary.
- Bricks should be capable of supporting proposed loads.
- Bricks should comply with BS EN771 and PD 6697.

Cavity barriers

- Cavity barriers should be provided in the external cavity at all compartment walls and floor junctions.
- Cavity barriers should have suitable third party accreditation.

Rendering on a masonry background

The walls which are to be rendered should be examined for excessive moisture content prior to rendering and suitable to receive rendering. Rendering should only be completed if the outside temperature is at least 2°C. There should be no frost within the construction and rendering should not take place where freezing weather conditions are expected before curing.

Ensure that all joints are finished flush with the surface to avoid shade variations.

The wall construction should not include dissimilar materials that may increase the potential of cracking due to differential thermal movement and effects that the different suction that each type of background material may create.

To control suction, always apply a specialist sealer key coat or suitable render preparatory coat. Allow a minimum of 48 hours for the key coat to fully dry before applying the next coat.

Note: For further guidance on the application of render please see the 'External Walls - Render' section.

Thermal insulation

Thermal insulation for cavity walls should be inserted to a high standard of workmanship to avoid poor insulation performance and to prevent dampness migrating to the inside of the building:

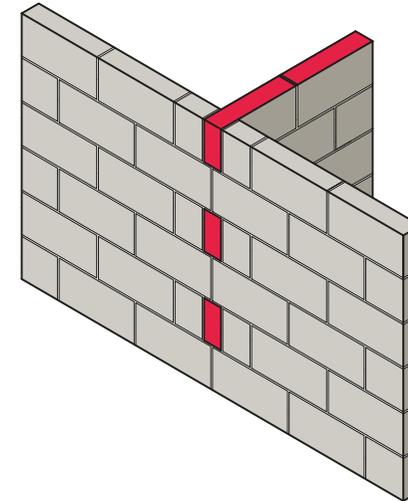
- Insulation should have appropriate third party certification and be installed in accordance with the manufacturers instructions.
- Insulation should not be cut or pierced to accommodate wall ties, unless increased centres at reveals or expansion joints are required.
- The wall ties should coincide with insulation joints.
- Partial fill insulation should be clipped or retained to the inner leaf using proprietary fixings in conjunction with wall ties.
- For full fill cavities, mortar joints to facing brickwork should not be recessed.
- Render on an external leaf of clay bricks (F2, S1 or F1, S1 designation bricks BS EN771) in severe or very severe exposures is not permitted where the cavity is to be fully filled with insulation. Partial fill cavity insulation should be adopted.

Bonding internal walls to external cavity walls

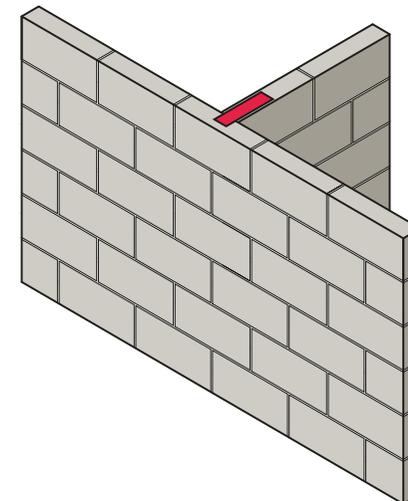
Bonded walls in brickwork are comparatively easy to construct, but this can be more difficult with blockwork, so either:

- Tooth every alternative course, or butt and tie.
- Where blocks are of a different density, always use a butted joint; party walls carry the separating wall through and butt up the inner leaf using a proprietary bed joint, reinforcement or suitable ties at each block course.

Block bonding internal masonry walls to the inner leaf



Block bonding internal walls to the inner leaf using ties



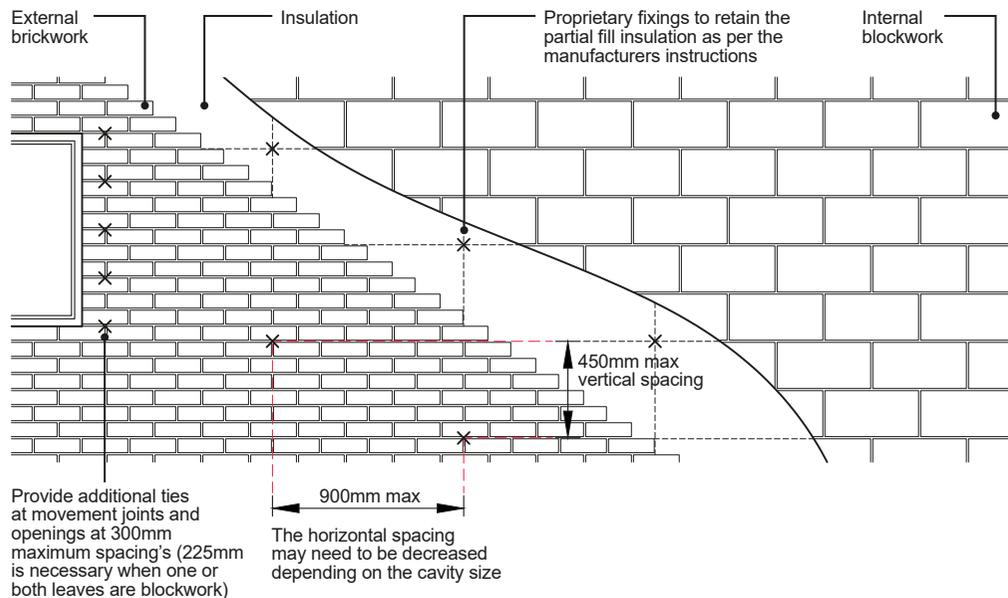
Suitability and spacing of wall ties

Unfilled or fully filled cavities		Spacing of ties	
Width of cavity	Recommended tie	Horizontal	Vertical
50mm to 75mm wide	Butterfly Double triangle Vertical twist Proprietary ties	900mm	450mm (increased to 300mm at reveals and movement joints)
75mm to 100mm wide	Double triangle Vertical twist	900mm	450mm (increased to 300mm at reveals and movement joints)
100mm to 150mm wide	Vertical twist	900mm	450mm (increased to 300mm at reveals and movement joints)
Greater than 150mm	Wall tie specification and design to be provided by an Engineer, or in accordance with appropriate third-party certification. Design will be determined by location and site-specific conditions.		

Notes:

- The design of wall ties for cavity wall construction will need to consider the site specific conditions and location of the masonry panels on the building façade.
- Proprietary ties must have appropriate third-party certification.
- Proprietary insulation retaining clips compatible with the tie should be used where the cavity is partially filled.

Spacing of wall ties (brick outer leaf shown)

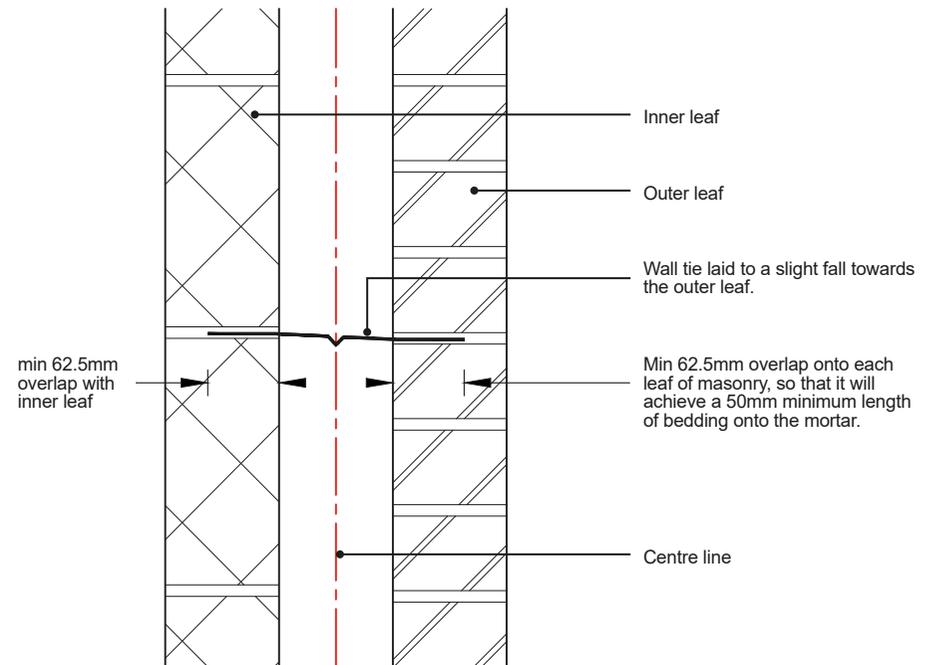


Wall ties

Wall ties should meet the following provisions:

- Stainless steel wall ties should always be used.
- The overall length of the wall ties must be long enough to ensure there is at least a 62.5mm overlap onto each leaf of masonry, so that it will achieve a 50mm minimum length of bedding onto the mortar.
- Wall ties should be laid to a slight fall towards the outer leaf and have the ability to hold insulation against an internal leaf for partial fill scenarios.
- Where a partial fill cavity insulation solution is proposed, a 50mm minimum residual cavity is to be provided.
- Wall ties should be in a staggered or in a diamond pattern.
- Wall ties should be installed at a minimum density in accordance with BS EN 1996 -1-1. This should not be less than 2.5 ties per m² and may increase with cavity width.
- It is important to note that only BS EN 845-1 type wall ties or specifically manufactured (and tested) party wall ties are permitted in cavity separating walls between dwellings to reduce the transfer of sound.

Wall tie provision



Movement joints

- Vertical movement joints should be provided to the outer leaf of cavity walls as indicated in the table below. The first joint from a return should be no more than half the dimension indicated in the table.
- The movement joints must be continued through the render construction and an appropriate weather resistant seal provided to prevent moisture ingress to behind the render finish.
- Movement joints below the DPC should also be provided at major changes in foundation level and at changes in foundation design.
- Wall ties should be provided at 300mm maximum vertical spacing either side of the expansion joint, and within 225mm horizontal spacing of the movement joint.
- For any given wall elevation where there is a mix of masonry e.g. brickwork external leaf lower level with a rendered block upper level, the requirement of a full height movement joint should be based on the shorter spacing requirement e.g. for the blockwork at 6m not brickwork at 12m
- Compressible filler, such as polyurethane foam, should be used to form the joint and be sealed to prevent water penetration.
- Fibreboard or cork are not acceptable materials for forming movement joints in masonry.
- When sealants are used in proximity with stone it is important to select a non-oil-based sealant to help prevent any staining to the stone.
- Elastic sealants (Type E) are suitable as they allow for reversible movement. Where a back-up material is used to control the sealant depth, it will also provide a compressible space into which the sealant can deform.

Where a backing material is used, the following must be considered:

- The material is compatible with the sealant.
- It will not adhere to the sealant, preventing cracking within the sealant.
- Provides sufficient density to allow the sealant to be applied.
- Allows sufficient flexibility so not to impede lateral movement (compressible to about 50% of its original thickness), fibreboard is not acceptable.

Bed joint reinforcement

Bed joint reinforcement may be required to critical areas to accommodate stresses such as above and below window openings. The Engineer may require this to be provided as part of the overall design specification. Where provided, they will be in addition to movement joints, not instead of. Bed joint reinforcement potentially can increase spacings of movement joints subject to the Engineer's specification.

Spacing of movement joints

Material	Normal spacing	Joint thickness
Clay brickwork ⁽²⁾	12m (Spacing up to 15m may be possible if sufficient restraint is provided - consult designer)	15mm
Calcium silicate	7.5-9m	10mm
Concrete brickwork ⁽¹⁾	6m	10mm
Concrete blockwork (used in outer leaf)	6m	10mm
Stone	12m	15mm

Note:

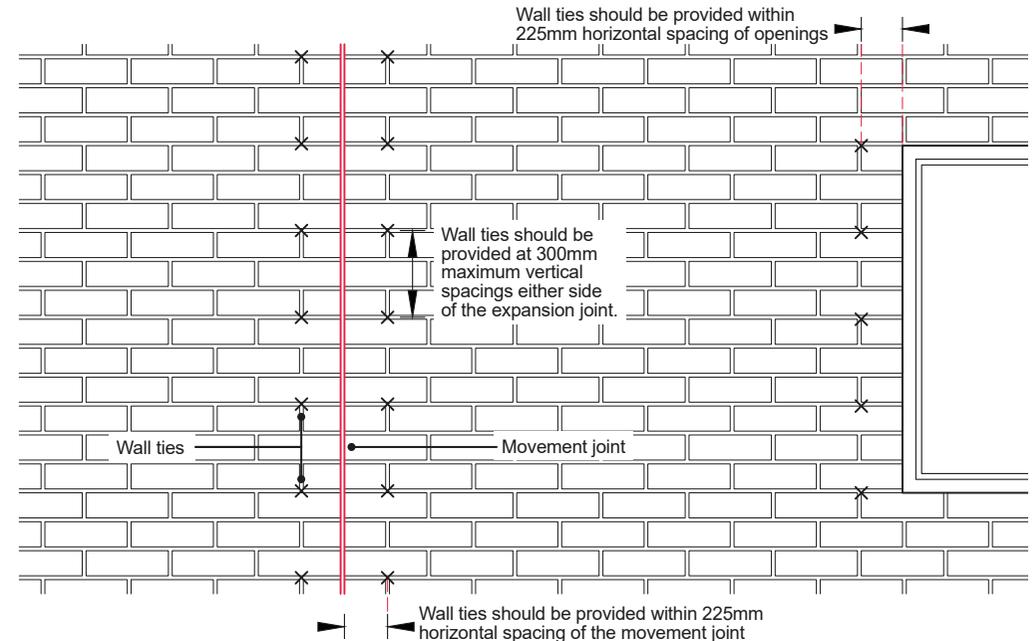
It is not normally necessary to provide movement joints to the internal leaf of cavity walls, but it should be considered for rooms with unbroken lengths of wall in excess of 6m.

The first joint from a return should be not more than half the dimension indicated in the table. Movement joints are not acceptable in solid party or separating walls; however, where cavity wall construction is adopted, offset movement joints with a solid rubber compressible strip may be acceptable.

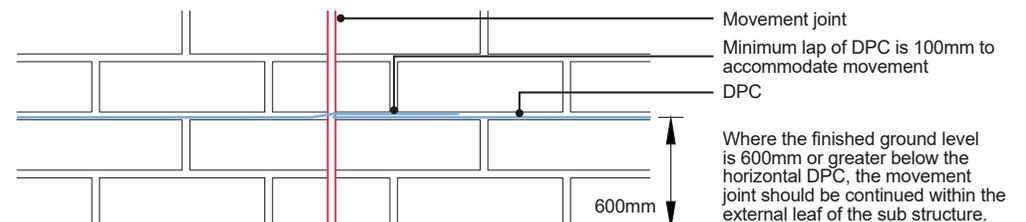
(1) Where openings are over 1.5m, masonry bed joint reinforcement should be considered.

(2) For unrestrained masonry such as parapets and free standing walls, vertical joint spacing should be reduced to 5m - 6m centres.

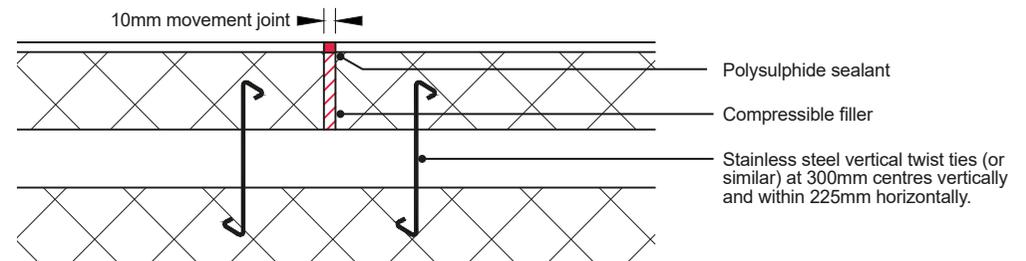
Wall ties in proximity to movement joints and windows (shown with brickwork)



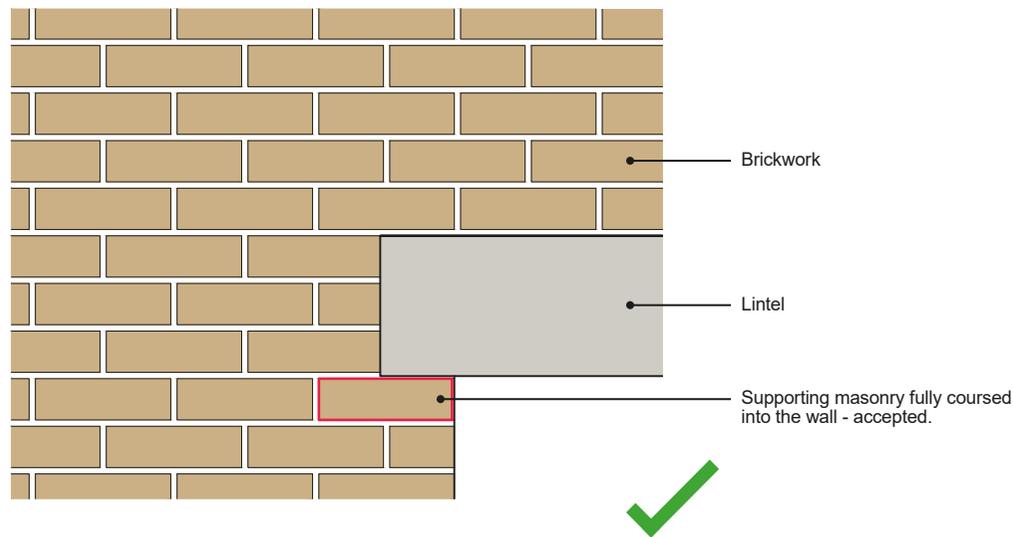
Movement joints below DPC



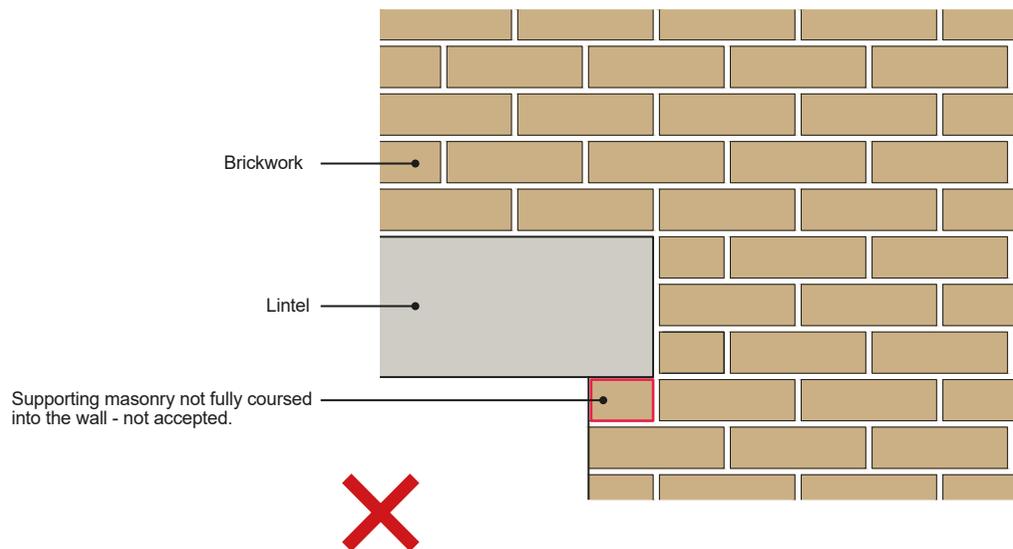
Typical movement joint detail



Correct method of brick bond around lintels



Incorrect method of brick bond around lintels



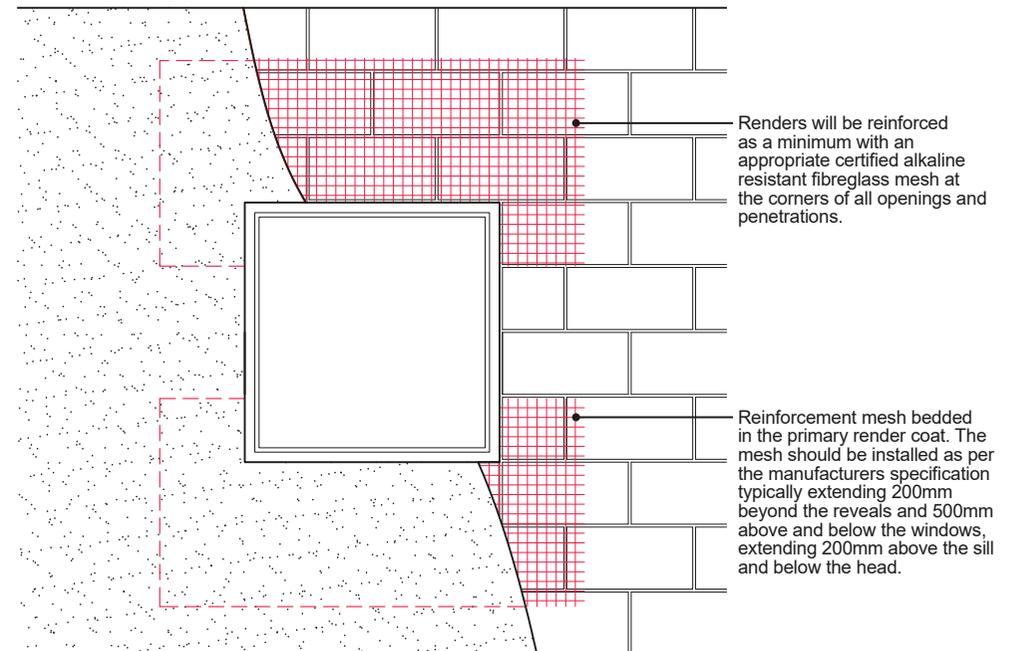
Lintels

- The lintel should be the correct length and width for the opening and cavity width, the bearing length should be at least 150mm.
- Do not let masonry overhang lintels by more than 25mm.
- Continuity of the masonry bond should be maintained at supports for beams and lintels.
- Lintels should be insulated to prevent excessive thermal bridging.
- Concrete or steel lintels are appropriate for use in supporting masonry walls; support for masonry walls should not be provided by timber lintels or beams (Oak or any species).
- Lintels should be provided over recessed meter boxes

Do not:

- Support lintels and beams on short lengths of cut blocks or make-up pieces.
- Apply load to lintels or beams before the masonry supporting has hardened.

Typical mesh reinforcement around openings



Rendering adjacent to openings

- For bellcasts and other beads uPVC beads or stainless steel beads are acceptable.
- Renders will be reinforced as a minimum with an appropriate certified alkaline resistant fibreglass mesh at corners of all openings and penetrations. For substrates that are prone to movement, an appropriate certified alkaline resistant fibreglass mesh will need to be incorporated throughout the substrate.
- Ensure that drips and throating to sills, coping, etc. project a minimum of 40mm beyond the face of the finished render above the DPC.

Window and door installations

Gaps around external windows and doors should be sized to allow for thermal movement and this will vary depending on the material of the frame.

Material	Recommended gap per side for width of structural openings (mm)		
	Less than 1.5m*	1.5m – 3.0m*	3.0 – 4.5m**
Upvc –white	5	5	7.5
Upvc-non-white	7.5	7.5	11
Timber	5	5	5
Steel	4	5	6
Aluminium	5	5	7.5

Notes:

* The maximum gap permitted for openings less than 3m should be 10mm.

** For openings more than 3m, the maximum gap permitted should be 15mm.

For gaps greater than 5mm, a backing strip should be provided behind the sealant and the sealant should have a minimum depth of 6mm.

Window and door frames should be installed in accordance with the manufacturer's instructions.

Please refer to the 'External Windows and Doors' section for further guidance on window and door installations

Finishing trims

The use of proprietary surface fixed finishing trims e.g. D-moulds, should be undertaken only as part of a designed junction between window and door framing and the surrounding opening. For further guidance on the use of finishing trims please refer to the 'External Windows and Doors' section.

The Building Control Body should be consulted for guidance on thermal compliance.

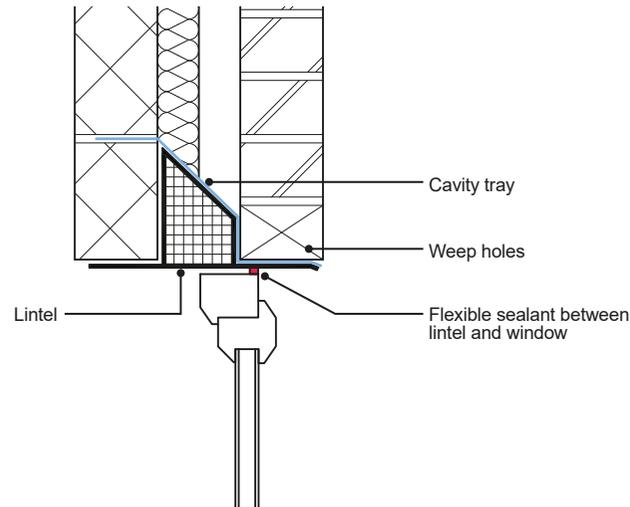
Checked rebates

In areas of very severe exposure, checked rebates should be provided. The frame should be set back behind the outer leaf and should overlap.

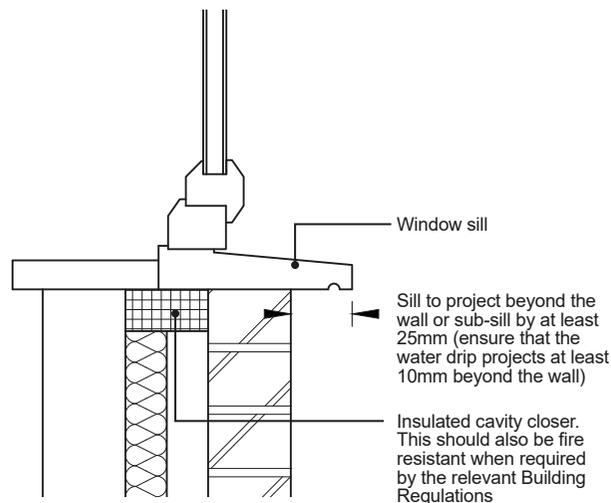
A suitable DPC must be provided at all window and door openings to prevent the passage of damp to the internal finishes. A third party certified cavity closure may be used.

These illustrations show accepted practice for forming weather resistant openings and may not indicate the full extent of insulation requirements to meet relevant Building Regulations.

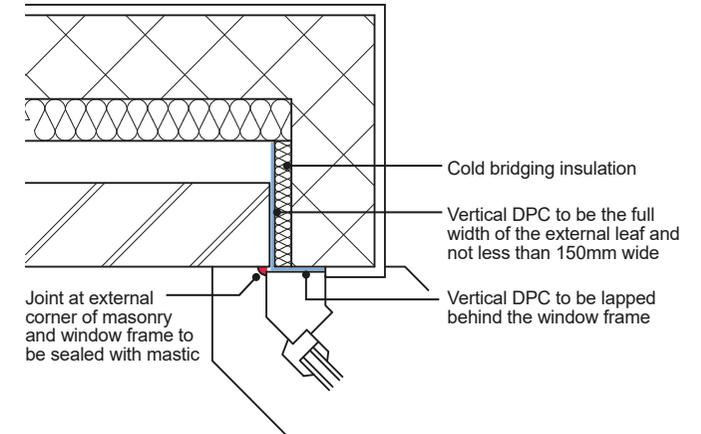
Typical vertical section through window head



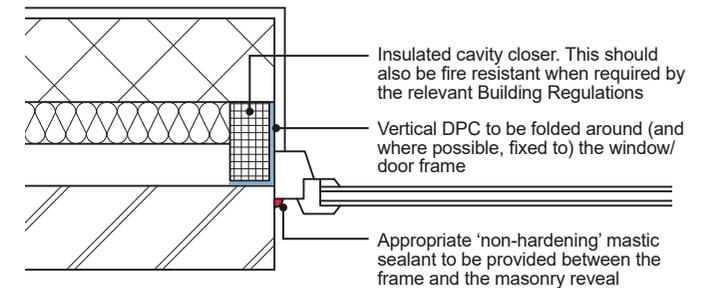
Typical vertical section through window sill



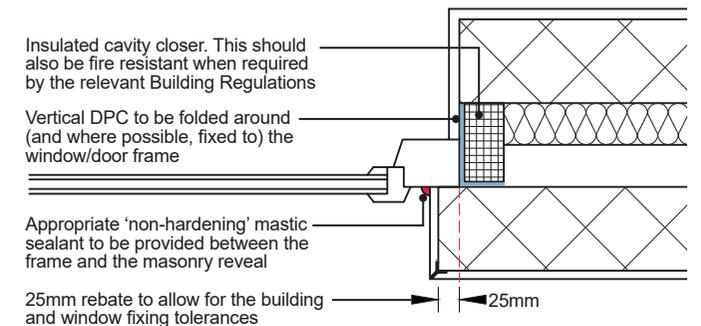
Bay window detail



Typical window reveal (normal exposure)



Typical rebated window reveal (very severe exposure)



When installing window/door frames in a checked rebate, allow for the frame to be deeper:

- To allow for opening lights to open clear of the masonry/render, and
- Where rendered, the render will need to extend beyond the 25mm of masonry.

Cavity trays

Cavity trays, associated weep-holes and stop-ends prevent the build-up of water within a cavity wall and allow the water to escape through the outer leaf. They are used in conjunction with lintels above openings, to protect the top surface of cavity insulation at horizontal cavity barriers and where the cavity is bridged.

Cavity trays must:

- Comply with relevant Building Regulations.
- Have third party certification or be to a relevant BS or BS EN code appropriate for the intended use. Please note: Polyethylene DPC's should not be used as a cavity tray.
- Be provided at all interruptions likely to direct rain water across the cavity, such as rectangular ducts, lintels and recessed meter boxes.
- Be provided above cavity insulation that is not taken to the top of the wall, unless that area of wall is protected by impervious cladding.
- Be provided above lintels in walls in exposure zones 3 and 4. In zones 1 and 2 where the lintel is not corrosion-resistant and not intended to function as its own cavity tray.
- Be provided continuously above lintels where openings are separated by short piers.
- Be provided above openings where the lintel supports a brick soldier course.
- Be provided directly above openings that are under a compartment floor with a cavity barrier and cavity tray already present.
- Be proprietary preformed cavity tray systems at stepped and lower storey abutments and around corners in low rise cavity masonry walls.

Ring beams or floor slabs that partially bridge the cavity, e.g. when dimensional accuracy cannot be guaranteed, should be protected by a continuous cavity tray, especially when full fill cavity insulation is employed.

Weep-holes

- Weep-holes must be installed at no more than 900mm centres to drain water from cavity trays and from the concrete cavity infill at ground level. When the wall is to be cavity filled, it is advisable to reduce this spacing.
- At least two weep-holes must be provided to drain cavity trays above openings.
- Weep-holes will be required in rendered masonry cavity walls for Warranty purposes.
- Weep-holes in exposure zones 3 and 4 should be designed to prevent ingress of wind-driven rain.

Stop-ends

Cavity trays should have water tight stop-ends to prevent water from running into the adjacent cavity. Stop-ends need to be bonded to the cavity tray material or clipped to the lintel, so that a stop to the structural cavity of at least 75mm high is provided. Normally, the stop-end is located to coincide with the nearest perpendicular to the end of the cavity tray. Stop-ends can be formed by sufficiently turning up the end of a DPC tray into the perpendicular joint. Surplus mortar should be removed from cavities and wall ties cleared of mortar droppings and debris as the work proceeds.

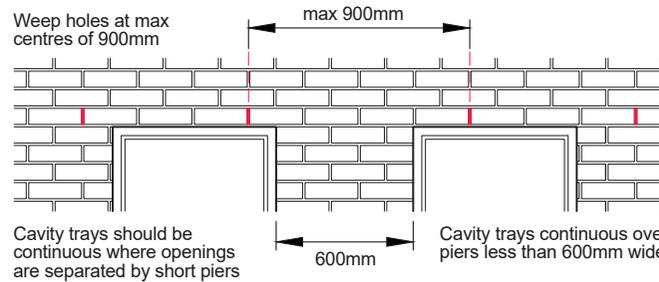
Other perforations of the building envelope

Proprietary elements, such as ventilators, soil pipes, etc. which perforate the building envelope should be installed and sealed to prevent ingress of moisture or vermin in accordance with the manufacturer's instructions. External meter boxes should be of a type approved by the Service Supply Authority and provided with a cavity tray and a vertical DPC between the back of the box and the wall.

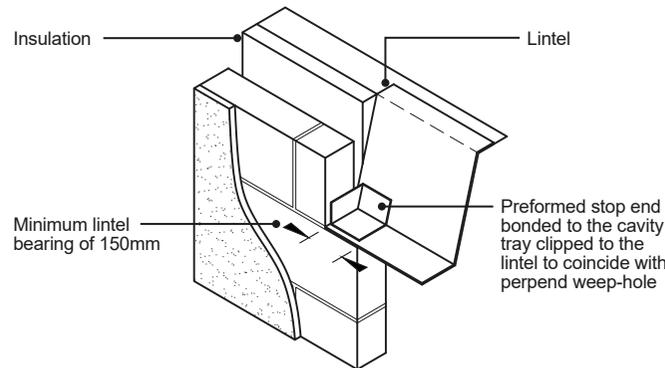
Steps and staggers

Particular care is needed in adequately preventing the ingress of water in a terrace of buildings with steps and staggers. A proprietary cavity tray system should be used, or alternatively, a suitable tanking system. Stepped cavity trays are required at all pitched (stepped) roof abutments with external cavity walls, e.g. attached garages or staggered terraces. The bottom (last) cavity tray must be supplied with two stop-ends and an associated weep-hole, allowing all water to escape over the lower roof covering. A lead cover flashing should be linked into the cavity tray (lapped in below).

Continuous cavity tray over two openings and a small pier

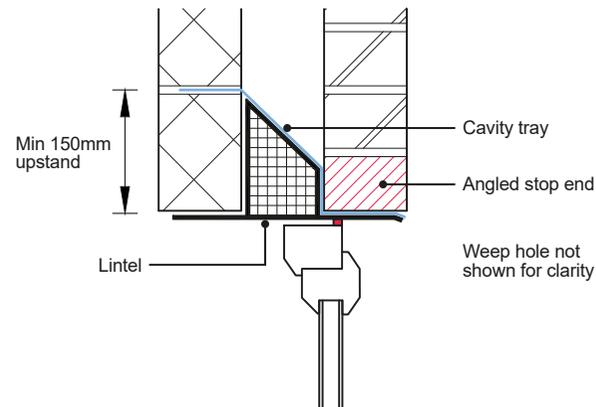


Stop end to cavity tray



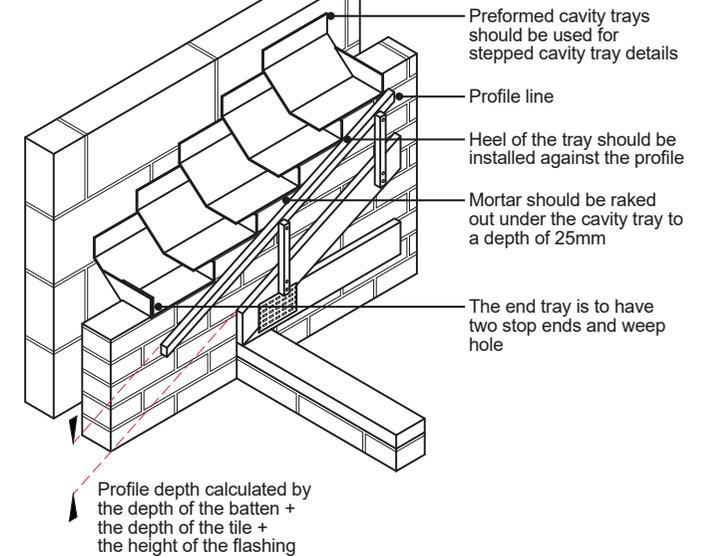
Cavity trays should rise at least 150mm from the outer to the inner leaf, be self-supporting or fully supported and have joints lapped and sealed.

Stop end in relation to cavity tray and lintel

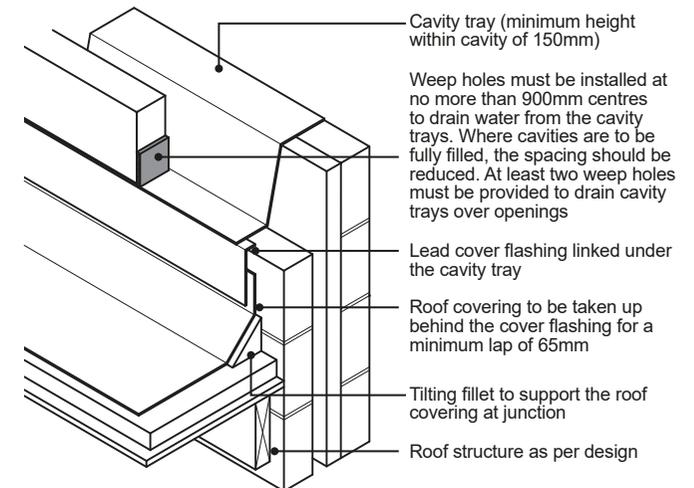


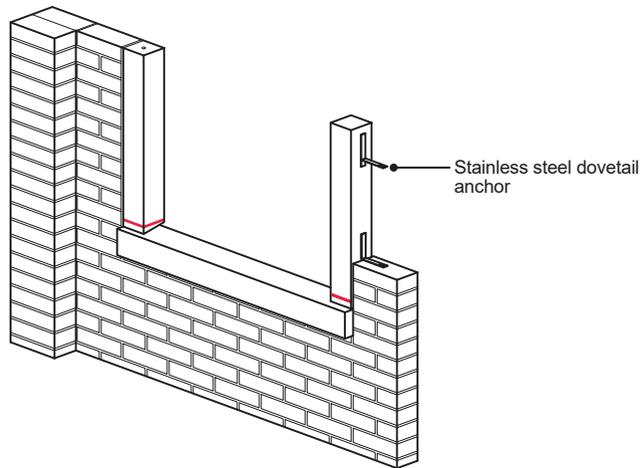
Installation of stepped cavity tray

Flashing details can be found in the 'Roofs' section.



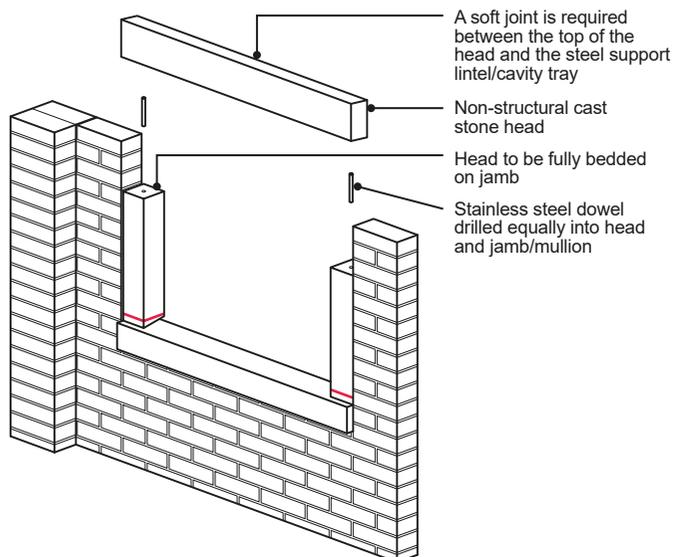
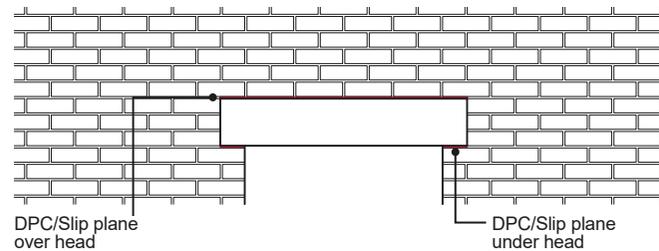
Flat roof abutment cavity tray construction



Stone jamb mullion fixing to walls

Stone jambs, mullions, and heads should not project into the cavity and insulated cavity closers should be inserted to prevent cold bridging.

Stone jambs and mullions should be fixed at the top and bottom with stainless steel pins. Stainless steel frame-type cramps can also be used to give extra stability at jambs.

Joining stone jambs to sills and head**Stone head****Cast stone heads**

A cavity tray must be provided above all heads as this not only discharges water to the outside face of the masonry, but also acts as a slip plane. A slip plane will be required at the end of the cast stone head as well as a soft joint between the top of the head and the steel support lintel.

Cast stone heads should be manufactured in accordance with BS 1217, confirmation of this should be provided to the Warranty Surveyor upon request.

Cast stone jambs and mullions

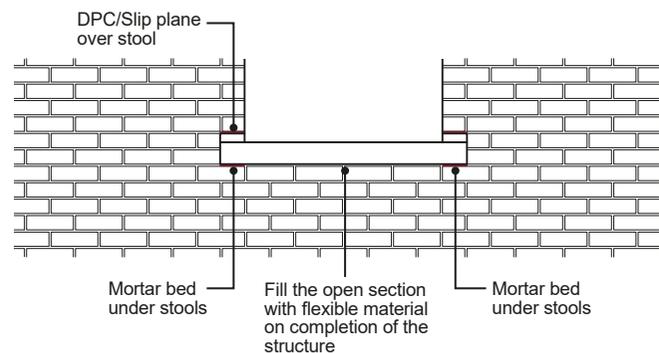
Stainless steel dowels in the sides of jambs should be bedded into adjacent mortar joints as the masonry is constructed.

Cavity Trays

When stone heads are being used, it is advisable to double up the cavity trays - with one above the stone head to provide stop-ends and weep holes.

Mortar

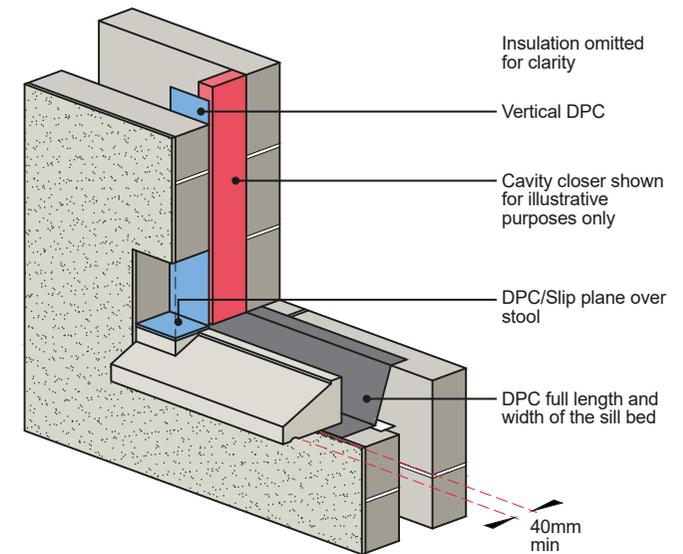
The mortar for use with stone should comply with the relevant British Standards for sand, lime, and cement as set out in BS 5390

Stone sill**Sills**

The DPC should be overlapped by the vertical DPC at the jambs and should be turned up at the back and ends for the full depth of the sill.

The mortar bed below sills should be trowelled smooth, allowed to set, cleaned off, and then a DPC laid over. The open section below the sill should be sealed with a flexible material only on completion of the structure.

To control water penetration through joints in window surrounds, e.g. at junctions between jambs and mullions and sills, rectangular and T-shaped water bars should be provided.

Stone sill with insulated cavity closer

Note: The insulated cavity closer should also be fire resistant when required by the relevant Building Regulations.

Cast stone window/door surrounds

Where cast stone butts up to other materials, allowance must be made to accommodate differential movement e.g. where cast stone abuts clay brickwork, a slip surface between the stone and clay brickwork.

Render

Ensure that drips and throating to sills etc. project beyond the face of the finished render above the DPC by a minimum of 40mm. Render around window/door openings to be reinforced with mesh.

For further guidance on the application of render please refer to the 'External Walls - Render' section.

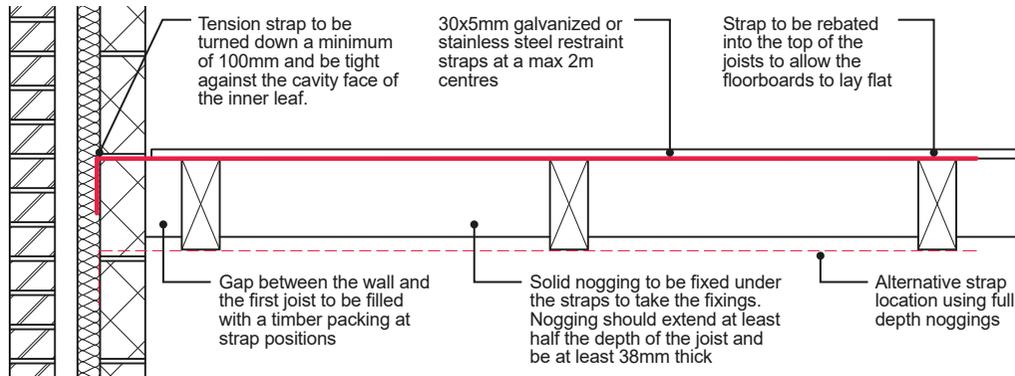
Restraint of walls

Walls should be adequately restrained at floors, ceilings and verges in accordance with the relevant Building Regulations.

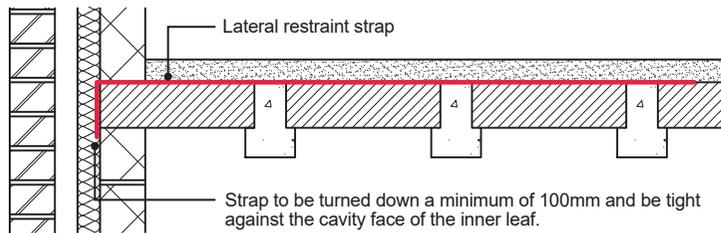
Restraint can be provided by:

- Lateral restraint straps.
- Restraint type joist hangers.
- Other forms of restraint proven by an Engineer.

Lateral restraint of walls (timber floors)



Lateral restraint of walls (beam and block floors)



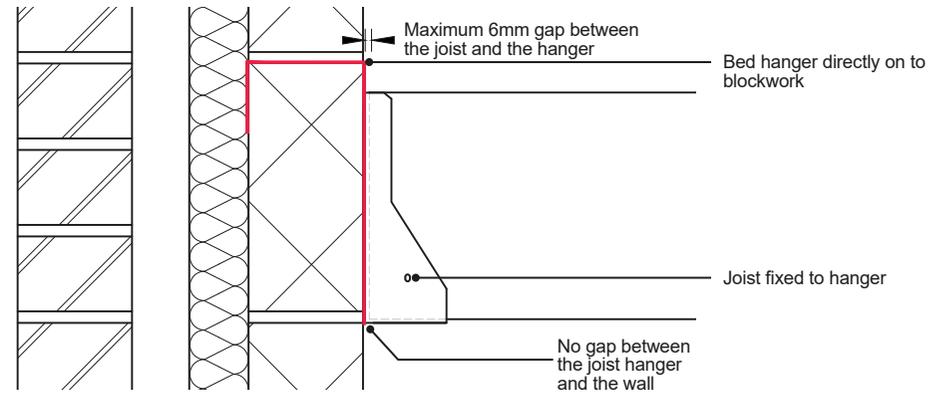
Lateral restraint straps

Floors, including timber, beam and block, and roofs should provide lateral restraint to all walls running parallel to them by means of 30mm x 5mm galvanised or stainless steel restraint straps at a maximum 2m centres (please refer to the 'Upper Floors' section for further guidance). Straps need not be provided to floors at, or about, the same level on each side of a supported wall and at the following locations:

Timber floors in two storey buildings where:

- Joists are at maximum 1.2m centres and have at least 90mm bearing on supported walls or 75mm bearing on to a timber wall plate.
- Carried by the supported wall by restraint type joist hangers as described in BS 5268: 7.1.
- Concrete floors with minimum 90mm bearing on supported wall.

Restraint type joist hanger



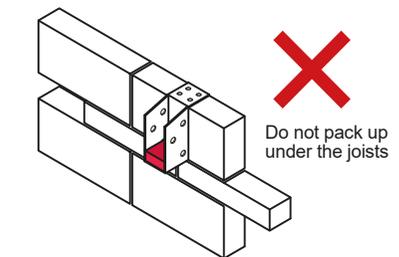
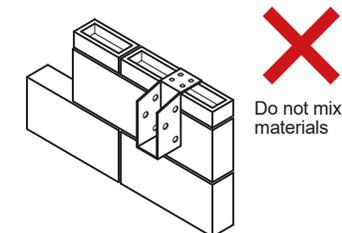
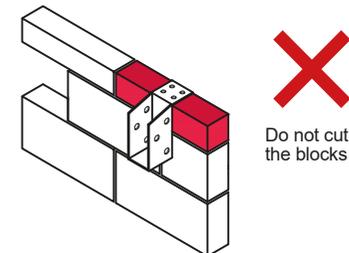
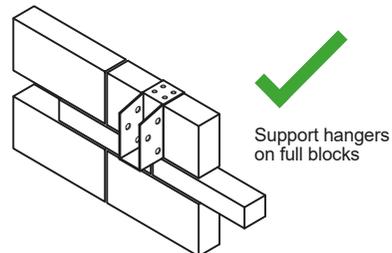
It is necessary to ensure that:

- The hanger is bedded directly on the masonry and there is no gap between the hanger back-plate and the face of the masonry.
- At least 450mm of masonry is provided above the hanger.
- Hangers are spaced at centres of floor joists included in the design.
- The hanger is suitable for the loadings and masonry strength.

Do not:

- Apply load while the mortar is still green and has not gained sufficient strength.
- Use brick courses in block walls under joist hangers as the thermal insulation of the wall may be reduced unless similar units to the blocks are used.

Correct use of hangers



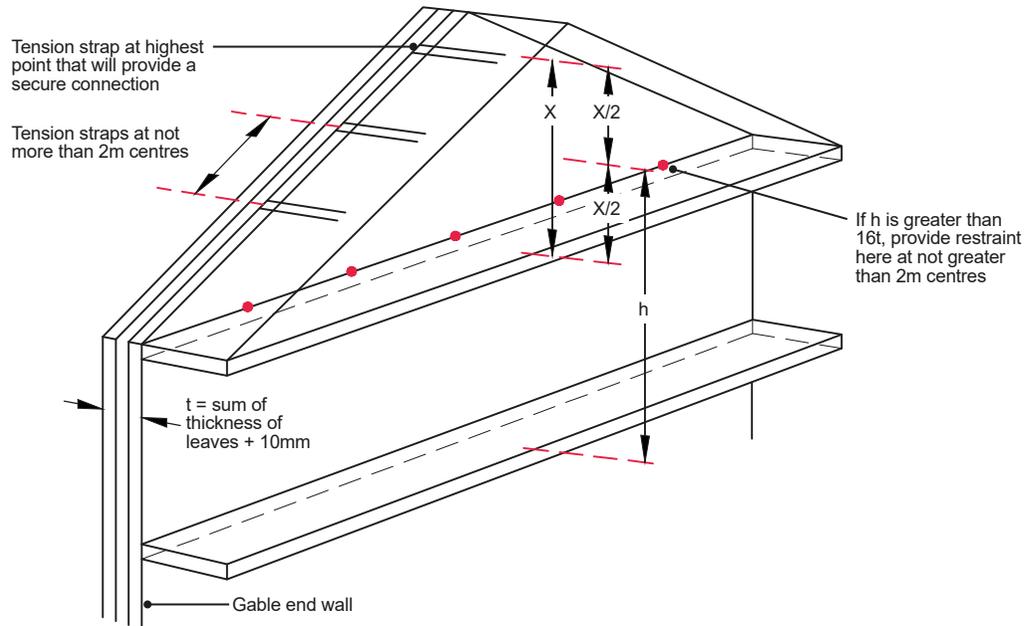
Restraint of walls

Walls should be adequately restrained at floors, ceilings, and verges in accordance with the Building Regulations.

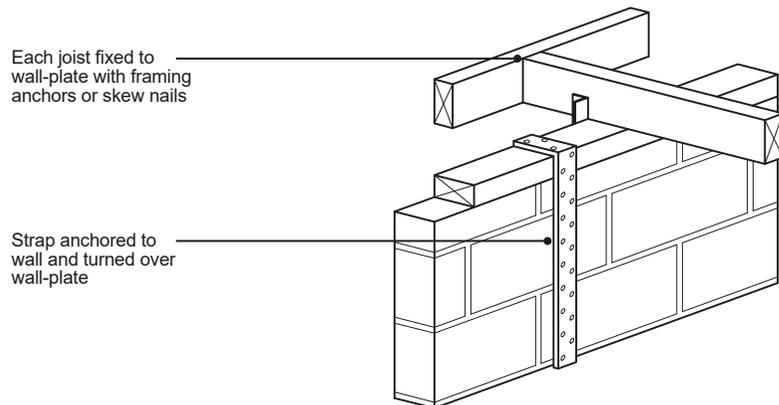
Restrains can be provided by:

- Restraint type joist hangers.
- Lateral restraint straps.
- Other forms of restraint proven by an Engineer.

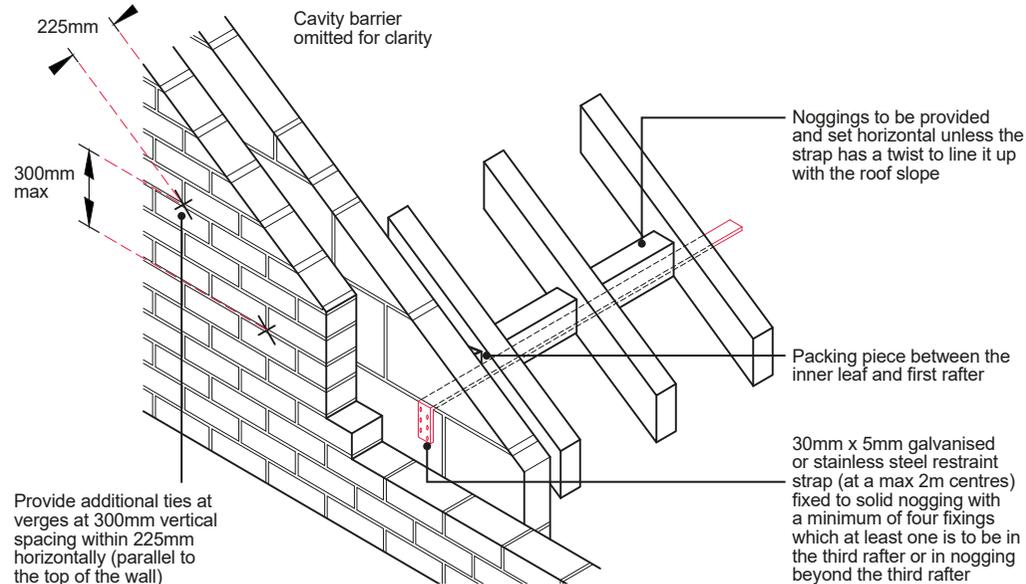
Tension strap location



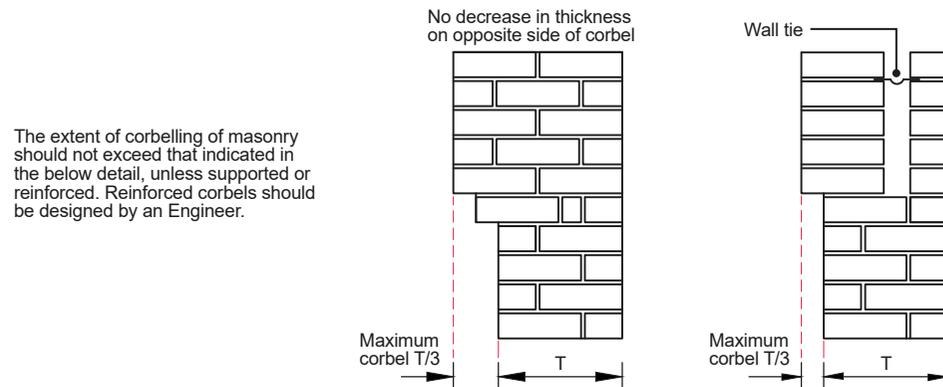
Vertical strapping at eaves - flat roofs



Rafter/gable wall detail



Corbelling



Eaves detailing for rendered walls

The eaves detail should extend past the masonry to provide protection to the top joint of the render and prevent rainwater percolating behind the render.

Chimneys

If the chimney is in a severe exposure zone the cavity should extend around the outside of the stack and be continuous up to roof level, as per BS 5628, Part 3. Where the chimney breast is gathered in, the lower projecting masonry should be protected with a suitable capping and cavity trays. A 50mm cavity at the back of the chimney breast is maintained to prevent rainwater penetration.

A specialist render system and mortar should be employed for parapets, chimneys, retaining walls and walls below DPC level. Further guidance can be found in the 'Chimneys and Flues' section.

New elements connecting to existing structures

Where residential developments are attached to existing buildings, and the existing elements form part of the new structure; these must meet the Functional Requirements of the Warranty. The details below give some guidance on the minimum information and standards required to meet the Functional Requirements.

Party wall

It is highly likely that improvements to an existing wall are necessary to meet the requirements of the Warranty. This may include underpinning, injected DPC and internal linings.

Where a wall is shared by two or more owners, the requirements of the Party Wall etc. Act may apply. This is separate legislation with different requirements to the Building Regulations or Warranty requirement.

Further guidance on the Party Wall etc. Act can be found on the Planning Portal website www.planningportal.gov.uk

Separating walls

The separating wall between the new and existing building must meet the relevant requirements of the Building Regulations.

The existing walls should prove to be structurally stable and resistant to water penetration.

Existing foundations

The existing walls and their foundations for retained structures must be suitable to support any proposed increased loading resulting from the construction of the new building.

Foundations to the existing wall should be exposed and assessed for suitability to support additional loadings. It is important to protect existing foundations at all times, and care must be taken not to 'undermine' existing foundations when clearing the site or reducing levels.

Where existing foundations require underpinning, a design by an Engineer should be provided and approved by the Warranty Surveyor prior to work commencing on-site.

The existing wall should also be appraised to determine whether it is structurally stable and suitable to support additional loadings.

Damp Proof Course (DPC)

An effective DPC should be present in the existing wall, linked to the new DPC and damp proof membrane (DPM) of the new building.

Acceptable existing DPC's are considered as:

- A continuous felt or proprietary DPC material.
- A chemically injected DPC supported by an insurance-backed guarantee.
- A slate DPC is considered acceptable if the existing wall incorporates an independent wall lining system to the inner face of the new building.

The new DPC should lap the existing DPC by at least 100mm.

Existing and new structure junctions

At the junction of the existing and new structures, detailing should allow for differential movement without cracking. Any settlement should be limited to 2mm-3mm, which would not normally adversely affect the roof covering.

In order to prevent excessive differential movement, the new building should have the same foundation type as the existing building. Where the foundation types are different, e.g. new building pile and beam, existing building traditional strip foundation, the new building should be completely independent of the existing building.

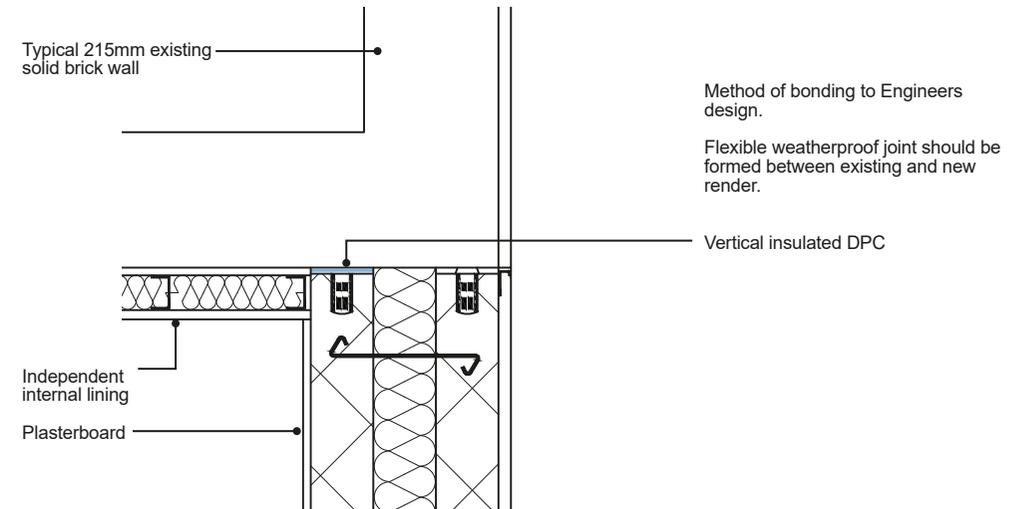
New wall junctions

The junction of the new walls to the existing walls must ensure that dampness cannot track back into the new building or the existing building.

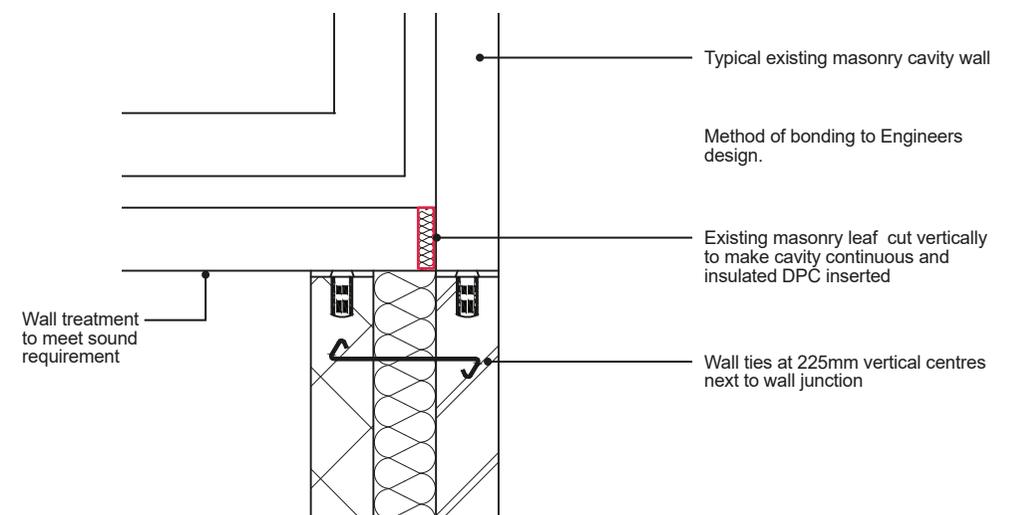
The detailing of this junction is critical to ensure that moisture ingress does not occur between the new and existing walls.

Typical acceptable details are indicated below.

Bonding new walls to existing solid masonry wall



Bonding new walls to existing masonry cavity wall



6.

External Walls

6.2 Timber Frame

Provision of information

A full set of design drawings and specifications shall be made available to the Warranty Provider and all other interested parties prior to the associated works starting on site. This may include:

Open panel and partially open panel*:

1. Details of the manufacturers relevant accreditation (BM TRADA, STA, etc). The accreditation must confirm the manufacturer has been assessed for the design of panels (not just joists or trusses).
2. A full set of detailed drawings, including:
 - a) Plan layouts indicating dimensions.
 - b) Elevations with dimensions shown.
 - c) Junction details showing position of DPC's, cavity trays, other building elements such as roofs, floors, etc.
 - d) Detailed drawings showing sole plate levels in relation to external ground levels for all elevations and how soleplate and timber frame is to be ventilated.
3. Details of proposed breather membranes and VCL's to be used.
4. Engineers drawings, calculations and fixing schedules for each connection made on site (framing, sheathing, structural connections, membranes, etc.) including number, spacing and method of fixing.
5. Details of proposed cavity barriers including location, materials and technical assessments (third party product conformity certificate).
6. Details of any cladding material fixed back to the timber frame including type, size, location of fixings provision of cavities. Where masonry cladding is present on the external leaf, details of wall tie and movement joint provision.
7. Where insulation in the external wall makeup are to be fitted on site we would require details of proposed insulation to be used.

*Closed panel systems must be sent to our Innovations team for approval.

Non-accredited timber frame:

Please note: this construction type is limited to a maximum of five plots per project.

Points 2–7 for open and partially open panels must be satisfied, in addition to:

1. Provide full structural calculations for each house type, to Eurocode 5 (BS EN 1995-1-1).
2. Designs to account for any fixed non-timber components (e.g. sheathing boards), which may impact on the stability if shrinkage of the frame is not accounted for.
3. An independent, third party Engineer, must inspect each plot once erected and prior to any closing up. They must then provide a sign-off sheet at completion for the waterproof envelope confirming the timber frame construction meets the Eurocode, as-built.

The Warranty Surveyor, at their discretion, may also request supporting information that demonstrates suitability for use of any materials or systems contained within the above.

Factory assembled timber frame

This Guidance refers to 'conventional' timber frame open panel* systems made off-site under factory conditions. Such panel systems are required to be manufactured and erected on-site under quality assured systems and be either Silver or Gold members of the Structural Timber Association (STA), BM TRADA Q-Mark Timber Frame Elements Certification Scheme or CATG - Frame mark.

Note: A standard membership of one of the above is not identified as being accredited.

*Open panel systems are defined as systems which may include the external breather membrane and sheathing board, insulation internally between the studs and a transparent Vapour Control Layer (VCL) which is left unfixed in order that the connections between panels can be viewed upon inspection.

Timber frame panels which arrive to site with additional elements e.g. external cladding or a non-transparent VCL will need to be assessed by the Warranty Innovations Team as meeting our Technical Manual requirements.

Timber frame external walls are generally considered to consist of load-bearing solid timber studs at regular centres with insulation between them, lined with a structural sheathing board, breather membrane, drained cavity and cladding. A VCL and fire-resistant linings are provided to the internal finishes. Alternatively, any timber frame kit, system or wall panel that has been assessed and accepted by the Warranty Innovation team will be acceptable.

Structural design

Wind, roof and floor loads should be considered in the design and all timber frame structures should be designed in accordance with Eurocode 5.

Please note, designers should not mix and match codes or standards.

Quality assurance

All timber frame Designers, Manufacturers, and Erectors should possess current certification from at least one of the following quality assurance schemes:

- The BM TRADA Q-Mark Timber Frame Elements Certification Scheme.
- Gold member of the Structural Timber Association.
- ISO 9001 to cover the manufacture of the timber frame panels.
- CE/UKCA marking
- CATG - Frame Mark
- Other relevant third party quality assurance scheme.

One off site assembled timber frame

For one off site assembled timber frame projects which are not accredited by one of the above organizations, the developer must:

- Provide full structural design calculations for each house type, confirming the design meets Eurocode 5 (BS EN 1995-1-1), and,
- The design accounts for any fixed non timber components (e.g. sheathing boards, claddings, parapets, junctions with other structures) which may impact on the stability if shrinkage of the frame is not accounted for, and,
- An independent Engineer (not the design Engineer) must inspect the plot once erected and prior to covering over (to allow full inspection) and provide a sign off statement at completion of the waterproof shell confirming that the timber frame construction meets the Eurocode requirements and is erected as per manufacturers' design, and,
- The Warranty Surveyor will collect the timber frame wall panel structural design calculations for each building/house type, and,
- The developer must satisfy the Warranty Surveyor that the materials/products used are suitable and meet the requirements of the Technical Manual (e.g. timber treatment, tolerances, drained and ventilated cavity, etc.)

Please note: This is limited to a maximum of 5 plots per project.

SIP construction

Structurally Insulated Panels (SIPs) are a form of stressed skin composite panel. Only systems with independent third-party certification will meet the Warranty requirements. Please refer to 'Appendix C' for further guidance.

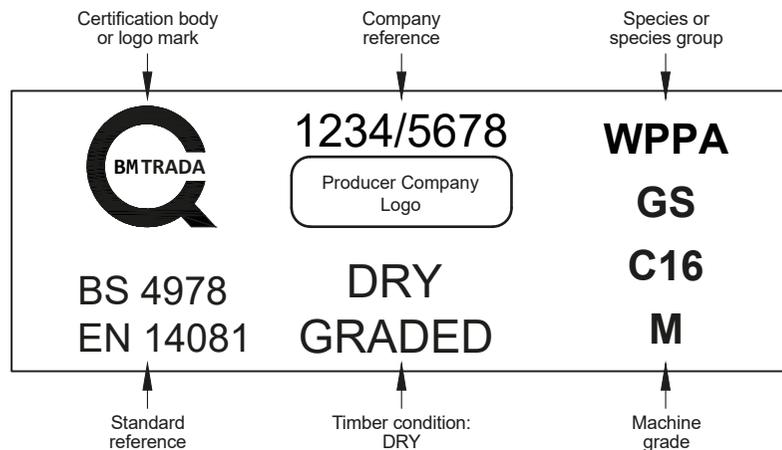
Timber specifications

Grading of structural timber

All structural timber whether machine or visually graded shall be graded in accordance with BS EN 14081: Timber structures - Strength graded structural timber with rectangular cross section.

All load-bearing solid timber studs, rails, binders and sole plates should be of a minimum dry graded C16.

Typical grading stamp



Preservative treatment of structural timber

All load-bearing timber components shall be either naturally durable or preservative treated in accordance with BS 8417: Preservation of wood code of practice. Sole plates and load-bearing timber studwork are considered to be in 'Use Class 2'. Sole plates are normally considered to be included in 'Service Factor Code C', while load-bearing timber studwork is included in 'Service Factor Code B'.

All structural timber should be treated with a preservative suitable for the 'Use Class' and 'Service Factor' applicable to its use.

Where treated timber is cut, the exposed end will not be protected by the original preservative treatment. When treated timbers are cut in the factory or on site, the cut ends shall be re-treated with a preservative compatible with the original treatment used, this treatment should be coloured to allow easy checking on site.

Timber moisture content

All structural timber components should be at a moisture content of 20% or less at the time of manufacture. Once panels are manufactured, they should either be stored in a covered storage area, or loosely covered with a water proof sheet material.

Manufacturing tolerances

The following are our manufacturing tolerances that timber frame manufacturers' must adhere to:

- Length: +3mm, -3mm.
- Height: +/-2mm.
- Diagonals should be equal, acceptable deviation is +/-5mm.
- Opening dimensions: 0mm, +5mm.

Thermal bridging

Wall panels and their junctions should be designed to minimise thermal bridging, whilst meeting structural requirements. All voids within the wall panel should be insulated to ensure thermal continuity is maintained and any small gaps which cannot be insulated effectively should be avoided.

Site preparation and erection

Pre-commencement

To allow the building to be constructed as designed all necessary drawings, specifications and fixing schedules shall be provided to site before work commences.

Foundations

It is important that the tight tolerances for timber frame are understood, getting the location and level of the foundation correct is one of the most important parts of the build process.

The foundations or upstands that support the timber frame should be set out to the dimensions noted on the timber frame drawings:

- Within +/-10mm in length, width and line.
- Diagonals should be within +/-5mm up to 10m, and +/-10mm more than 10m.
- Levelled to +/-5mm from datum.

Timber frame delivery and storage

Timber frame components should be:

- Carefully unloaded to avoid damage or distortion of components.
- Stored off the ground on an adequate number of level bearers.
- Loosely covered with a waterproof membrane to allow protection from moisture while allowing ventilation if they are not to be used for a prolonged period.
- Unwrapped if tightly bound in polythene and loosely recovered with a waterproof membrane to allow ventilation.
- Below 20% moisture content.
- Confirmed as square by sample checking for equal diagonal measurements, lengths and heights.
- Handled and stored with particular consideration to moisture damage where insulation and VCL are incorporated.

Timber frame erection

Wall panel erection tolerances

Wall panels should be erected to the tolerances as per the 'Tolerances' section:

- +/-10mm from plumb per storey height.
- +/-10mm from plumb over the full height of the building.
- +/-3mm from line of sole plate, with maximum +/-5mm deviation from drawing.
- +/-5mm from line at mid height of wall panel.
- Inside faces of adjacent wall panels should be flush.
- Adjacent wall panels should be tightly butted.

Breather membranes providing temporary protection

Where the breather membrane is used to provide the temporary protection, the daylight exposure and durability aspects must be taken into account. Extended exposure to UV light can lead to premature failure of the membrane, the exposure period should therefore be kept to a minimum. Regardless of the artificial age testing, under certain conditions such as heavy rainfall followed by freeze thaw conditions, the membrane should not be exposed for more than a few days. If a membrane has to be left without a wall and/or roof covering for a period of time when adverse rainfall and weather is expected, a ventilated tarpaulin or similar protective sheeting may be used to protect the membrane until such time that the final wall/roof structure can be completed. The transport and storage of wall/roof panels should not rely on the breather membrane to provide weather protection.

Dealing with areas of high exposure to frost and wind-driven rain

The design and construction of external walls should be suitable for the site specific exposure location.

For further information on determining the exposure for the site location please see 'Appendix C - Materials, Products, and Building Systems - Determining the sites exposure to wind driven rain'.

Key points: Construction below DPC

1. Brickwork and blockwork must be selected to have suitable durability for its use in the wall construction in accordance with BS EN 771-1 and PD6697.
2. Mortars below DPC are exposed to higher levels of saturation and therefore require higher durability classification (see BS EN 998-2).
3. Cavities below ground should be filled with concrete ensuring there is a minimum gap of 225mm between DPC and the top of concrete.
4. Concrete for cavities should be GEN 1 grade and a consistence class S3.
5. External ground levels should be a minimum of 150mm below DPC.
6. The compressive strength of the masonry units must meet the requirements of the relevant Building Regulations.

Damp proof course (DPC)

1. DPC should be of a flexible material, be suitable for the intended use, the DPC should have appropriate 3rd party certification. The installation specification of DPC's should follow good design practice in accordance with BS 8215.
2. Blue bricks or slate will not be accepted as a DPC.
3. DPC's should correctly lapped at junction and corners. The depth of the lap should be the same width as the DPC.
4. Any DPC which is not acting as a cavity tray should not encroach into the cavity space, as there is a potential risk for this to provide a position for mortar snots or debris bridging the cavity leading to moisture penetration issues.
5. Damp proof membranes within the floor structure should be lapped with the DPC under the sole plate by a minimum of 100mm. The DPC at sole plate level should also provide 100mm lap to any AVCL provided within the wall panel. Configurations for this damp proofing and air-tightness arrangement should appropriately designed.

Rendering on masonry cladding

1. Rendering below DPC should only be carried out using a specialist render manufacturer's specification. No render system should bridge the DPC and a proprietary uPVC bead or stainless steel bead should be used above and below where the renders meet at the DPC.
2. DPC should extend through the rendering system in between the bellcast beads or render stop system.
3. For bellcasts, uPVC beads or stainless steel beads are acceptable.

Note: For further guidance on the application of render please see the 'External Walls - Render' section.

Drainage and ventilation

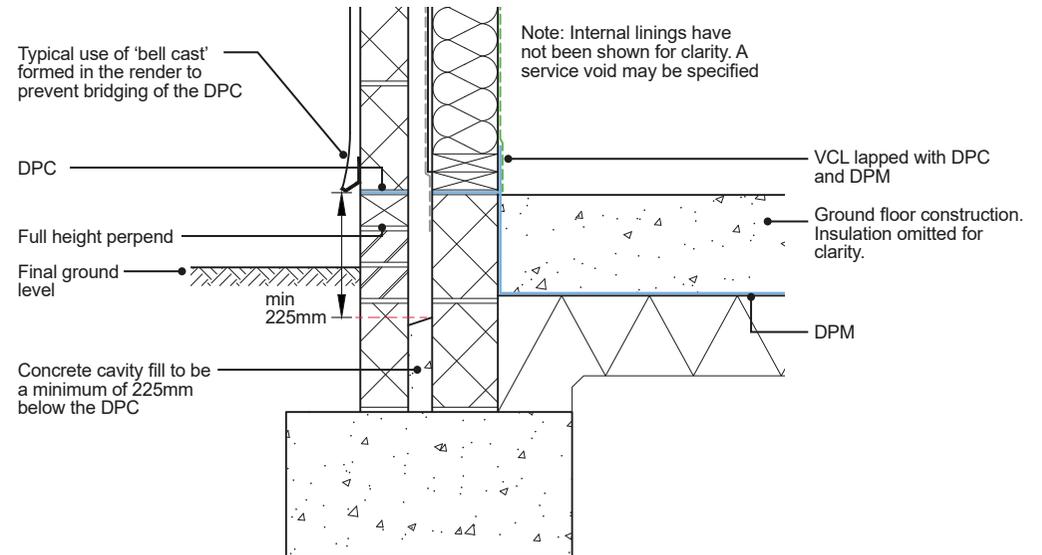
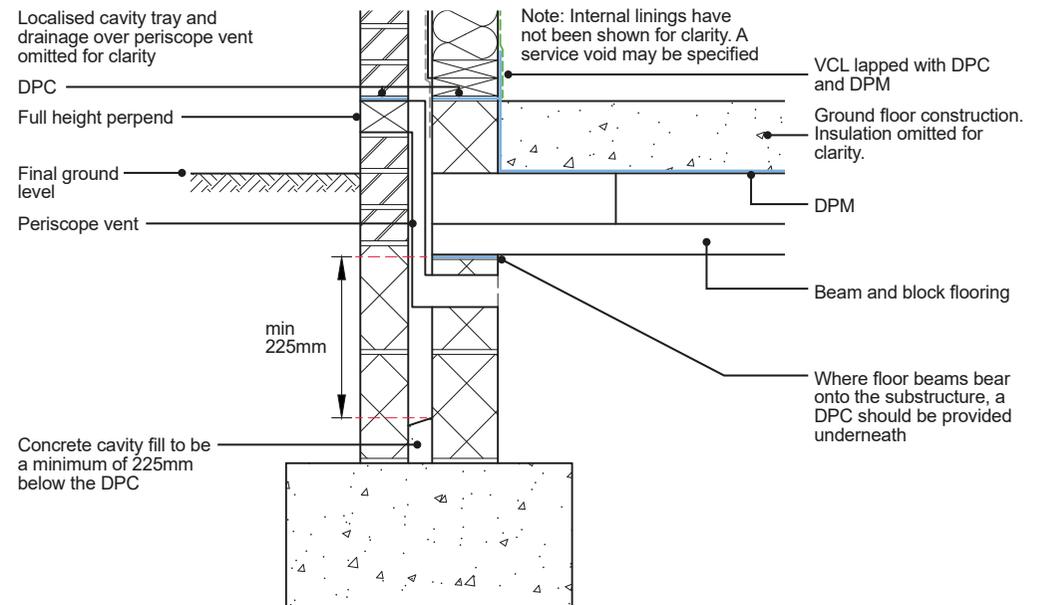
Cavity drainage and ventilation in masonry cladding should:

- Achieve at least 500mm² per metre run, which equates to a whole brick open perpend every 6th brick length.
- Be fitted in the brick or block course below the lowest timber sole plate above external finished ground level and below DPC.
- Maintain a clear cavity with care taken to reduce mortar droppings at the base of the wall.

Weep-holes alone are unsuitable for timber frame construction, and open perpend should be used.

Proprietary open perpend must be used. Proprietary open perpend inserts are available with insect screening incorporated. Their equivalent open area must be considered and installation centres reduced accordingly.

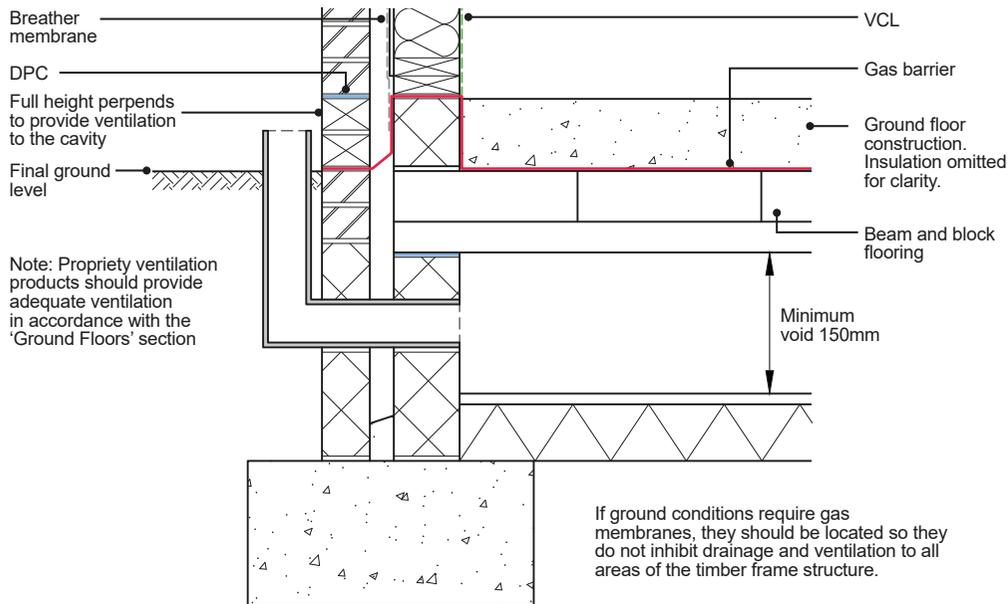
All of the drawings shown in this sub-section are strictly in relation to our Warranty requirements. Please refer to the Building Control Body to ensure the detailing achieves compliance with relevant Building Regulations in respect of thermal and fire requirements.

Ground supported floor - no sub-floor ventilation (shown with rendered masonry)**Suspended floor with ventilation provision**

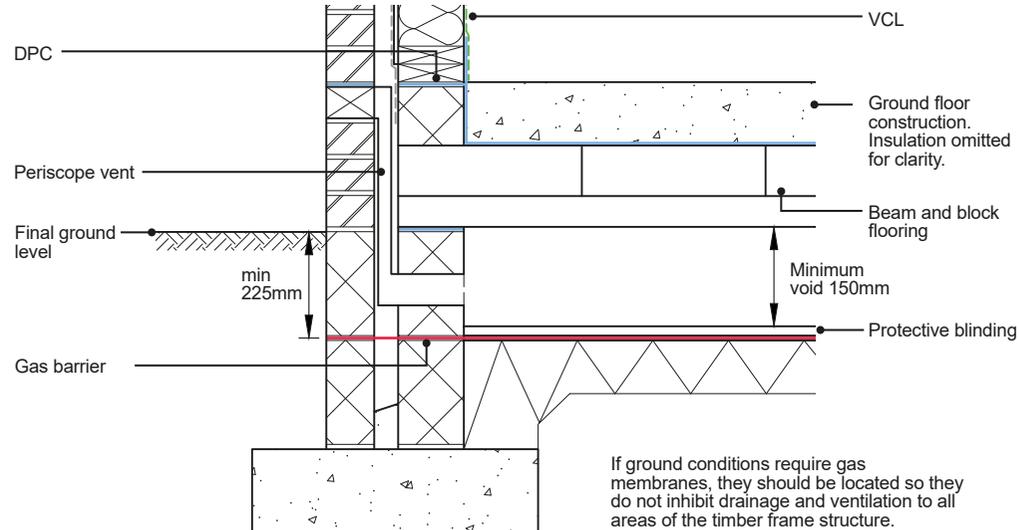
Ventilation for timber frame structures

It is important that whilst setting out the walls below ground that suitable forethought is given to the subsequent construction above DPC. The cavity should be constructed so that the appropriate widths are achieved in line with the appropriate relevant Building Regulations and our Warranty requirements. For timber frame structures early consideration of ventilation and drainage is key. Radon barriers should be positioned in such a way to not impair or restrict ventilation to any part on the timber frame structure.

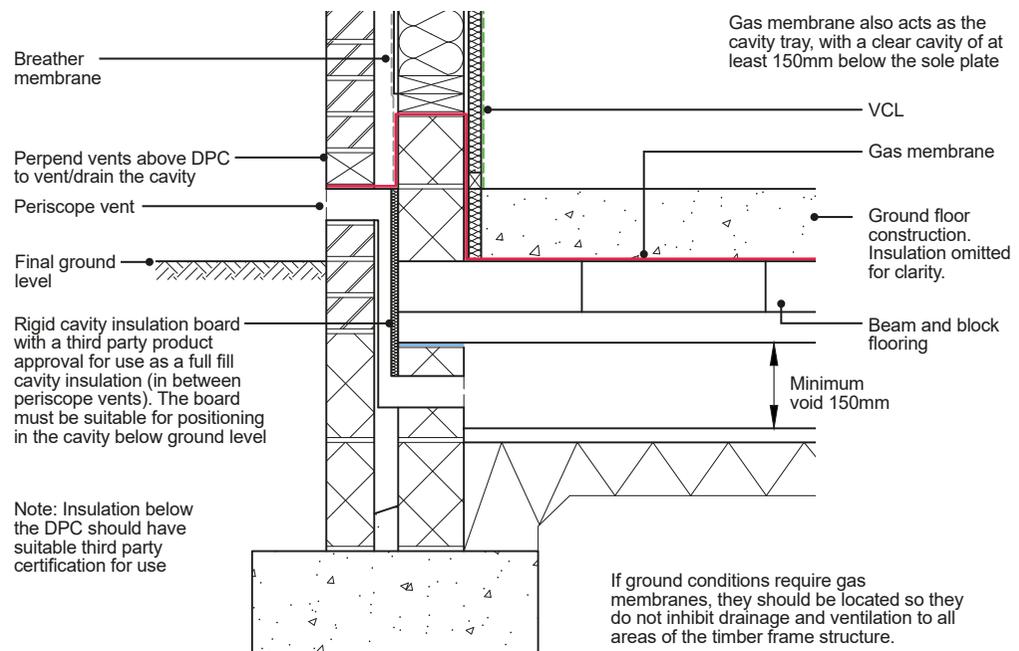
Possible gas membrane detail



Possible gas membrane detail



Possible gas membrane detail with raised sole plate



All of the drawings shown in this sub-section are strictly in relation to our Warranty requirements. Please refer to the Building Control Body to ensure the detailing achieves compliance with relevant Building Regulations in respect of thermal and fire requirements.

Sole plates

The sole plate is the first structural timber component installed on site. Its purpose is to set out the building, transfer loads to the foundations and provide a level base for erecting the wall panels. All structural timber should be located at least 150mm above finished external ground level, except for localised ramping (incorporating satisfactory drainage and ventilation detailing) for level threshold requirements.

The sole plate should be accurately levelled, located, and securely fixed to the substructure as specified by the Engineer. Where no sole plate is specified, the following guidance applies equally to wall panel bottom rails. Timber sole plates should be preservative treated in accordance with BS 8417. Further information on timber treatment can be found in 'Appendix C - Materials, Products, and Building Systems'.

Location

Sole plates should:

- Be located so that all structural timber is at least 150mm above external ground level. The use of a masonry foundation kerb upstand may be an appropriate method to achieve this.
- Be levelled to ± 5 mm from datum.
- Not overhang or be set back from the foundation edge by more than 10mm.
- Be set out within ± 10 mm in length and in line within ± 5 mm, as defined by the timber frame drawings.
- Diagonals should be within ± 5 mm up to 10m, and ± 10 , for more than 10m.

Note: Internal and party wall timber sole plates should not be installed below internal finished floor level.

Damp Proof Course (DPC)

A DPC should:

- Be located directly below all timber sole plates.
- Overlap at DPC junctions by at least 100mm.
- Be located flush to the outside edge of the sole plate.

Fixings

Fixings should:

- Be installed to the Engineers specification.
- Not damage the substructure or sole plates during installation.
- Be placed to provide adequate lateral restraint at door openings.
- Be specified with consideration for use with gas membranes where appropriate.
- Sole plates should be fixed to foundations with shot fired nails, proprietary sole plate fixings, anchors, brackets, or straps, as specified by an Engineer.
- If holding down straps are used, they should be stainless steel grade 1.4301 steel to BS EN 10088

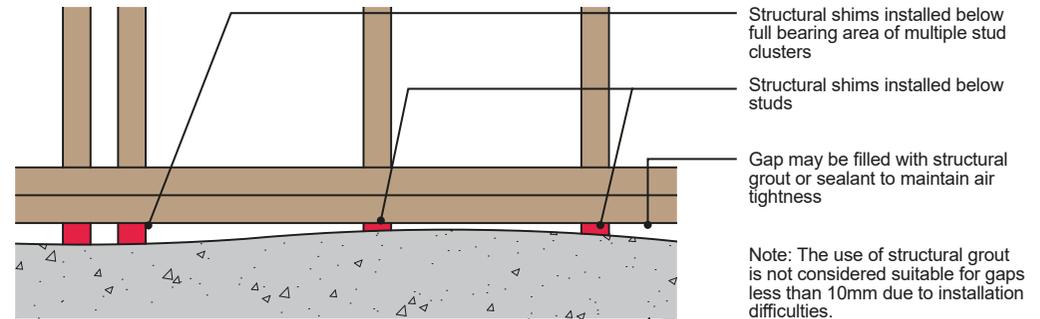
Ventilation to sole plate area

Regardless of the cladding system used, a cavity with provision for drainage and ventilation should be provided between the cladding and the timber frame ensuring that adequate ventilation provision is provided to all areas of the timber frame including the sole plate.

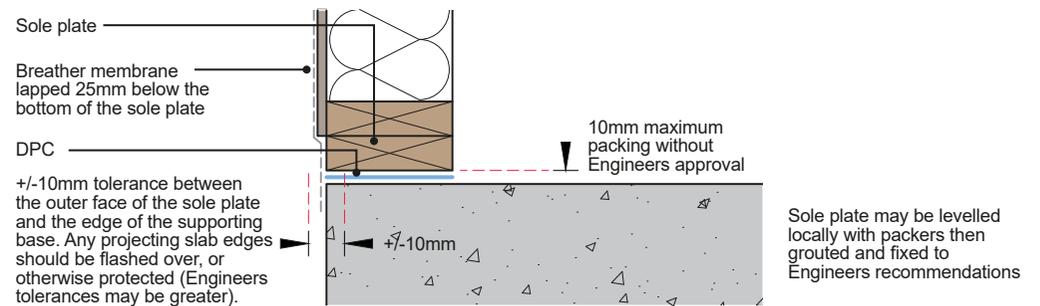
Packing

Structural shims or grout may be required under sole plates to level them and transfer vertical load. Longer fixings may be needed to allow for the size of the gap. Structural grout is difficult to install into gaps less than 10mm and therefore shims are preferred.

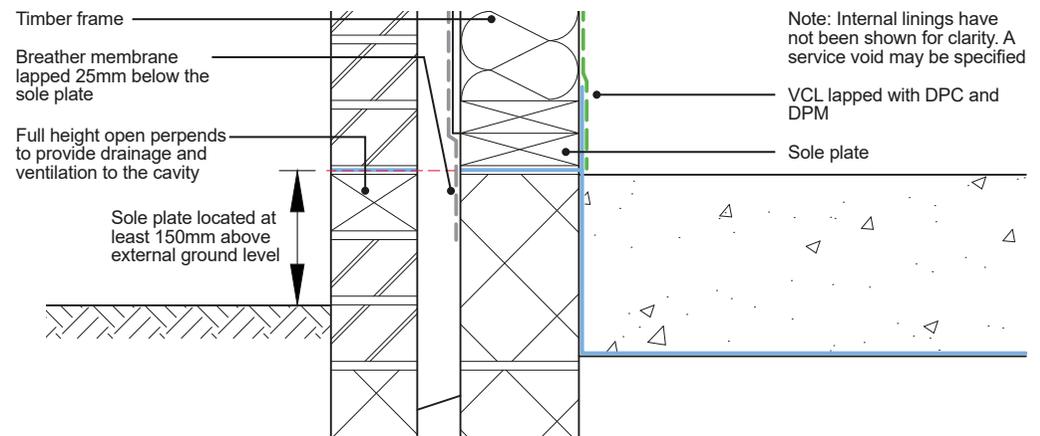
Packing of sole plates



Locating sole plates



Sole plate membrane junctions



All of the drawings shown in this sub-section are strictly in relation to our Warranty requirements. Please refer to the Building Control Body to ensure the detailing achieves compliance with relevant Building Regulations in respect of thermal and fire requirements.

Timber frame wall panels

Timber frame external wall panels shall:

- Be manufactured in accordance with the Engineer's design.
- Consist of solid timber studs and rails.
- Have studs at a maximum of 600mm centres and a minimum width of 37mm
- Be braced with a structural sheathing board.

Provision of cavities to all framed structures

All timber and light steel frame external wall panels must be provided with a drained cavity between the cladding and the structural frame. In addition; the cavity will be required to be ventilated for timber framed external walls. The frame should also be protected by a suitable third party approved breather membrane. Breather membranes should be of minimum Class W2 zero leakage in accordance with BS EN 13859, higher Class W1 will be requested when used in areas of high exposure to wind driven rain or where rain penetration of the cladding is expected.

Fixings and junctions

All fixings are to be installed to the Engineer's specification, unless otherwise justified:

- Junctions of wall panels and sole plates/head binders should not occur together.
- Head binder laps should wherever possible occur over a stud, preferably at least 600mm from the panel junction.
- Wall panel to wall panel connections should be a maximum of 300mm centres.
- Bottom rail to sole plate fixings should be one or two per stud bay.
- Wall panels should be adequately braced during erection to maintain tolerances.
- Disproportionate collapse components and fixings must be installed if specified.
- Multiple stud clusters which are considered structural (e.g. point load-bearings) should be designed by an Engineer.
- Point loads must be transferred down through wall panels and floor zones to foundations.
- Special considerations should be given to protecting closed panels from exposure to moisture during delivery, storage and erection.
- Engineered timber components should not be exposed to moisture for longer periods than those stated by the manufacturer.
- Roof trusses/rafters should be adequately fixed to wall panels.
- Floor joists should be nailed down to wall panels.
- If no head binder is present, floor joists must bear directly over studs.
- Waistbands and alignment of floors over walls should remain within tolerances for wall panels.

Timber framing components and structural sheathing boards may be fixed with:

- Nails
- Staples

Nail fixings should be:

- Austenitic stainless steel
- Galvanised
- Sherardized

Staple fixings should be austenitic stainless steel or similar.

Openings

All openings including doors, windows, flues and ventilation ducts should be designed and constructed to maintain structural performance.

Vapour control layer (VCL)

Unless proved otherwise by calculation, a 500 gauge (125 micron) polyethylene sheet, vapour control plasterboard or a proprietary membrane with appropriate third party accreditation should be located on or near the warm side of the thermal insulation.

For Warranty purposes, the boundary conditions for a condensation risk analysis should be as follows:

- 60% relative humidity.
- External temperature -2 degrees.
- Internal temperature 21 degrees.

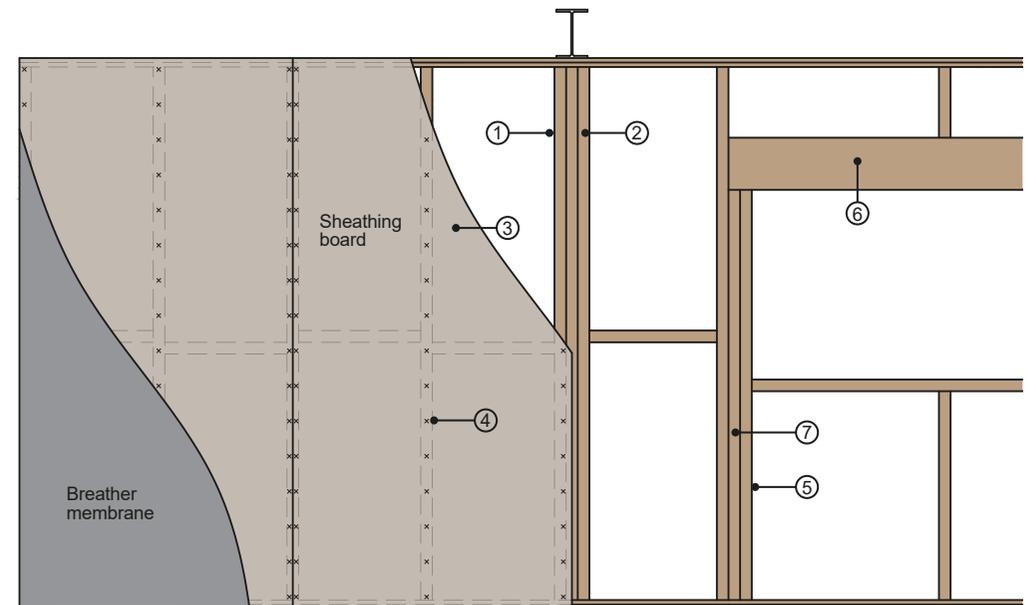
Sheathing boards

Sheathing boards are fixed to the timber frame in order to provide racking resistance to the structure. Structural sheathing board materials may be any of the following:

- Orientated strand board (OSB).
- Plywood.
- Impregnated soft board.
- Other board material with suitable third-party certification.
- All wood-based panel products should comply with BS EN 13986: Wood-based panels for use in construction characteristics, evaluation of conformity and marking.
- OSB should be grade 3 or 4 in accordance with BS EN 300: Oriented Strand Boards (OSB) - Definitions, classification and specifications.
- Plywood should be at least Class 2 Structural in accordance with BS EN 636: Plywood Specifications.
- Impregnated soft boards should be Type SB.HLS in accordance with BS EN 622-4: Fibreboards, specifications and requirements for soft boards.
- Non timber based boards must have third party accreditation that has been approved by the Warranty provider.

Please note: We do not accept the use of MgO boards.

Typical wall panel



1. All structural timber whether machine or visually graded shall be in accordance with BS EN 14081: Timber structures - Strength graded structural timber with rectangular cross section. All load-bearing solid timber studs, rails, binders and sole plates should be of a minimum dry graded C16.
2. Any point load imparted onto the timber frame should be transferred down through the building to the foundations with the use of multiple studs, as required by the Engineers design. If these are not installed during the manufacture of the panels the requirement for installation must be clearly conveyed to site.
3. Wood-based board materials used for sheathing should be fixed to the studwork frame leaving a 3mm minimum gap between boards to allow for moisture-related movement.
4. The fixings securing the structural sheathing board to the timber studwork wall panels provide racking resistance as calculated by the Engineer. The sheathing board shall be fixed to the timber studwork in strict accordance with the Engineer's fixing schedule. Fixing centres should not exceed 150mm around the perimeter of the board and 300mm centres in the field of the board. Sheathing fixings must not be over-driven through the face of the sheathing board.
5. Studs should be provided around window and door openings and adjacent to movement joints to allow the installation of wall ties or other cladding fixings. They should be accurately cut to length and bear tightly against the wall panel top and bottom rails.
6. A lintel may be required where openings do not fall between studs unless the vertical load is adequately transferred by other elements.
7. Lintels will require support of cripple studs. All structural timber should be treated with a preservative suitable for the 'Use Class' and 'Service Factor' applicable to its use.

Breather membrane

A breather membrane is a water-resistant moisture vapour permeable membrane used to provide secondary protection from moisture once the building is complete and may be used to provide temporary weather protection during construction.

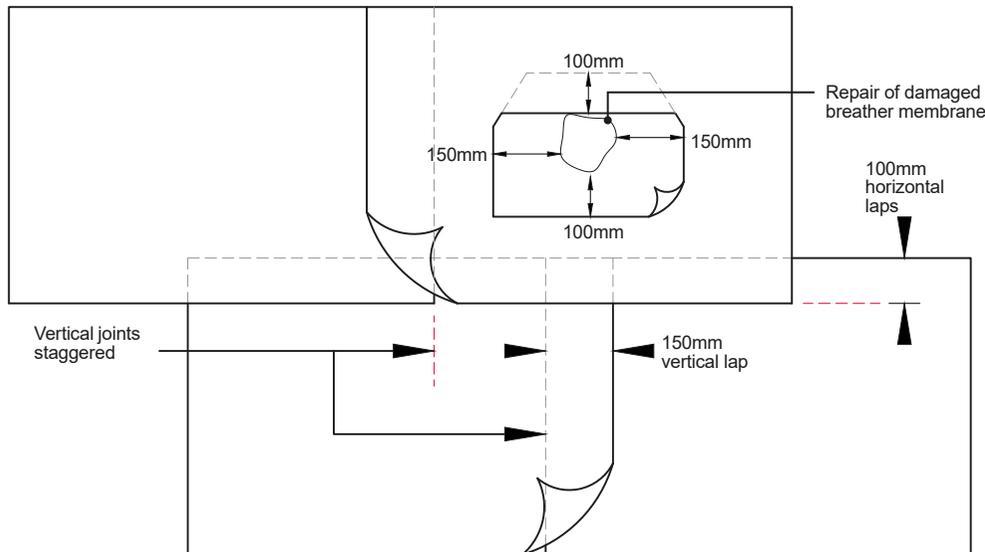
The timber frame structure should always be protected by a breather membrane facing the external wall cavity.

Breather membranes should be:

- All breather membranes should have appropriate third party product approval.
- Minimum Class W2 or better in accordance with BS EN 13859: Flexible sheets for waterproofing - Definitions and characteristics of underlays.
- Be self-extinguishing
- Securely fixed to protect the outside face of the timber frame structure with austenitic stainless steel staples.
- Placed on the outside of the timber structure and any external insulation adjacent to the external wall cavity.
- Lapped to deflect moisture away from the timber frame structure.
- Trimmed to leave 25mm lap below the lowest timber sole plate.
- Repaired if damaged.
- In areas of very severe exposure a minimum of a W1 class breather membrane should be used.

Breather membranes should be lapped by a minimum of 100mm at horizontal joints, and a minimum of 150mm at vertical joints. If breather membranes are trimmed flush with the edges of wall panels, additional strips of breather membrane, at least 300mm wide, should be supplied and site fixed over panel junctions. The location of solid timber studs should be clearly marked on the outer face of the breather membrane to ensure that cladding fixings are installed into solid timber.

Lapping and repair of breather membrane



Services

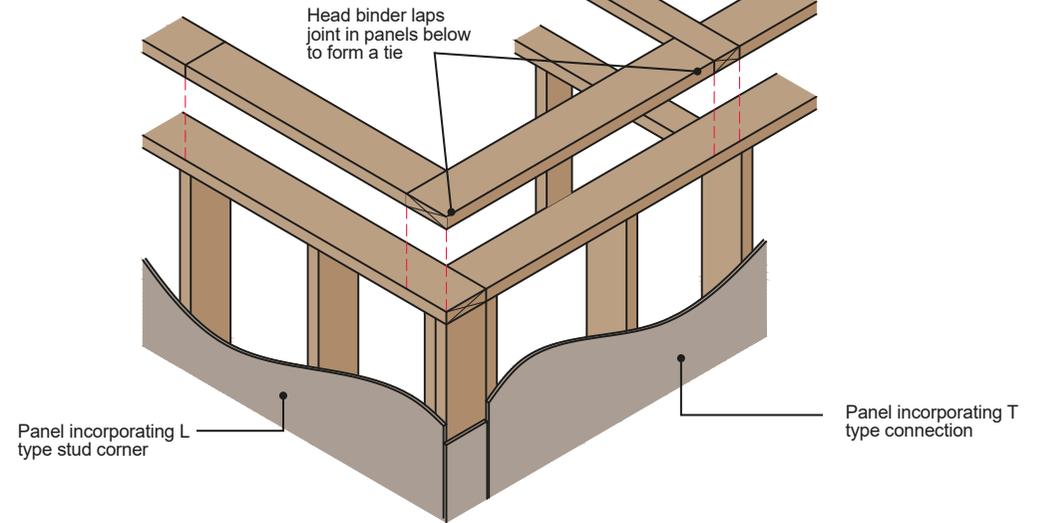
In addition to general provisions for the installation of services, the following are of particular note for timber frame construction external walls:

- The routing and termination of services should not affect the fire resistance of the structure.
- Electrical services are to be rated for their location with consideration for insulation.
- Wet services are not to be installed on the cold side of the insulation.
- Service penetrations through the VCL should be tight fitting to reduce air leakage and the passage of moisture vapour.
- Avoid running electrical services in the external wall cavity, except for meter tails.
- Services should be protected with metal plates if they pass within 25mm from face stud.
- Adequate allowance for differential movement to occur without causing damage should be provided for rigid services rising vertically through a building.
- Services that pass through the external wall cavity and provide an opening (such as flues/vents) should be enclosed with a cavity barrier and protected with a cavity tray.

Head binder lapping - Timber frame

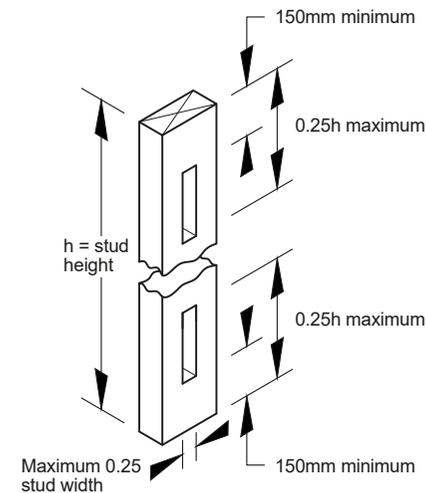
Head binder butt jointed over stud or lintel which is fixed to the underside of the top rail

Head binder nailed to frames. Fixings determined by timber frame engineer's calculations

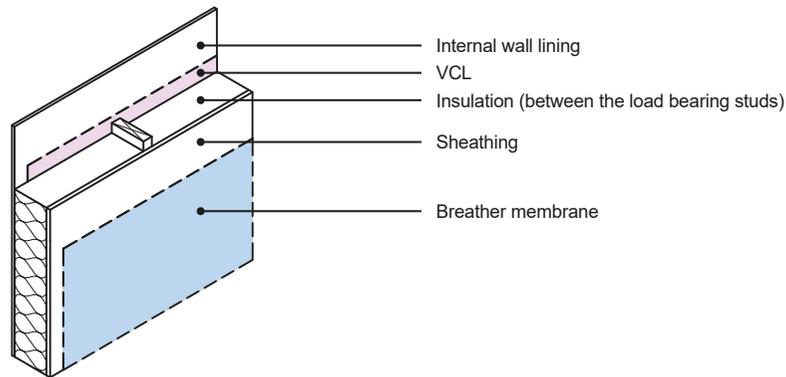


Drilling of studs

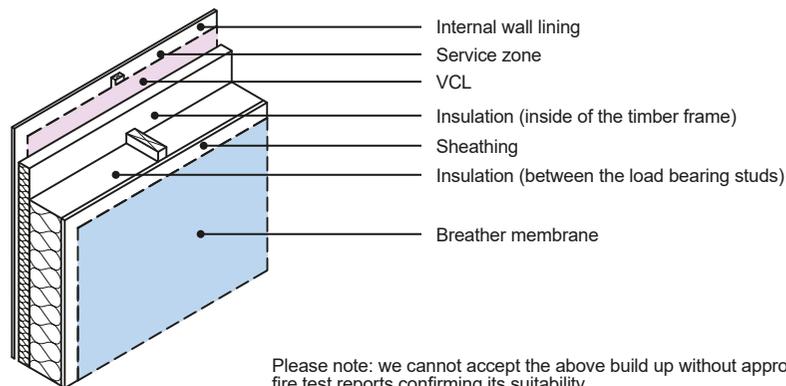
Drilling on centre line only. Hole diameters should not be greater than 0.25 the stud width and hole centres should not be closer than 4d (d = hole diameter).



Conventional wall with insulation between studs

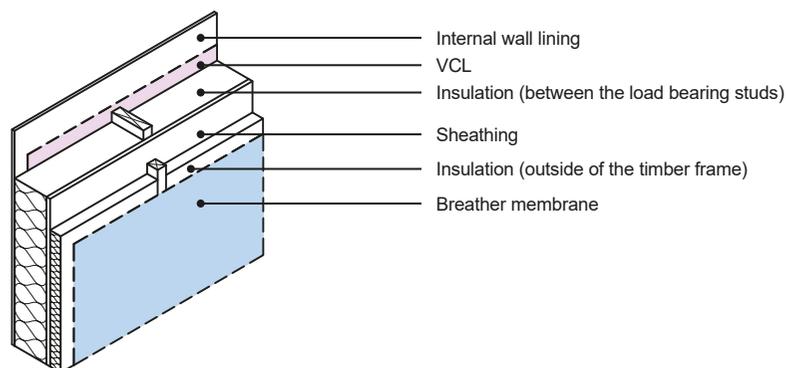


Continuous internal insulation



Please note: we cannot accept the above build up without appropriate fire test reports confirming its suitability.

Continuous external insulation



Insulation materials

Insulation materials should be chosen with consideration for their breathability and interaction with the timber frame.

All thermal insulation products used should have appropriate third party certification.

Insulation may be specified in any or all of the following locations:

- Between the load-bearing studs.
- On the outside of the timber frame.
- On the inside of the timber frame.

Insulation installed to the outside of the timber frame structure should have third-party certification for this application and retain a minimum of a clear 50mm cavity. The outer layer of insulation should also be covered with a breather membrane adjacent to the cavity.

External walls should be subject to U-Value and condensation risk calculations. A wall build up will be considered satisfactory if there is no calculated risk of surface or interstitial condensation at any time of the year, and it fulfils the minimum national requirement for thermal performance.

Special consideration should be given to condensation risk where non-breathable insulation products are installed on the outside of the timber frame structure. Joints between foil faced external insulation boards, must not be taped as this forms a vapour control layer on the cold side of the insulation.

Depending on the specification of insulation materials to be added to the structural frame, timber battens may be required to support the insulation or allow fixing of plasterboard linings, or external cladding to achieve the specified period of fire resistance.

Insulation installed within stud walls

If insulation is specified between external walls studs all voids shall be filled with insulation to maintain the thermal envelope of the building. When nogginns or boards are installed between studs to support services or heavy fittings the void behind them shall be fully insulated.

Insulation should not be installed until the structural timber frame is below 20% moisture content and the building is weather tight, as wet insulation can retain moisture. If closed panel timber frame is specified, additional care must be taken to protect the panels from exposure to moisture during construction, with moisture content checks carried out before full closure.

Note: The above also applies equally to insulated party wall cavities. There needs to be consideration for how party wall insulation is to be kept dry during the build process.

Insulation installed within the external wall cavity

If external wall insulation is to be used:

- Insulation should be installed in a manner to maintain its stated performance by minimising gaps that lead to thermal bridging and air washing.
- Insulation should be covered with a breather membrane to ensure that external wall cavity moisture does not become trapped in or between the insulation and the timber frame.
- Cavity trays should be fixed and lapped behind the cavity facing breather membrane by 100mm to deflect cavity moisture away from the timber frame.
- Allowance should be made for differential movement to occur at floor zones.
- Cavity barriers should be tightly fitting; depending on the type of insulation used, cavity barriers may need to pass through the insulation, back to solid timber within the timber frame structure behind to remain effective in a fire.
- It should not retain or transmit moisture to cause the timber structure to exceed 20% moisture content.
- Stud locator marks should be transferred onto the outer face of the breather membrane adjacent to the external wall cavity.
- Wall ties should transfer loads to the timber frame structure. To achieve this, wall ties will typically need to be installed through the external insulation rather than bearing onto it.
- Joints between foil faced insulation boards must not be taped.

Vapour control layer (VCL)

A VCL is a moisture vapour-resistant material located on, or near, the warm side of the thermal insulation. Its purpose is to

- Restrict the passage of moisture vapour through the structure of the wall.
- Mitigate the risk of interstitial condensation.

The VCL may take the form of:

- A vapour control plasterboard comprising a metallised polyester film bonded to the back face of the plasterboard.
- A minimum 125 micron thick (500 gauge) polythene sheet.
- A third-party approved proprietary vapour control membrane product.

Subject to a favourable condensation risk analysis, a novel or reverse wall construction may not require the use of a high moisture vapour-resistant vapour control membrane.

A VCL should not be installed until the structural timber frame is below 20% moisture content and the building is weather tight.

Installation of a VCL

A sheet membrane (polythene or proprietary) VCL should be:

- Securely fixed to and cover all areas of the timber frame external walls, including all sole plates, head binders, and lapped/sealed fully into window/door reveals.
- Lapped and sealed by at least 100mm at joints.
- Lapped and sealed over studs, rails or noggins.
- Sealed around service penetrations.
- Lapped and sealed with DPM/DPC at the junction with the ground floor/foundation by a minimum of 100mm.

Note: Small holes in the VCL should be sealed with a suitable self-adhesive tape. If a proprietary membrane is being used, the manufacturer's proprietary sealing tape should be used. Larger holes should be re-covered to lap over adjacent studs and rails.

Vapour control plasterboard should be:

- Fixed in accordance with the plasterboard manufacturer's installation guidance.
- Tightly cut and fitted around service penetrations.
- Discarded if the vapour control backing is damaged.

Wall linings

The internal lining of the timber frame wall may be required to perform four functions:

- Provide the finish or a substrate to accept the finish on the inner face of the wall.
- Contribute to the racking resistance of the wall.
- Contribute to the fire resistance of the wall.
- Contribute to the acoustic performance of the wall.

Wall linings are typically:

- Gypsum plasterboard.
- Fibre reinforced gypsum board.
- Cement bonded particle board.

Lining materials must satisfy all relevant performance criteria, e.g. fire resistance, acoustic performance and have relevant third-party certification.

Please note: we do not accept the use of MgO boards.

Plasterboard

Installation

In order to provide the specified period of fire resistance, the plasterboard must:

- Protect all areas of the timber frame structure.
- Have all edges supported by timber studs or rails.
- Be fixed in accordance with the plasterboard manufacturer's guidance.
- Be cut and tightly fit around service penetrations.
- Have junctions of wall and ceiling linings detailed to maintain continuity.
- Be installed using the specified number of layers to achieve the required fire resistance.
- Have all joints staggered when installing multiple layers.

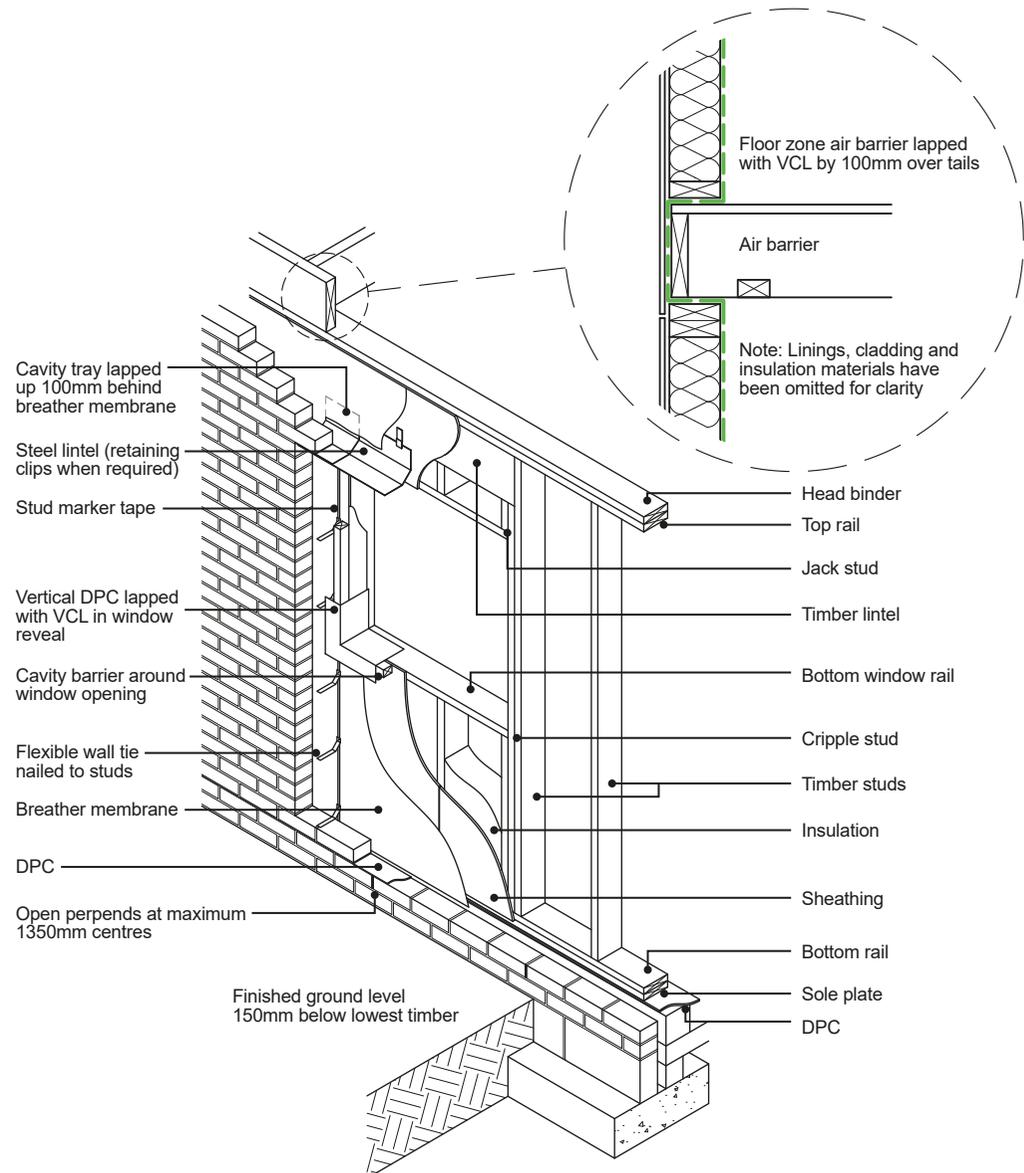
When fixing plasterboard linings:

- Each layer must be fully and independently fixed.
- Fixings of the correct length and centres should be installed in accordance with the plasterboard manufacturer's installation instructions.
- Walls requiring plasterboard to provide racking resistance should be clearly identified with plasterboard installed to the Engineer's specification or the plasterboard manufacturer's specification, whichever is more onerous.

Air leakage

Detailing and installation instructions must be followed to achieve adequate air tightness.

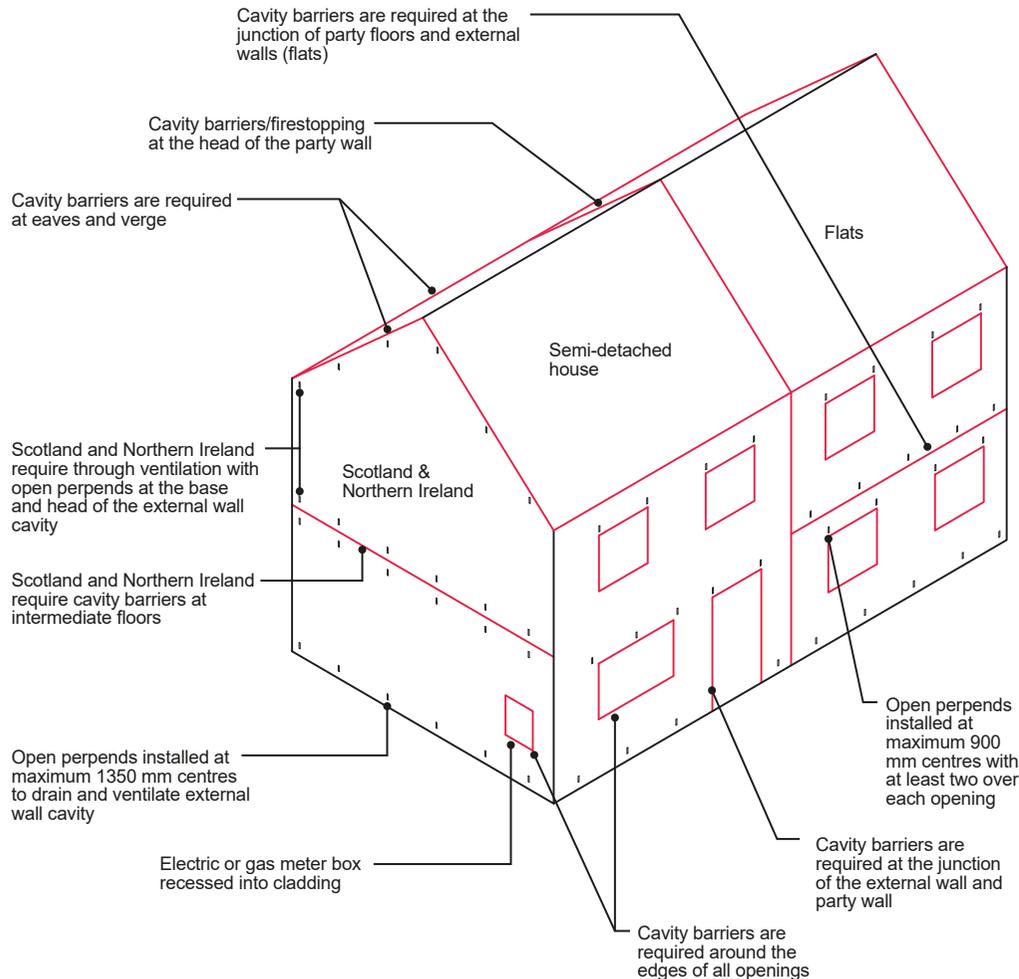
Wall panel with brick cladding



Locations of cavity barriers and open perpend within the external wall

Note: Lightweight cladding systems will require a cavity barrier along the bottom of the cavity.

Note: Cavity barriers may also be required between walls and floors within the building, consult National Regulations for further guidance.



Cavity barrier locations

In England and Wales, cavity barriers shall be installed:

- At the edges of all cavities including around openings, e.g. windows and doors (even if the opening is in close proximity to a compartment floor or intermediate floor level in Scotland and Northern Ireland).
- Between an external cavity wall and a compartment wall or compartment floor.
- Around meter boxes in external walls.
- Around service penetrations in external walls e.g. extract duct or boiler flue.
- To sub-divide extensive cavities; please refer to National Regulations for specific requirements.

Cavity barrier installation

Cavity barriers shall be installed:

- So they fully close the cavity.
- So the ends are tightly butted (or adequately lapped in accordance with the manufacturer's instructions) to form a continuous barrier.
- Backed by solid timber studs, rails or floor joist at least 38mm wide.
- In accordance with manufacturer or independent certifier's guidance.
- So they are mechanically fixed to rigid construction (for both vertical and horizontal positions).

A cavity tray should be installed directly above a horizontal cavity barrier and lapped up at least 100mm behind the breather membrane (except at eaves and verges).

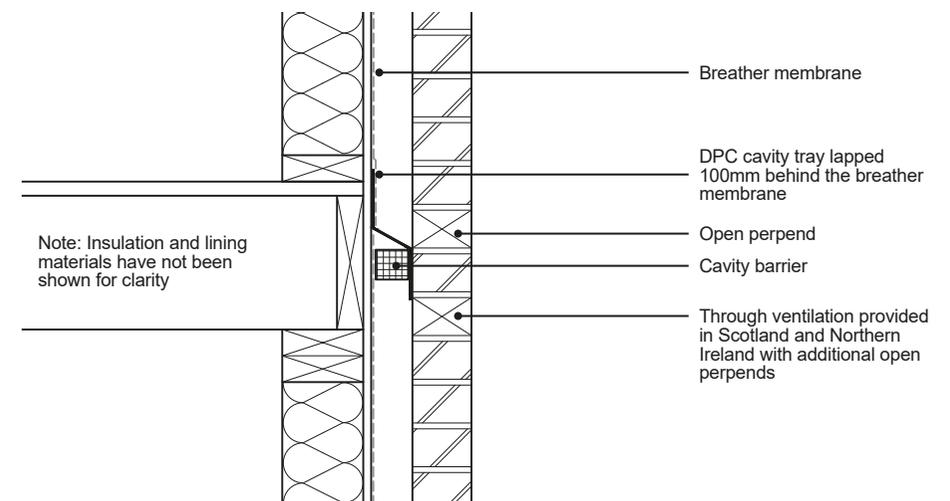
Cavity barriers are required to prevent the spread of smoke and flame within concealed spaces.

Cavity barriers may be constructed from:

- Steel at least 0.5mm thick.
- Timber at least 38mm thick.
- Proprietary 3rd party approved mineral wool product.
- Calcium silicate, cement-based or gypsum-based board at least 12mm thick.
- An independently assessed and certified proprietary product.

Timber cavity barriers should be protected from masonry cladding by the use of a DPC. The cavity face of the barrier should be left uncovered to allow drainage and ventilation of the timber. The use of timber cavity barriers around openings allows for effective sealing to be installed between them and the opening frame.

Cavity tray above horizontal cavity barrier



Masonry cladding

Timber frame external walls should be finished externally with a cladding system, which may take the form of masonry or a lightweight rainscreen system. Regardless of the cladding system used, all external wall claddings should be separated from the timber frame structure by a drained and ventilated cavity. In some locations, for example close to boundaries, national regulations require claddings to provide fire resistance to the structure from the outside in. Where a masonry cladding is proposed the vertical loadings from the masonry cladding must not be supported by the timber frame structure.

Self-supporting masonry claddings

Self-supporting masonry claddings should be connected to the timber frame using wall ties, wall ties should meet the following provisions:

- Comply with BS EN 845: Specification for ancillary components for masonry, ties, tension straps, hangers, and brackets.
- Be constructed from austenitic stainless steel.
- Accommodate all anticipated differential movement.
- The overall length of the wall ties must be of adequate length to provide a minimum 50mm clear cavity. The minimum length of embedment into the external leaf mortar joints should be 50mm.
- Be installed into solid timber studs, not just through sheathing.
- Additional studs should be provided in the timber frame structure for wall ties at vertical movement joints and around openings in the masonry cladding.
- Angled to drain moisture away from the timber frame even after differential movement has occurred.
- Installed at a maximum of 300mm centres vertically and 225mm horizontally around openings and movement joints.
- Installed within 225mm of the head of the wall.
- Wall tie density: For buildings up to three storeys in height wall ties should be installed at a minimum density of 4.4/m² (a maximum of 375mm vertically with studs at 600mm centres and a maximum of 525mm vertically where studs are at 400mm centres). A tie density of 4.4 ties/m² may be suitable for buildings on flat sites within towns and cities anywhere in the UK, except the north western fringes of Scotland and Ireland (where the basic wind speed exceeds 25m/sec) and any areas where the site is at an altitude of 150m or more above sea level. An increased wall tie density may be required in exposed locations or for buildings higher than three storeys in height, the actual performance required for each site location or building should be determined by an Engineer.

Cavity drainage and ventilation in masonry cladding should:

- Be provided with full height open perpend at a maximum of 1350mm centres or equivalent open area.
- Be provided in the brick or block course below the lowest timber sole plate above external finished ground level and below DPC.
- Be provided to ensure drainage and ventilation to each external wall concealed space directly above horizontal cavity barriers/trays.
- Be installed over openings in the external wall cavity e.g. windows and doors at a maximum of 900mm centres.
- Maintain a minimum 50mm clear cavity with care taken to reduce mortar droppings at the base of the wall.

Weep-holes alone are unsuitable for timber frame construction, and open perpend should be used. Proprietary open perpend inserts are available with insect screening incorporated however their equivalent open area must be considered and where this is less than that of an open perpend, their installation centres should be reduced accordingly.

- Cavity drainage and ventilation should provide an open area of not less than 500mm² per metre run:
- At the base of the external wall concealed space.
- Above horizontal cavity barriers/trays.
- Over openings in the external wall cavity, e.g. windows and doors.
- Allowing differential movement to occur while retaining an adequate gap.
- With openings protected by a mesh to prevent the passage of insects.

Masonry cladding - Brick suitability

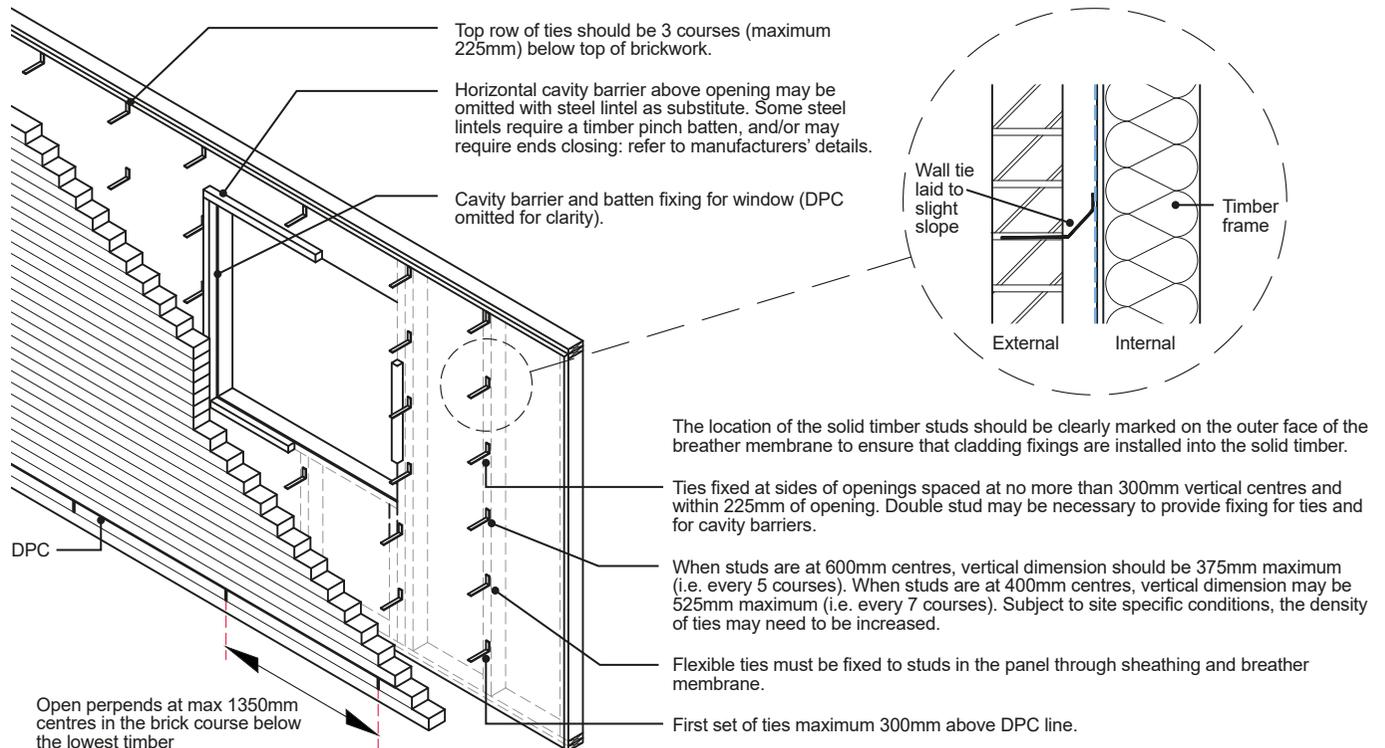
- Facing bricks must have a suitable level of durability and particular attention should be paid to the bricks resistance to frost and moisture.
- Bricks should be capable of supporting proposed loads.
- Bricks should comply with BS EN771 and PD 6697.
- Frost resistant bricks should be used in areas of prolonged frost.

For further information on the suitability of masonry claddings and installation of stone heads within masonry cladding, please refer to the 'External Walls - Traditional Masonry' and 'Appendix C - Materials, Products, and Building Systems' sections of the Technical Manual.

Minimum cavity width to timber frame

Timber frame external wall minimum cavity widths	
Masonry	50mm
Render on unbacked lath	50mm
Render on backed lath or board	25mm
Timber	19mm
Tile hanging	25mm

Location of wall ties



Movement joints

Movement joints should be provided in external masonry cladding in accordance with the 'External Walls - Traditional Masonry' section of the Technical Manual. Additional timber studs may need to be installed within the timber frame to enable the correct installation of wall ties adjacent to movement joints.

Claddings supported on the timber frame

Claddings supported on the timber frame should be connected to it on vertical treated timber battens, or a carrier system, to form a drained and ventilated cavity to all areas of the external timber frame wall. These should be fixed into structural timber not just through the sheathing and to the Engineer's specification.

Cavity drainage and ventilation should provide an open area of not less than 500mm² per metre run:

- At the base of the external wall concealed space.
- Above horizontal cavity barriers/trays.
- Over openings in the external wall cavity, e.g. windows and doors.
- Allowing differential movement to occur while retaining an adequate gap.
- With openings protected by a mesh to prevent the passage of insects.

For additional guidance on claddings supported on timber frame please see the 'External Walls - Render' and 'External Walls - Claddings' section of the Technical Manual.

Window and door installations

Gaps around external windows and doors should be sized to allow for thermal movement and this will vary depending on the material of the frame.

Material	Recommended gap per side for width of structural openings (mm)		
	Less than 1.5m*	1.5m – 3.0m*	3.0 – 4.5m**
Upvc –white	5	5	7.5
Upvc-non-white	7.5	7.5	11
Timber	5	5	5
Steel	4	5	6
Aluminium	5	5	7.5

Notes:

* The maximum gap permitted for openings less than 3m should be 10mm.

** For openings more than 3m, the maximum gap permitted should be 15mm.

For gaps greater than 5mm, a backing strip should be provided behind the sealant and the sealant should have a minimum depth of 6mm.

Please refer to the 'External Windows and Doors' section for further guidance on window and door installations.

Please note, gaps under window and door openings will also need to be provided to cater for differential movement between the timber frame and the external brickwork. For further guidance please refer to the 'External Walls – Timber Frame – Differential Movement' section of this Technical Manual.

Finishing trims

The use of proprietary surface fixed finishing trims e.g. D-moulds, should be undertaken only as part of a designed junction between window and door framing and the surrounding opening. For further guidance on the use of finishing trims please refer to the 'External Windows and Doors' section.

The Building Control Body should be consulted for guidance on thermal compliance.

Openings

All openings including doors, windows, flues and ventilation ducts, should be designed and constructed to maintain:

Fire performance:

- Internal reveals require equal fire resistance to the rest of the structure.
- Window fixing straps should not compromise the integrity of any fire-resistant reveal linings.
- Cavity barriers should be installed in the external wall cavity around the perimeter of openings. They must be mechanically fixed to rigid construction (for both vertical and horizontal positions)
- If profiled steel lintels are used as cavity barriers, triangular gaps behind lintels, which occur at each end, should be closed with careful positioning of adjacent cavity barriers.

Acoustic performance:

- Seal gaps between timber frame wall and the element being installed into the opening.
- The element being installed into the opening may have a minimum acoustic requirement.

Weather tightness and thermal performance, including thermal bridging and air tightness:

- The element being installed into the opening will have a minimum thermal performance.
- Junction between the window/door frame and the opening also has a thermal performance value assigned to it (psi value) designs may incorporate insulated reveals.
- The gaps between the timber frame wall and the element being installed into the opening should be sealed using air sealing tapes, compressible seals or EPDM to promote thermal performance and continuity, weather tightness and air tightness.
- Cavity trays should be installed over the heads of all openings and lapped behind the breather membrane by a minimum of 100mm. A flashing may be acceptable for some types of claddings.
- Lap cavity barrier DPC with internal VCL around openings. Where no DPC is used, breather membrane should be lapped with internal VCL.

Lintels

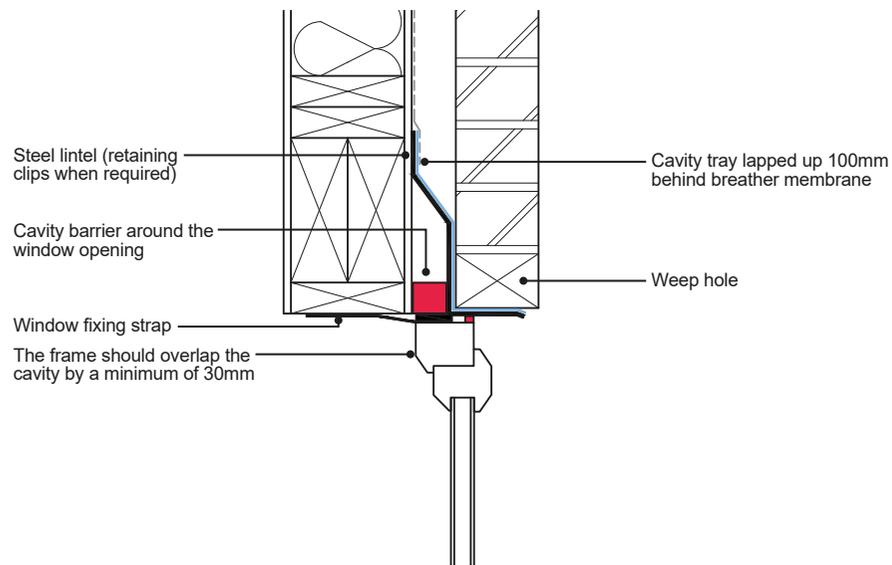
- The lintel should be the correct length and width for the opening and cavity width, the bearing length should be at least 150mm.
- Do not let masonry overhang lintels by more than 25mm.
- Continuity of the masonry bond should be maintained at supports for beams and lintels.

Do not:

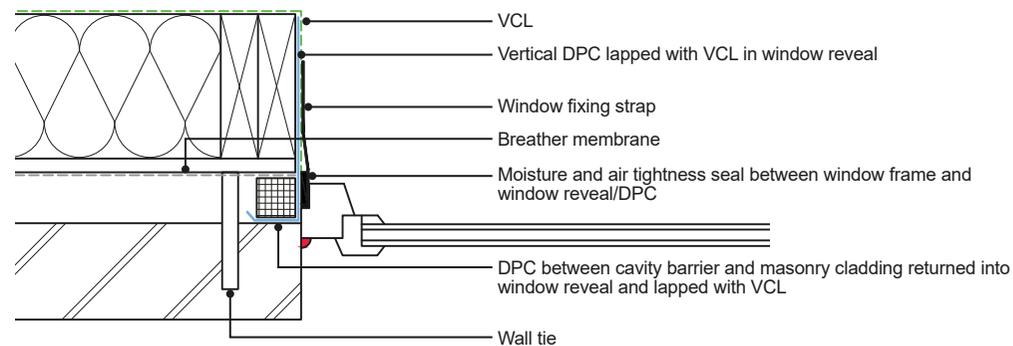
- Support lintels and beams on short lengths of cut blocks or make-up pieces.
- Apply load to lintels or beams before the masonry supporting has hardened.

Further information on the installation of lintels can be found in the 'External Walls - Traditional Masonry Cavity Wall' section of the Technical Manual.

Typical vertical section through window head



Typical window reveal (normal exposure)



External windows and doors

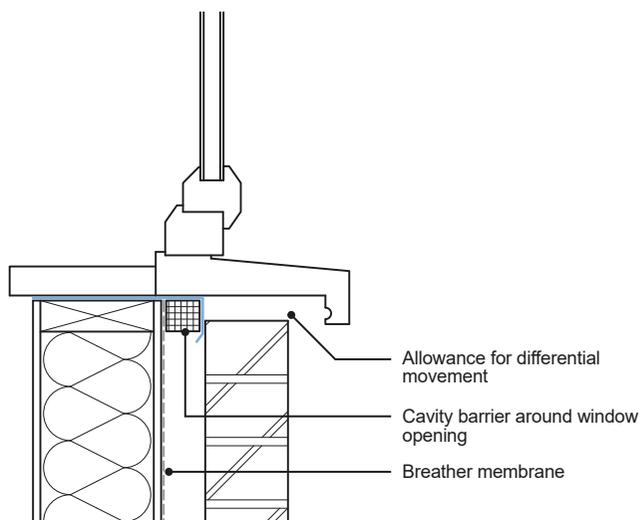
In areas of very severe exposure, checked rebates should be provided. The frame should be set back behind the outer leaf and should overlap.

When installing window/door frames in a checked rebate, allow for the frame to be deeper:

- To accommodate the 25mm rebate, and;
- To allow for opening lights to open clear of the masonry/render.

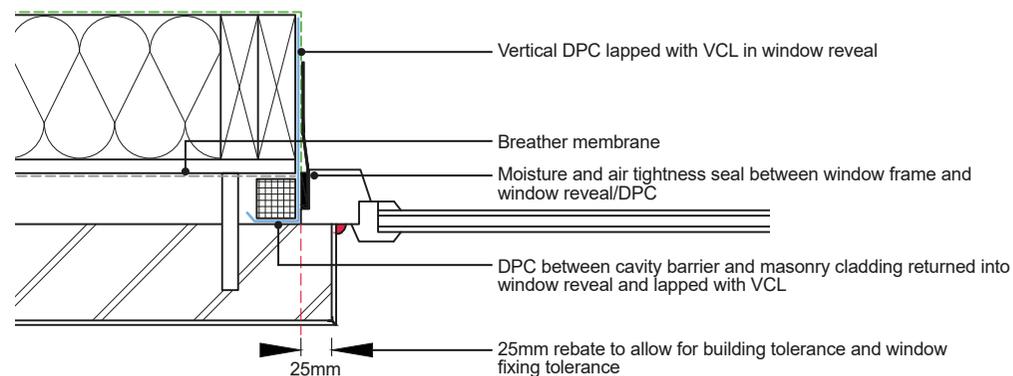
For further information on external windows and doors please refer to the 'External Windows and Doors' section.

Typical vertical section through window sill



Note: Internal linings have not been shown for clarity. A service void with additional insulation may be specified.

Typical rebated window reveal (very severe exposure) - rendered masonry clad



Cavity trays

Cavity trays, associated weep-holes and stop-ends prevent the build-up of water within the cavity between the timber frame and external cladding and allow the water to escape through the outer leaf. They are used in conjunction with lintels above openings, where horizontal cavity barriers are fitted to compression and where the cavity is bridged.

Cavity trays must:

- Comply with relevant Building Regulations.
- Have third party certification or be to a relevant BS or BS EN code appropriate for the intended use. Please note: Polyethylene DPC's should not be used as a cavity tray.
- Be provided at all interruptions likely to direct rain water across the cavity, such as rectangular ducts, lintels and recessed meter boxes.
- Be provided above lintels in walls in exposure zones 4 and 3, and in zones 2 and 1 where the lintel is not corrosion-resistant and not intended to function as its own cavity tray.
- Be provided continuously above lintels where openings are separated by short piers.
- Be provided above openings where the lintel supports a brick soldier course.
- Be fixed and lapped behind the cavity facing breather membrane by 100mm to deflect cavity moisture away from the timber frame.
- Must be proprietary preformed cavity tray systems at stepped and lower storey abutments and around corners in low rise cavity masonry walls.
- Cavity trays must be designed and constructed to allow for differential movement.

Weep-holes

Weep-holes must be installed at no more than 900mm centres to drain water from cavity trays and from the concrete cavity infill at ground level.

- At least two weep-holes must be provided to drain cavity trays above openings.
- Weep-holes in exposure zones 3 and 4 should be designed to prevent ingress of wind-driven rain (including ground level).
- Weep holes will be required in all external cladding, including rendered claddings.

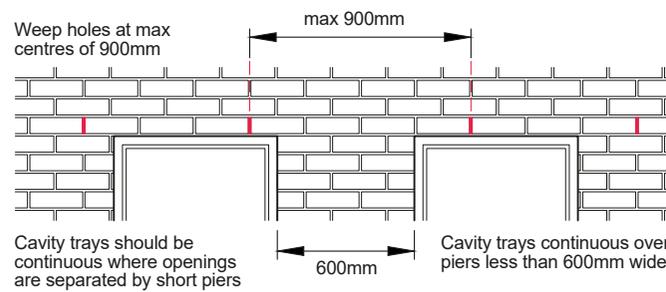
Stop-ends

Cavity trays should have water tight stop-ends to prevent water from running into the adjacent cavity. Stop-ends need to be bonded to the cavity tray material or clipped to the lintel, so that a stop to the structural cavity of at least 75mm high is provided. Normally, the stop-end is located to coincide with the nearest perpendicular to the end of the cavity tray. Stop-ends can be formed by sufficiently turning up the end of a DPC tray into the perpendicular joint. Surplus mortar should be removed from cavities and wall ties cleared of mortar droppings and debris as the work proceeds.

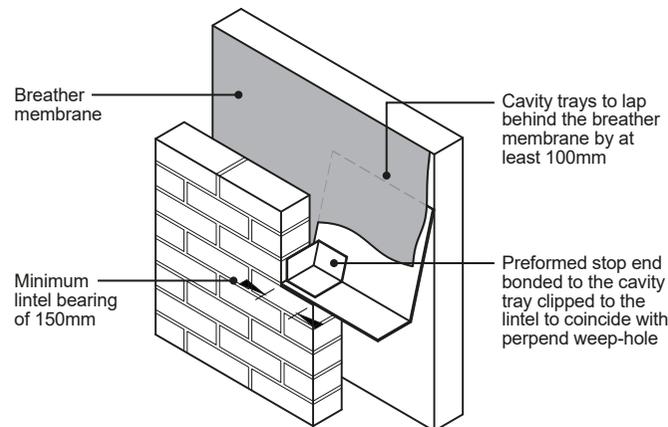
Steps and staggers

Particular care is needed in adequately preventing the ingress of water in a terrace of buildings with steps and staggers. A proprietary cavity tray system should be used. Stepped cavity trays are required at all pitched (stepped) roof abutments with external walls, e.g. attached garages or staggered terraces. The bottom (last) cavity tray must be supplied with two stop-ends and an associated weep-hole, allowing all water to escape over the lower roof covering. A lead cover flashings should be linked into the cavity tray (lapped in below).

Continuous cavity tray over two openings and a small pier

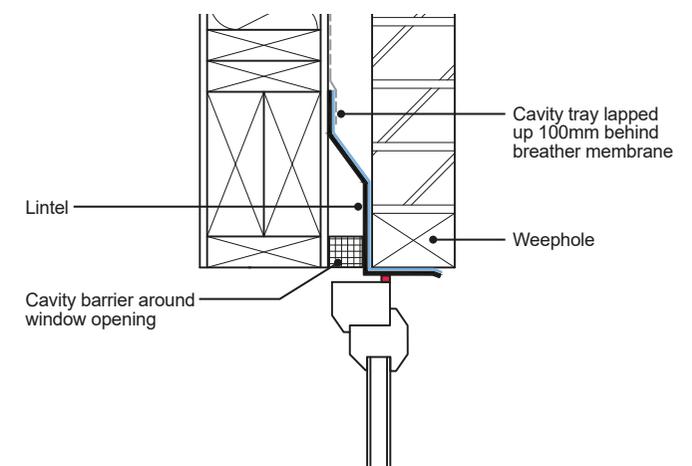


Stop end to cavity tray



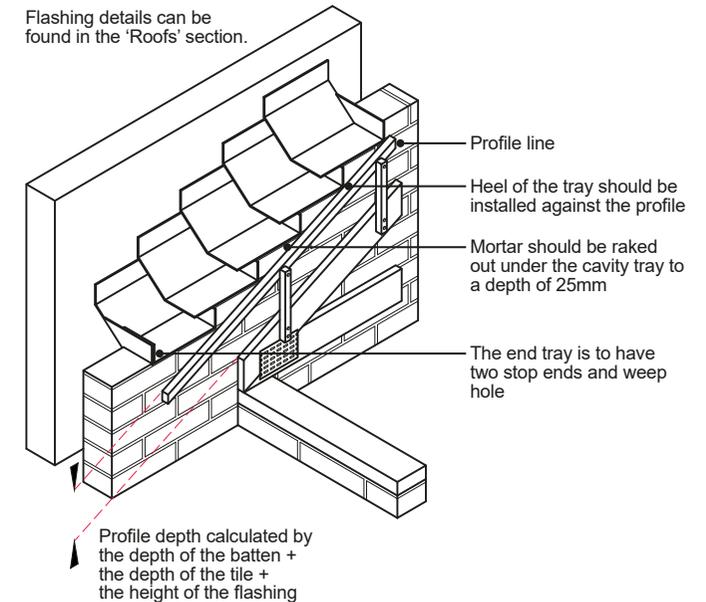
Cavity trays should rise at least 150mm from the outer to the inner leaf, be self-supporting or fully supported and have joints lapped and sealed.

Cavity tray and lintel



Installation of stepped cavity tray

Flashing details can be found in the 'Roofs' section.



Preformed rigid cavity trays should be used for stepped cavity tray details. Stepped cavity trays to lap behind breather membrane by at least 100mm. Additional measures may be needed to ensure the breather membrane adequately laps the tray to prevent moisture ingress behind the stepped cavity tray.

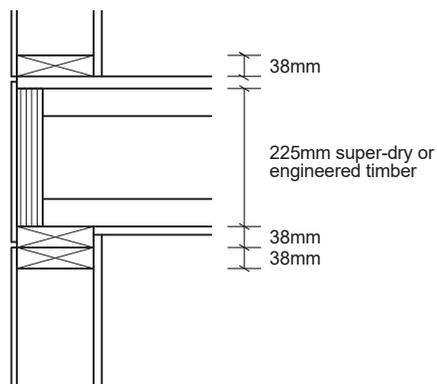
Differential movement at floor zones

Differential vertical movement occurs as a result of compression, closing of gaps and shrinkage of the timber frame structure and occurs during the first 24 months or so following completion. Shrinkage occurs across the grain and is due to a reduction in the moisture content of timber elements. The shrinkage of plates, rails, binders, floor and roof joists should be considered. The building should be designed to ensure that differential movement occurs evenly to external elevations and the internal structure.

Anticipated differential movement can be calculated using the allowance of 1mm for every 38mm of horizontal cross grain timber. As solid timber joists contribute significantly to anticipated differential movement, engineered timber joists should be considered where it is desirable to reduce differential movement.

Appropriate allowances must be made for differential movement to occur without causing damage to the building.

Engineered Timber

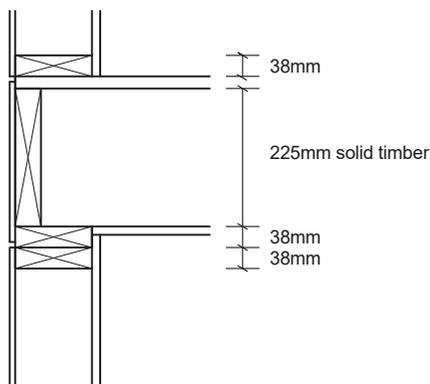


225 mm engineered timber = 2-3mm differential movement depending on tightness of build.

Expect 6mm movement per storey, or 7mm per storey if a locator plate is used on upper stories.

Note: when super-dry timber or engineered timber platform frame ground floor is used, add 3-4mm (depending on tightness of build) to the differential movement allowances quoted.

Solid Timber



225 mm solid timber = 6mm differential movement.

Expect 9mm movement per storey, or 10mm per storey if a locator plate is used on upper stories.

Note: when solid timber platform frame ground floor is used, add 7 mm to the differential movement allowances quoted.

If fillers or seals are to be installed into differential movement gaps their fully compressed dimension, considering the area of the seal and force required to compress it, must be added to calculate gap size. Materials should be chosen to provide an effective weather tight seal dependent on whether they are to be subjected to compression, expansion, or shear forces. Cover strips may also be used.

Self-supporting claddings (masonry)

Any material or component attached to the timber superstructure that overhangs the brick or blockwork (e.g. cladding attached to the timber frame, window sills, roof eaves, and verges) or projects through the masonry (e.g. balcony supports, flues, extractor fan vents, or overflow pipes) should have a clear gap beneath and at the top of the masonry cladding to allow differential movement to take place, thus avoiding damage to the components or cladding.

Masonry cladding should not be supported on the timber frame structure.

Gap sizes should allow for anticipated differential movement while allowing for drainage and ventilation requirements. Insect infestation should be avoided by using screens to cover gaps exceeding 4mm.

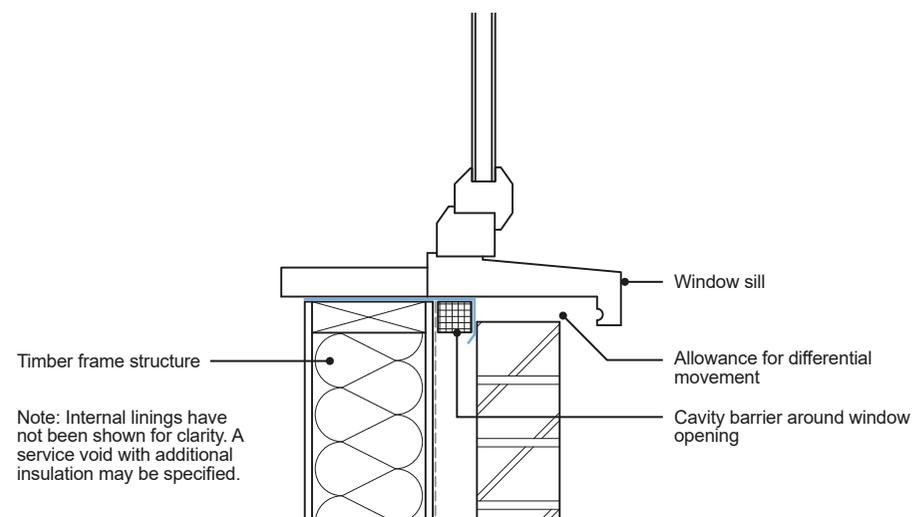
Anticipated differential movement

Gap Location	Differential movement gap size	
	Engineered floor joists*	Solid timber floor joists*
5th storey	53mm	Engineer design required
4th storey	45mm	
3rd storey	35mm	45mm
2nd storey	25mm	35mm
1st storey	15mm	20mm
Ground floor	5mm	5mm

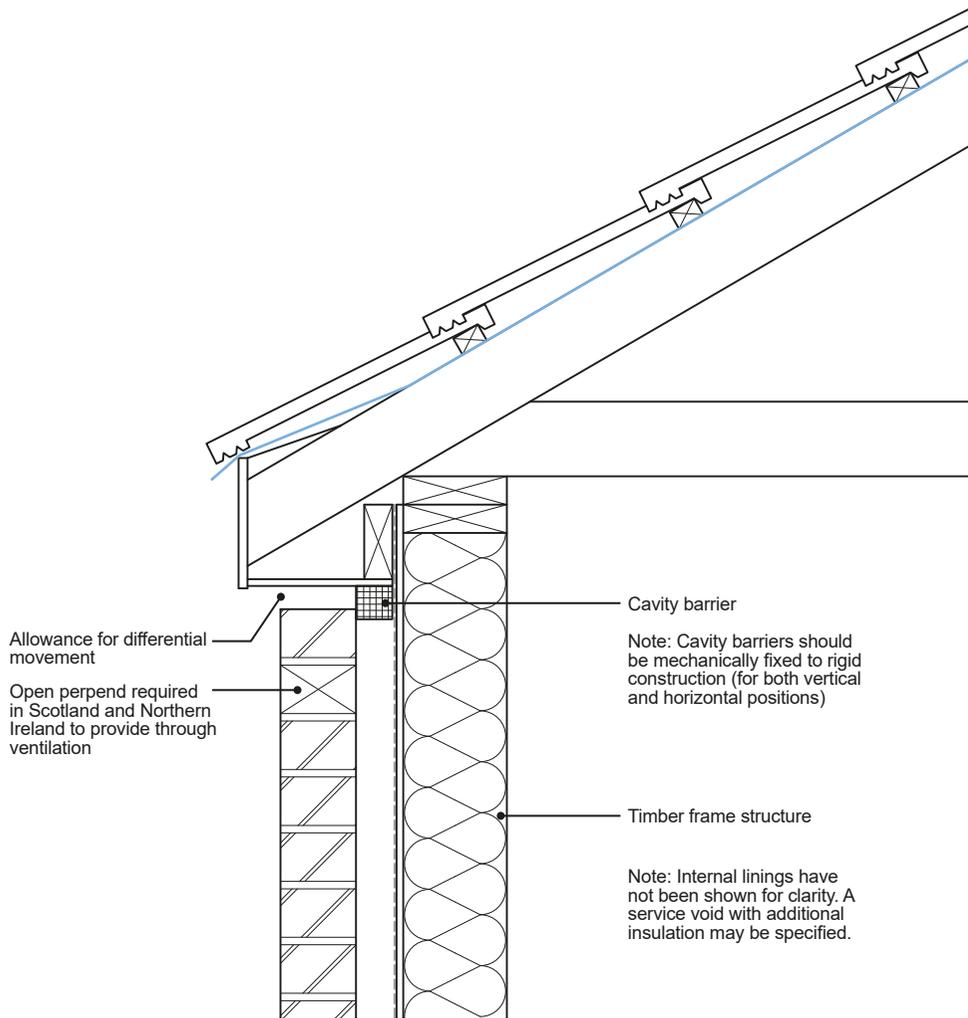
* The compressed thickness of the material used to fill the gap must be added to the dimensions given.

- For eaves and verge, add 5mm to the dimensions given in the table.
- The compressed thickness of the material used to fill the gap must be added to the dimensions given.
- The product used for differential movement must be capable of compressing without causing undue stress to the surrounding construction.
- Moisture content of all timber must be less than 20%.
- Table is based on a concrete ground floor. Where timber joists are used at ground floor level, 15mm for solid timber joists and 10mm for engineer I-Joists should be added.
- The table assumes outer leaf brickwork with expansion rates no greater than 2.5mm per storey.
- Services that are rigid from the foundations, e.g. soil stack, dry riser, gas and water, require differential movement gaps above the service entry. The gaps should be equal to those recommended for the bottom of openings at the appropriate floor level.
- There should be consideration for differential movement at lift door/thresholds and at the top of self-supporting elements such as masonry or steel lift shafts.
- Table based on a maximum depth of timber joists and rim beam/header to be 240mm.
- Single head binder at the eaves. Maximum double sole plates.

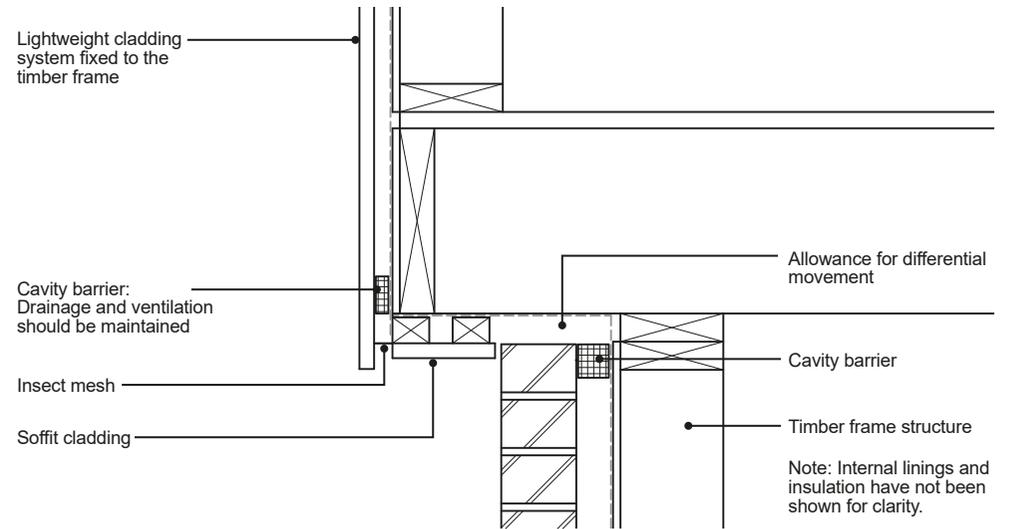
Allowance for differential movement at sill



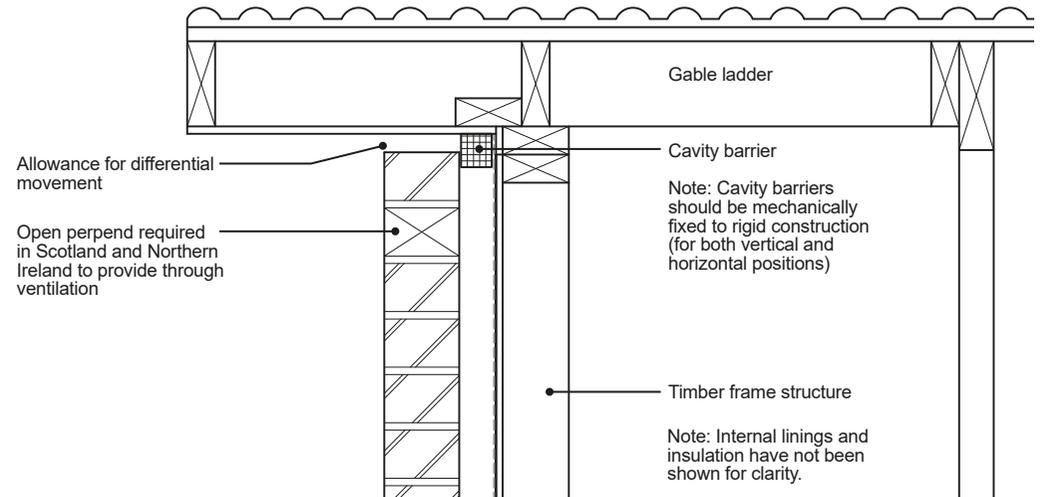
Differential movement at eaves



Differential movement at cantilevered overhang



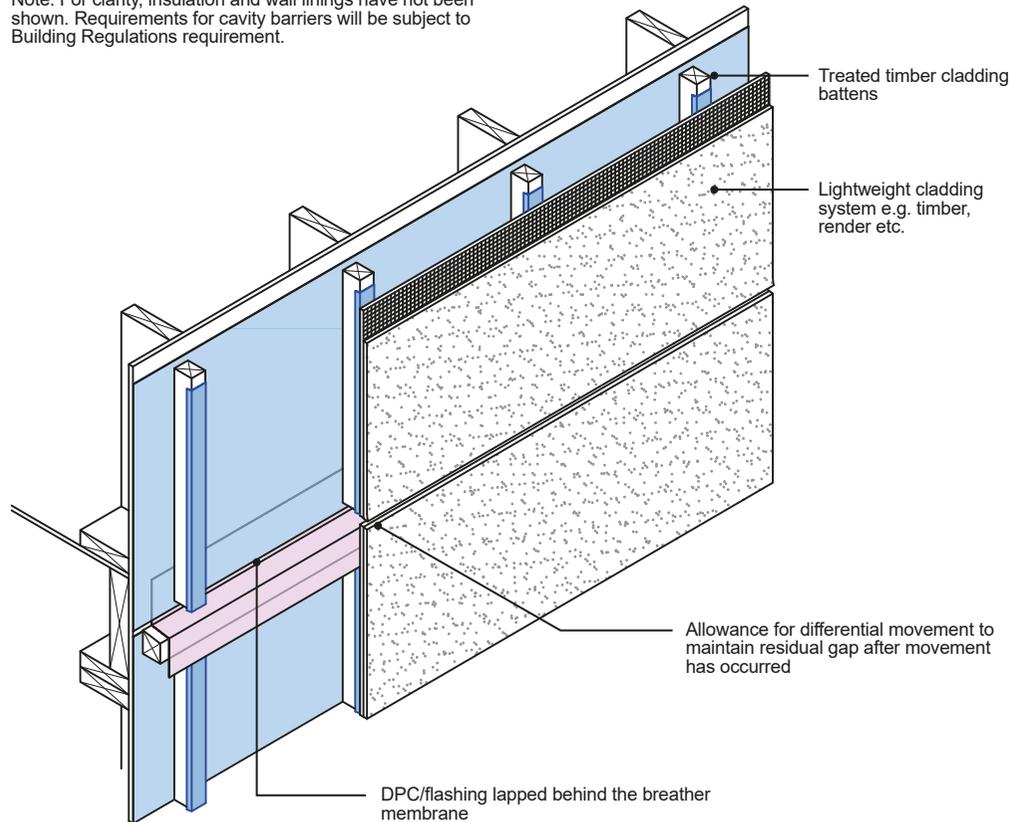
Differential movement at verge



Differential movement at floor zone with cladding supported on timber frame

Horizontal cross grain timber and construction gaps are concentrated at floor zones and this is where the majority of movement occurs. Vertical timber battens or other rigid cladding support systems should not span over the floor zones of timber frame buildings. Gaps should be provided to accommodate anticipated differential movement and the compressed size of any filler. Unlike self-supporting claddings, movement is not cumulative but should be calculated individually for each floor zone using the formula of 1mm for every 38mm of horizontal cross grain timber.

Note: For clarity, insulation and wall linings have not been shown. Requirements for cavity barriers will be subject to Building Regulations requirement.



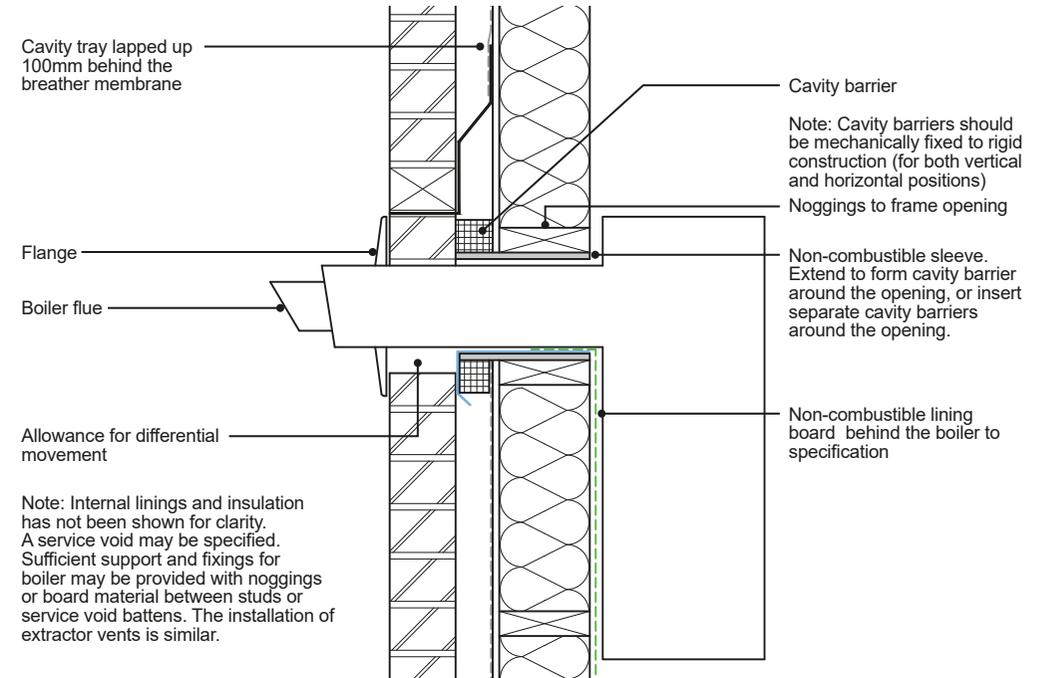
Gap sizes should allow for anticipated differential movement while allowing for drainage and ventilation requirements. Insect infestation should be avoided by using screens to cover gaps exceeding 4mm.

For additional guidance on claddings supported on timber frame please see the 'External Walls - Claddings' section of the Technical Manual.

Services

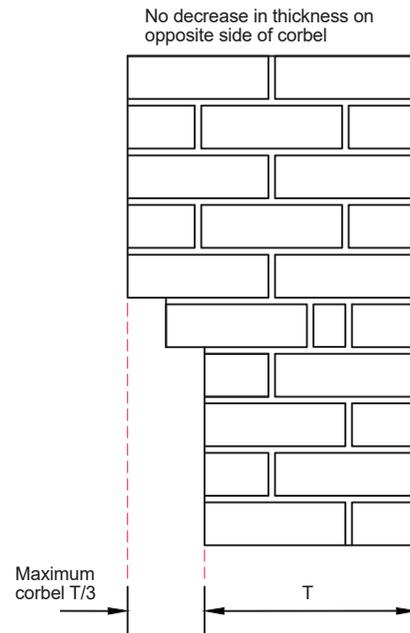
Rigid services within the timber frame structure also require an equal allowance for differential movement, as shown. Examples include copper gas and water pipes, dry risers, internal downpipes, SVP's, cable trays and blockwork lift shafts. While gap allowances externally are allowed below, for example, a sill, when a branch comes off a rigid stack internally, the gap needs to be left above a service to allow the timber frame to drop around it.

Differential movement at services



Feature brick corbelling

The extent of corbelling of masonry should not exceed that indicated in the below detail, unless supported or reinforced. Reinforced corbels should be designed by an Engineer.

**Gable spandrel panels**

The gable spandrel panel should be suitably designed to transmit loads to the roof structure and down through the timber frame.

It is important that gable spandrel panels are designed to transmit these loads to the roof structure via lateral restraints and vertically down to the timber frame. A full design with structural calculations be provided.

The timber frame designer should provide details of the lateral restraint to the gable spandrel panel, including details of the restraint used and the fixings should be provided.

6.

External Walls

6.3

Light Gauge Steel Frame

Provision of information

A full set of design drawings and specifications shall be made available to the Warranty Provider and all other interested parties prior to the associated works starting on site. This may include:

1. Evidence of SCI stage 1 and 2 certification.
2. Evidence of an ISO 9001 Quality management system covering the manufacturing of the panels including material supply chain.
3. A full set of detailed drawings, including:
 - a) Plan layouts indicating dimensions.
 - b) Elevations with dimensions shown.
 - c) Junction details showing position of DPC's, cavity trays, other building elements such as roofs, floors etc.
 - d) Detailed drawings showing sole plate levels in relation to external ground levels for all elevations.
4. Details of proposed breather membranes and VCL's to be used.
5. Engineers drawings, calculations and fixing schedules for each connection made on site (framing, sheathing, structural connections, membranes etc.) including size, type, number, spacing, method of fixing. Details of the corrosion protection of the fixing should also be provided.
6. Details relating to the securing and fixing of the panels to the substructure.
7. Details relating to the galvanisation rating of the frame, taking consideration of the anticipated exposure rating and potential aggressive meteorological environments.
8. Details of proposed cavity barriers including location, materials and technical assessments (third party product conformity certificate).
9. Details of any cladding material fixed back to the timber frame including type, size and location of fixings. Where masonry cladding is present on the external leaf, details of wall tie and movement joint provision.
10. Where insulation in the external wall makeup are to be fitted on site we would require details of proposed insulation to be used.
11. A condensation risk analysis should be provided for the external wall makeup.

The Warranty Surveyor, at their discretion, may also request supporting information that demonstrates suitability for use of any materials or systems contained within the above.

Building Regulations

All steel frame construction should meet the Building Regulations.

Stage 1 and Stage 2 SCI System Certification

Light Gauge Steel Frame systems which have been assessed on behalf of and endorsed by our Warranty through the SCI Light Steel Frame System certification process (stages 1 & 2) and have adequate Quality Management Systems in place (i.e. a valid ISO9001 Certificate from UKAS accredited certification body) will be acceptable as meeting the requirements of this Technical Manual for structural design principles for open panel construction.

Note – Actual wall makeup, components, individual products used for the external waterproof, thermal and fire resistant envelope, are outside the scope of the SCI Stage 1 assessment. These elements will still need to meet the requirements of this Technical Manual.

Light steel frame systems

The following guidance relates to the use of light gauge steel frame systems, factory manufactured to form structural components of a building, i.e. load bearing/non-loadbearing walls, floors and roof framing, etc. which are:

- Open panelised systems, acting a load bearing walls or as infill panels in conjunction with another form of construction
- Stick framing

Developers wishing to use 'Off site' manufactured light gauge steel frame systems to form buildings which are to be covered on one of our Warranty projects must provide evidence of a third party system approval (UKAS or equivalent) for the

system and has been assessed by our Warranty Innovations Team. Alternatively, all the following must be satisfied:

- A SCI Stage 1 certificate and then Stage 2 project specific assessment certificate (SCI Stage 2 certificate is required for buildings up to 5 storeys high).
- A comprehensive full structural design specification and supporting calculations for each house type on the proposed project,
- Evidence of a valid ISO 9001 Quality Assurance Certification (or equivalent) held by the Manufacturer, covering the manufacture of their product/system,
- Evidence of valid EN 1090 certification must be provided by the manufacturer of all structural steel. The certification body should be accredited by UKAS or equivalent ILAC signatory.
- Full details of all claddings and specifications of DPC's, breather membranes, vapour control layers, sheathing boards, insulation, separating wall details, roof and intermediate floor constructions and positioning of ground floors in relation to the surrounding ground levels in order to demonstrate compliance with this section of our Technical Manual.

Where a valid Steel Construction Institute (SCI) certificate is provided for the system, the information required in the above five bullet points must still be provided.

In addition to the above where the light gauge steel framing is used to form the structure of the building, the manufacturer will need to confirm how lateral stability will be achieved by the steel frame design. Structural calculations from an Engineer will be required, for all buildings registered for Warranty.

Please note our Warranty does not accept Light Steel Frame systems which rely on racking resistance of the sheathing board. Engineers Design Philosophy must clearly identify how lateral stability will be achieved by the steel frame design. This Engineers Design Philosophy should confirm that the stability system can resist the full horizontal wind and notional loadings, without any assistance from the sheathing board.

Any external wall make up incorporating external cladding, must meet our Warranty requirements in respect of weather resistance. Please see the 'External Walls - Claddings' section for further information.

Any modular or closed panel system or other modern method of construction using light gauge steel framing, must be accepted by our Innovation Department. Please refer to 'Appendix C' of the Technical Manual.

Steel frame - General design requirements

The structural design should be in accordance with BS EN 1993-1-3:2006, and imposed loads should be calculated in accordance with BS EN 1991, including:

- Dead loads.
- Imposed loads.
- Wind loads.

Steel and fixings should be suitable for the design and adequately protected against corrosion.

Galvanised strip steel should be designated grade S280GD to 450GD to BS EN 10346.

All light gauge steel frame framing:

- Should be only used in warm or hybrid construction - including floors, walls, pitched roofs, flat roofs and terraces,
- Must be protected from the external conditions with the use of appropriate wall and roofing membranes.
- Must be located entirely above DPC level and a minimum 150mm above external ground level, the use of a masonry foundation kerb upstand may be an appropriate method to achieve this.
- Walls, upper floors and pitched roof framing, should be pre-galvanised in accordance with BS EN 10346 with a minimum 275g/m² zinc coating (Z)
- Ground floor joists and ring beams in such floors should be pre-galvanised to 450g/m² zinc coating (Z).
- Positioned below the waterproofing layer of a flat roof, balcony or terrace should be pre-galvanised to a minimum 600g/m² zinc coating (Z).
- Where level access requirements result in the floor joists, ring beams and base rails etc. being less than 150mm above external ground level, then these

elements should be pre-galvanised to 600g/m² zinc coating (Z). Level access arrangements should be kept to a minimum.

- Load-bearing walls should be designed to support and transfer loads to foundations safely and without undue movement.

Wall panels may provide resistance to racking forces using one or more of the following techniques:

- Internal bracing.
- Cross flat bracing.
- Rigid frame action.

Note: Sheathing board should not be considered as contributing to the racking resistance of the structure.

The design should detail how joints between the wall panels and other elements are to be securely fixed:

- To the structure.
- To adjacent panels.
- To the floors and roof.

The design should ensure that the structure is adequately protected from the effects of moisture.

Exterior claddings should be compatible with the steel frame. Suspended floors should be designed to support and transmit loads safely to the supporting structure without undue deflection.

Services should be adequately protected from damage, walls and floors should resist the spread of fire. Internal walls and floors should be designed to resist the passage of sound adequately.

Metal stud framework

The wall panel usually consists of a head rail, base rail (sole plate) and possibly horizontal noggins at mid-height, together with vertical wall studs:

- Recommended site connections include self-drilling, self-tapping screws or 10mm-12mm diameter grade 4.6 bolts. Welding is not recommended on-site.
- Workmanship should comply with BS 8000: 5.
- Framed walls should be accurately aligned, plumb, level without twist and securely fixed to adjacent elements.

Vertical installation tolerances are:

- +/-15mm in overall height of wall 3 storey, or
- +/-10mm in overall height of wall 2 storey, or
- +/-5mm in storey height (approx. 2.5m).

Please refer to the 'Tolerances' section for further guidance.

A lintel should be provided where one or more studs is cut or displaced to form an opening. A lintel is not required where an opening falls between studs. Non-load bearing walls should have adequate strength and support.

Non-load bearing walls should not bridge movement joints in the main structure. A movement joint should be constructed between the frame and any chimney flue or lift shaft to prevent load transfer. Cavity barriers and fire stops should be provided in accordance with relevant Building Regulations, and steel joists should be spaced at centres no greater than 600mm.

Cutting holes in steel frame for services on-site is not recommended without approval from the steel frame designer. Holes, penetrations and cuts should be carried out in factory environments in accordance with the structural design. Holes should be fitted with grommets.

Accommodation of deflection

Infill walls should accommodate anticipated deflection within the primary frame

Determining the site exposure to wind driven rain.

For further information on determining the exposure for the site location please see 'Appendix C - Materials, Products, and Building Systems - Determining the sites exposure to wind driven rain'.

Key points: Construction below DPC

1. Brickwork and blockwork below DPC level must be selected to have suitable durability for its use in the wall construction in accordance with BS EN 771-1 and PD 6697.
2. Mortars below DPC are exposed to higher levels of saturation and therefore require higher durability classification (see BS EN 998-2).
3. Cavities below ground should be filled with concrete ensuring there is a minimum gap of 225mm between DPC and the top of concrete.
4. Concrete for cavities should be GEN 1 grade and a consistence class S3.
5. External ground levels should be a minimum of 150mm below DPC.
6. The compressive strength of the masonry units must meet the requirements of the Building Regulations.

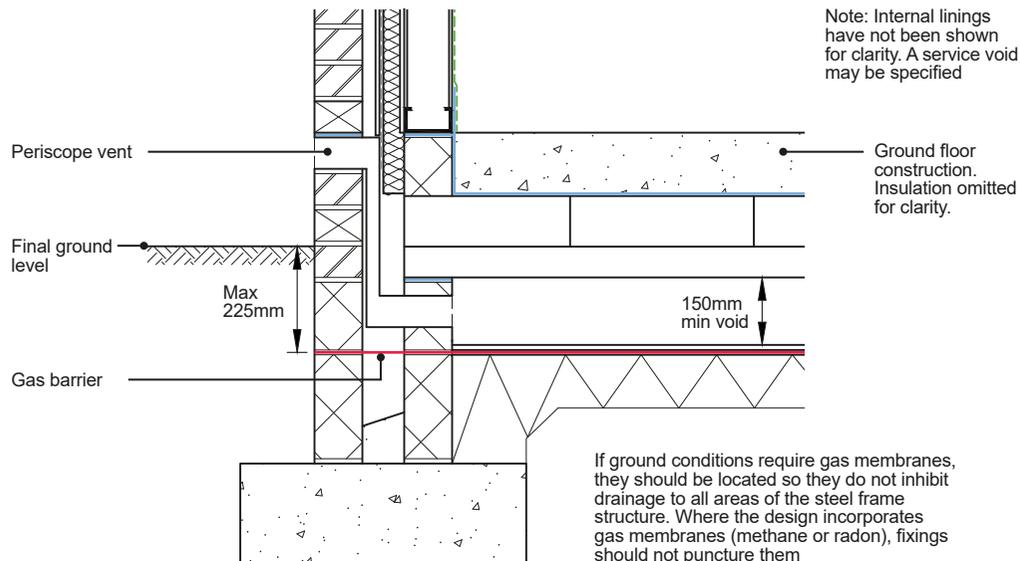
Damp proof course (DPC)

1. DPC's should be of a flexible material, be suitable for the intended use, and should have appropriate 3rd party certification. The installation specification of DPC's should follow good design practice in accordance with BS 8215.
2. Blue bricks or slate will not be accepted as a DPC.
3. DPC's should be laid on a mortar bed and correctly lapped at junction and corners. The depth of the lap should be the same width as the DPC.
4. The DPC should not bridge any cavity unless it is acting as a cavity tray (e.g. over a telescopic floor vent). Please refer to the cavity tray details for further information.
5. Damp proof membranes (DPM) should be lapped with the DPC, and VCL by a minimum overlap of 100mm.

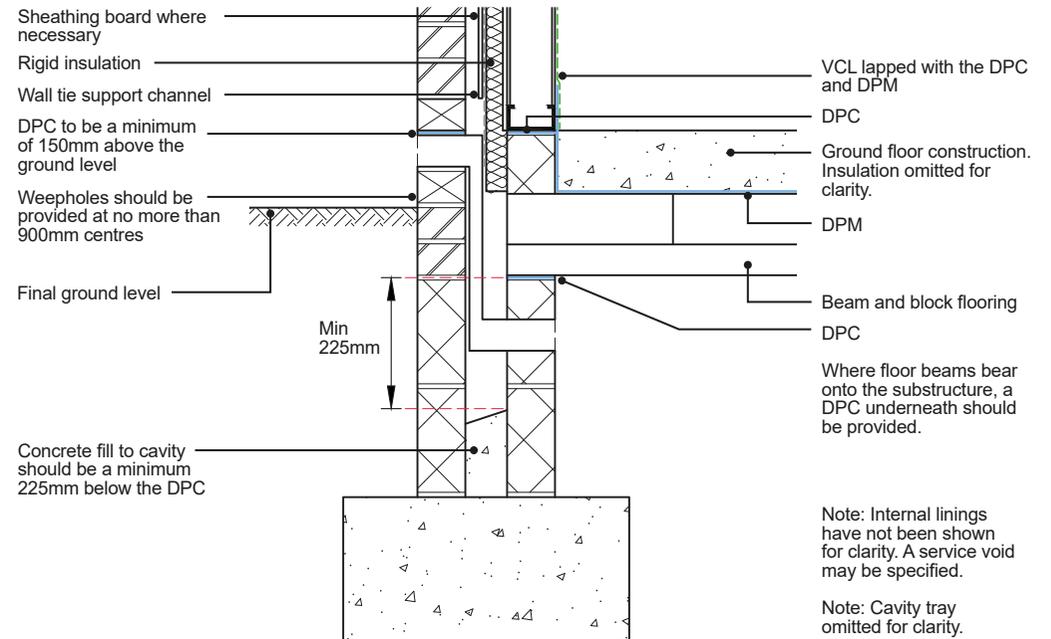
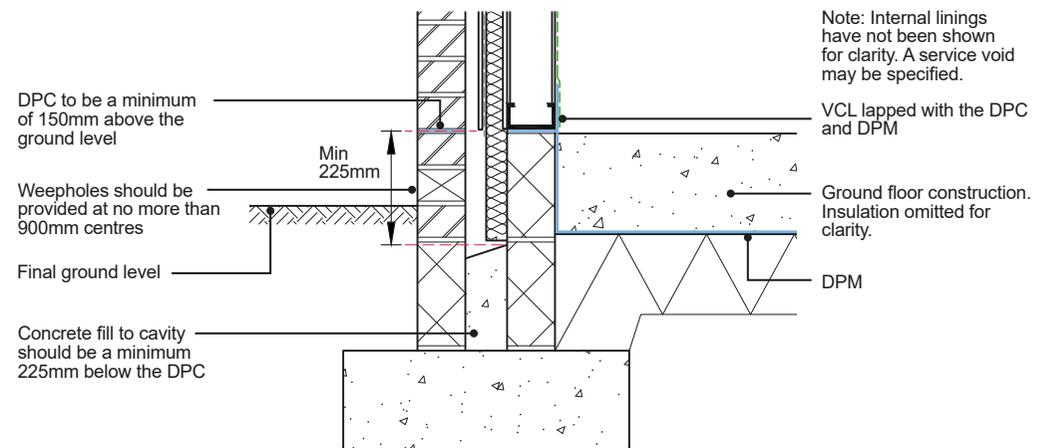
Rendering on masonry walls

1. Rendering below DPC should only be carried out using a specialist render manufacturer's specification. No render system should bridge the DPC and a proprietary uPVC bead or stainless steel bead should be used above and below where the renders meet at the DPC.
2. DPC should extend through the rendering system in between the bellcast beads or render stop system.
3. For bellcasts, uPVC beads or stainless steel beads are acceptable.

Note: For further guidance on the application of render please see the 'External Walls - Render' section.

Possible gas membrane detail

All of the drawings shown in this sub-section are strictly in relation to our Warranty requirements. Please refer to the Building control Body to ensure the detailing achieves compliance with relevant Building Regulations in respect of thermal and fire requirements.

Suspended floor with ventilation provision**Ground supported floor - no sub floor ventilation**

Site tolerances

It is essential that the accuracy of setting out foundations and ground beams are checked well in advance of materials being delivered to site.

For accurate erection of the frame the following tolerances are required at the level of the base of the wall frame:

- Length of wall frame: +/-10mm in 10m.
- Line of wall frame: +/-5mm from outer face of plate.
- Level of base of wall frame: +/-5mm over complete wall line.

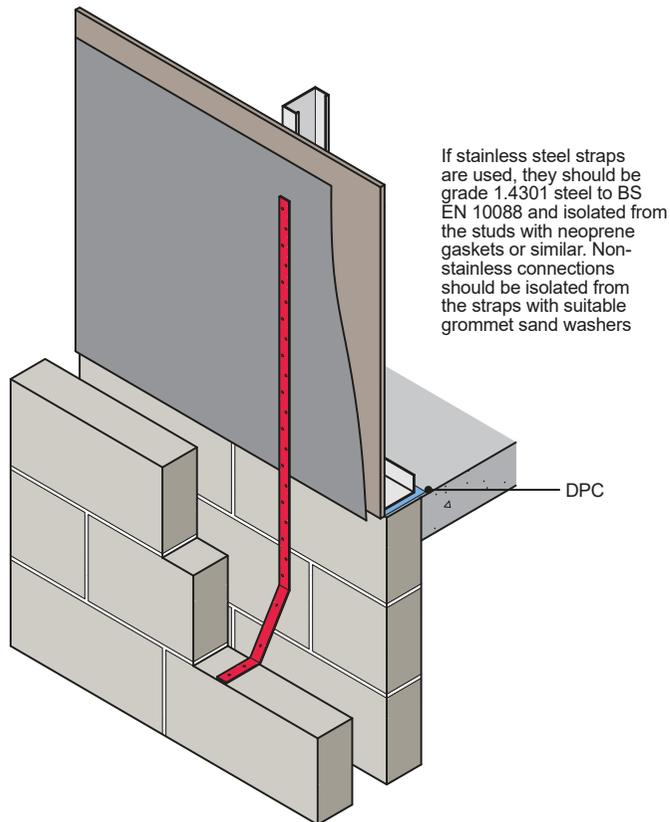
Some packing may be needed to achieve the required tolerances.

Fixing of frames to substructures

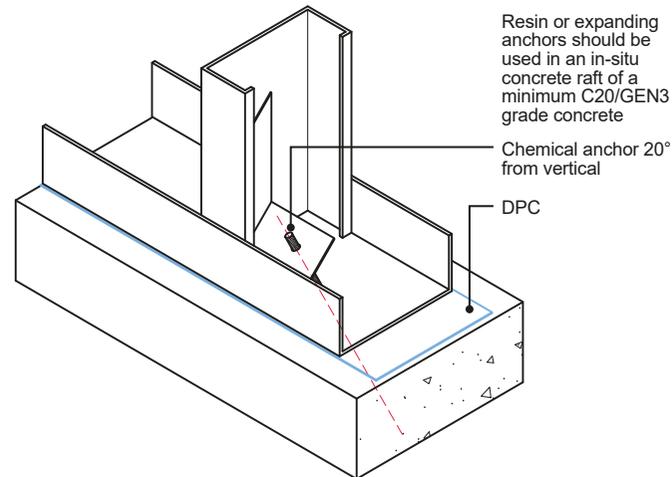
The oversite DPM should be attached to the side of the slab and returned under the DPC on which the frame is placed. The DPC/DPM detail requires careful attention to prevent the cavity being bridged and providing a ledge for mortar droppings.

Holding down anchors may be galvanised, or preferably stainless steel straps that are fixed to the stud wall and attached to masonry supports or concrete foundation, or holding down bolts fixed to the concrete slab.

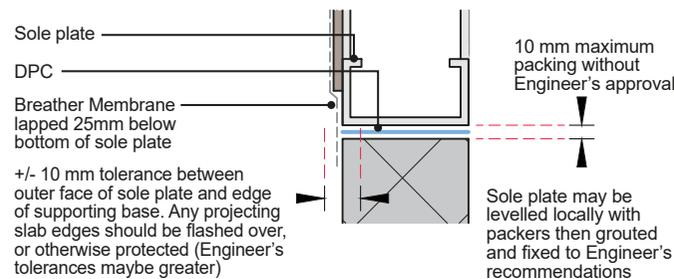
Example of holding down strap



Example of frame anchors



Locating sole plates



Location of frame above ground level

The metal frame should be located entirely above DPC level and a minimum 150mm above external ground level. The use of a masonry foundation kerb upstand may be an appropriate method to achieve this.

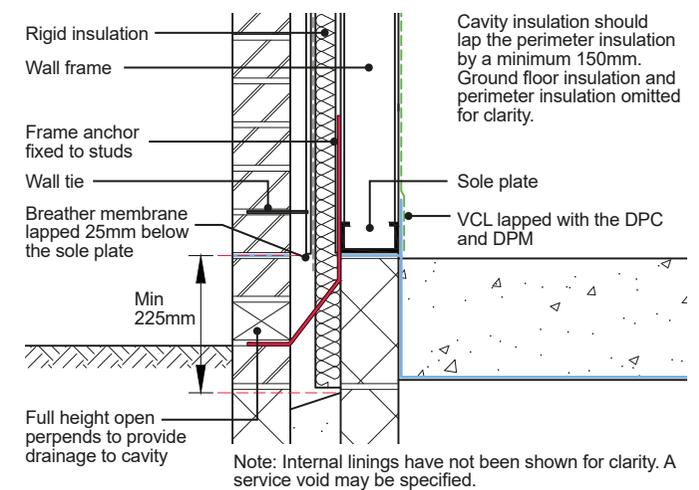
Where level access ramps are required these should only be limited to the entrance door area only (not the entire perimeter). Provision for a slotted drainage channel should be constructed with a gradient away from the door (see the 'External Windows and Doors' section for level threshold guidance).

Where level access requirements will result in the floor joists, ring beams and base rails etc. being less than 150mm above external ground level, then these elements should be pre-galvanised to 600g/m² zinc coating (Z).

It is recommended that the inner leaf DPC is turned up approximately 30mm above the screed to protect the bottom of the studs from construction moisture and spillage, and weep-holes are provided at 900mm centres to drain cavities at ground level.

Where light steel frame ring beams or floor joists are used in ground floors these should be a minimum of 150mm above ground level and be galvanised to a minimum 450g/m². Alternately where 150mm between ground level (or waterproofing layer of a flat roof, balcony or terrace) and the lowest steel or base rail cannot be achieved, e.g. at localised areas for level access the steel should be galvanised to a minimum 600g/m².

Sole plate/foundation junctions

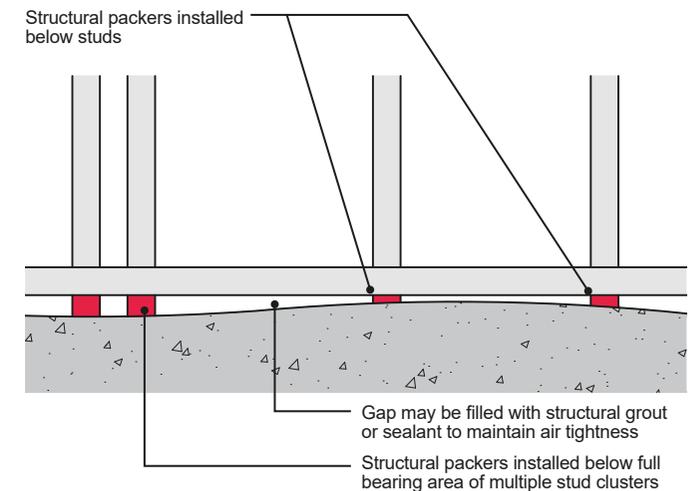


Packing under the steel frame

Structural shims or grout may be required under the steel frames to level them and transfer vertical load. Longer frame to foundation fixing may be needed to allow for the size of the gap.

- Less than 10mm; pack under each steel with pre-galvanised steel shims.
- 10mm-20mm; pack under each steel with steel shims and grout over length of sole plate.
- Over 20mm; refer to the frame designer.

Packing of sole plates



Provision of cavities to all framed structures

Light gauge steel frame external wall panels must be provided with a cavity between the cladding and the structural frame. Where rainscreen cladding systems are specified in front of the LGSF, adequate drainage and ventilation should be provided at the head and base of the rainscreen cladding system. Where masonry cladding is specified in front of the LGSF, the cavity only needs to be drained. With suitable drainage weeps and cavity tray systems. The amount of ventilation required will also depend on the type of sheathing board used and this should be considered as early as possible in the design stage.

The frame should also be protected by a suitable third party approved breather membrane. Breather membranes should be of minimum Class W2 zero leakage in accordance with BS EN 13859, higher Class W1 will be requested when used in areas of high exposure to wind driven rain or where rain penetration of the cladding is expected.

Thermal insulation

Rigid or high density fibre thermal insulation material should be fixed to the outside face of the steel studs to create a 'warm frame' construction.

Insulation installed to the outside of the steel frame structure should have third-party certification for this application and retain a minimum of a clear 50mm cavity.

The outer layer of insulation should also be covered with a breather membrane adjacent to the cavity.

External walls should be subject to U-Value and condensation risk calculations. A wall build up will be considered satisfactory if there is no calculated risk of surface or interstitial condensation at any time of the year, and it fulfils the minimum National Requirement for thermal performance. Special consideration should be given to condensation risk where non breathable insulation products are installed on the outside of the steel frame structure. Joints between foil faced external insulation boards, must not be taped as this forms a vapour control layer on the cold side of the insulation.

Where the condensation risk has been assessed and shown to be negligible additional insulation may be placed between the studs. The additional insulation should be placed in contact with the studs to minimise air gaps and prevent local condensation.

All thermal insulation should hold suitable third party certification.

Breather membranes

A breather membrane should be provided to the 'cold side' of the steel frame. Breather membranes should be capable of allowing water vapour from within the frame to pass out into the cavity and protect the sheathing and frame from external moisture. These should:

- Have suitable third party certification.
- Be vapour-resistant to less than 0.6MN/g when calculated from the results of tests carried out in accordance with BS 3177 at 25°C, and with a relative humidity of 75%.
- Be capable of resisting water penetration.
- Be self-extinguishing.
- Be suitably durable.
- Be adequately strong when wet to resist site damage.
- Be type 1 to BS 4016 in areas of very severe exposure to wind-driven rain.

An independent breather membrane may be required to the 'cold side' of the insulation if the insulation is required to be protected

Breather membranes should be lapped by a minimum of 100mm at horizontal joints, and a minimum of 150mm at vertical joints. If breather membranes are trimmed flush with the edges of wall panels, additional strips of breather membrane, at least 300mm wide, should be supplied and site fixed over panel junctions. The location of steel studs should be clearly marked on the outer face of the breather membrane to ensure that cladding fixings are installed into steel studs.

Where the breather membrane is used to provide the temporary protection, the daylight exposure and durability aspects must be taken into account. Exposure to UV light can lead to premature failure of the membrane, the exposure period should therefore be kept to a minimum. Regardless of the artificial age testing, under certain conditions such as heavy rainfall followed by freeze thaw conditions, the membrane should not be exposed for more than a few days. If a membrane has to be left without a wall and/or roof covering for a period of time when adverse rainfall and weather is expected, a ventilated tarpaulin or similar protective sheeting may be used to protect the underlay until such time that the roof covering can be completed. The transport and storage of wall/roof panels should not rely on the breather membrane to provide weather protection.

Vapour control layers (VCL)

A vapour control layer should be provided to the warm side of the steel frame. VCL's resist the passage of water vapour from within the dwelling and should be a minimum of 500-gauge polyethylene sheet or vapour control plasterboard.

Installation

A sheet membrane vapour control layer (VCL) should be:

- Lapped and sealed by at least 100mm at joints.
- Lapped over studs, rails or noggins.
- Sealed around service penetrations.
- Lapped and sealed fully into window and door reveals.
- Lapped and sealed with DPM/DPC at the junction with the ground floor/foundation.
- Able to accommodate differential movements.

Small holes in the VCL should be sealed with a suitable self-adhesive tape. Larger holes should be re-covered with new laps located over adjacent studs and rails.

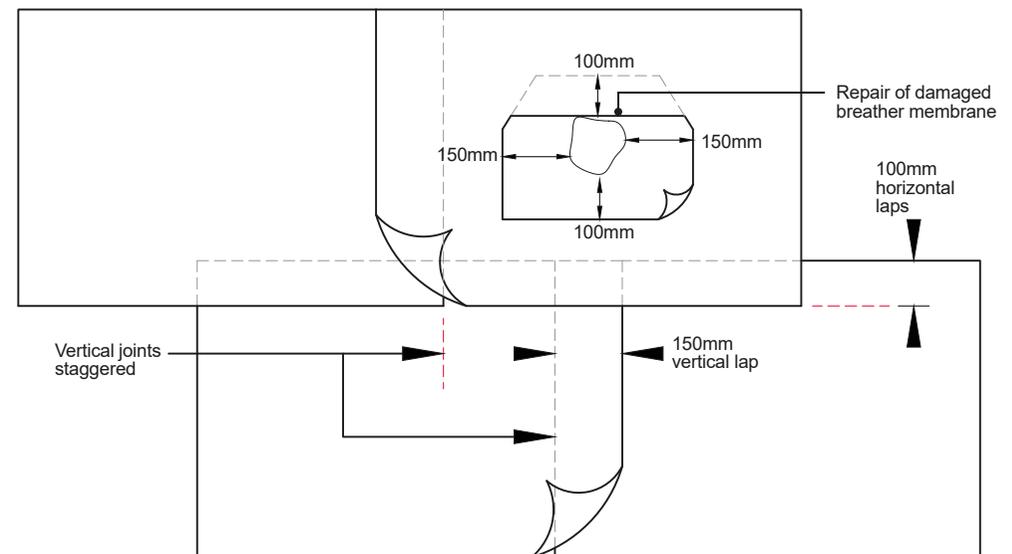
Plasterboard

Plasterboard should be to BS 1230 and not less than:

- 9.5mm for stud spacing up to 450mm, or
- 12.5mm for stud spacing up to 600mm.

To provide fire resistance fire rated boards should be used and installed in accordance with the manufacturer's instructions.

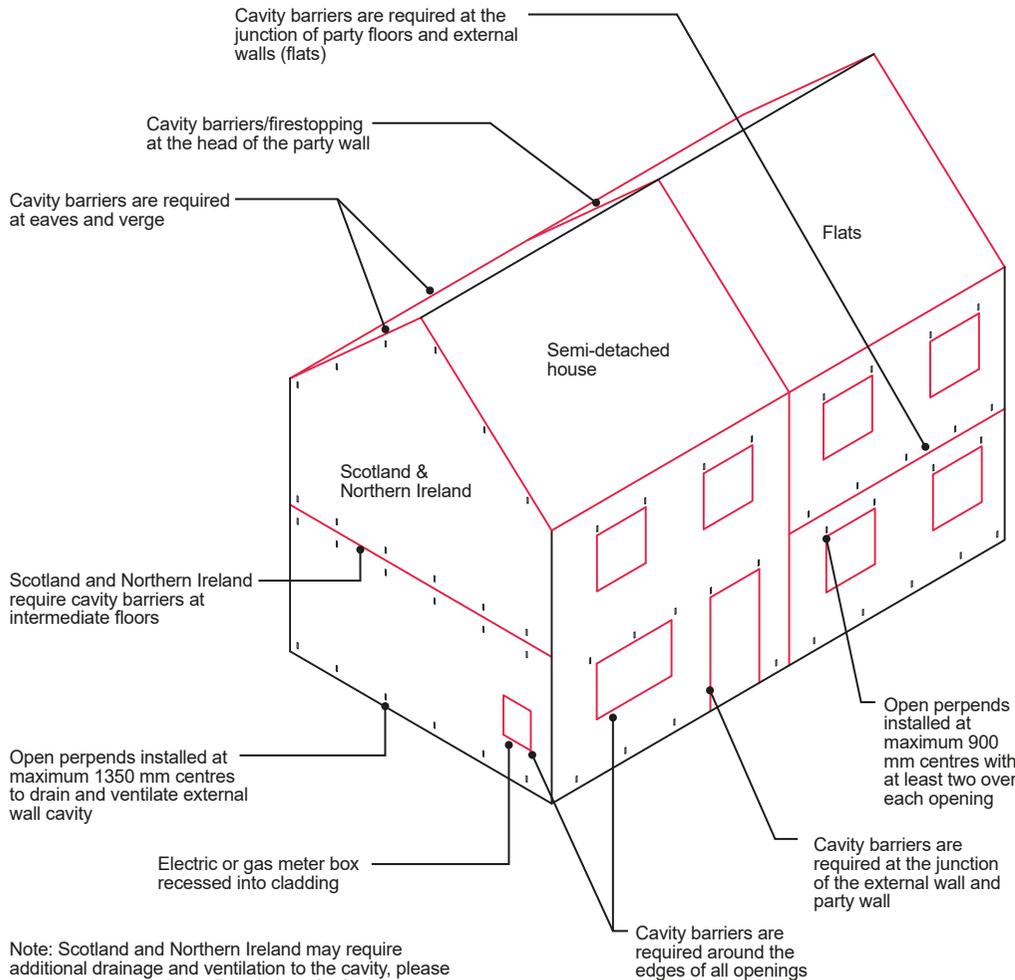
Lapping and repair of breather membrane



Locations of cavity barriers and open perpend within the external wall

Note: Lightweight cladding systems will require a cavity barrier along the bottom of the cavity.

Note: Cavity barriers may also be required between walls and floors within the building, consult relevant Building Regulations for further guidance.



Cavity barrier locations

In England and Wales, cavity barriers shall be installed:

- At the edges of all cavities including around openings, e.g. windows and doors (even if the opening is in close proximity to a compartment floor or intermediate floor level in Scotland and Northern Ireland).
- Between an external cavity wall and a compartment wall or compartment floor.
- Around meter boxes in external walls.
- Around service penetrations in external walls e.g. extract duct or boiler flue.
- To sub-divide extensive cavities; please refer to relevant Building Regulations for specific requirements.

Cavity barrier installation

Cavity barriers shall be installed:

- So they fully close the cavity.
- So the ends are tightly butted (or adequately lapped in accordance with the manufacturer's instructions) to form a continuous barrier.
- Backed by studs, rails or floor joist.
- In accordance with manufacturer or independent certifier's guidance.
- So they are mechanically fixed to rigid construction (for both vertical and horizontal positions).

A cavity tray should be provided directly above a horizontal cavity barrier and lapped at least 100mm behind the breather membrane (except at eaves and verges).

Cavity barriers are required to prevent the spread of smoke and flame within concealed spaces.

For lightweight claddings, a clear drained (and sometimes ventilated) cavity may need to be maintained so careful consideration will be required when specifying cavity barriers.

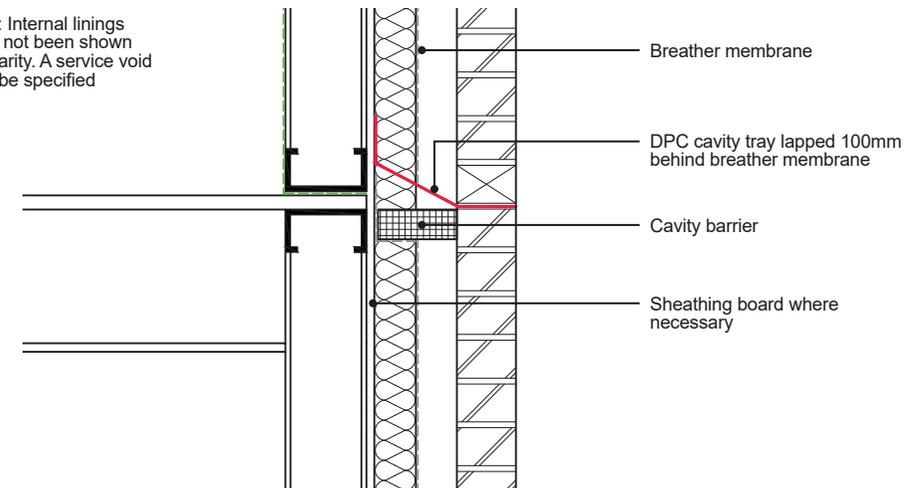
It is important that cavity barriers should extend through PIR insulation.

Cavity barriers may be constructed from:

- Steel at least 0.5mm thick.
- Timber at least 38mm thick.
- Proprietary 3rd party approved mineral wool product.
- Calcium silicate, cement-based or gypsum-based at least 12mm thick.
- An independently assessed and certified proprietary product such as an open state cavity barrier.

Cavity tray above horizontal cavity barrier - Steel frame

Note: Internal linings have not been shown for clarity. A service void may be specified



Window and door installations

Gaps around external windows and doors should be sized to allow for thermal movement and this will vary depending on the material of the frame.

Material	Recommended gap per side for width of structural openings (mm)		
	Less than 1.5m*	1.5m – 3.0m*	3.0 – 4.5m**
Upvc –white	5	5	7.5
Upvc-non-white	7.5	7.5	11
Timber	5	5	5
Steel	4	5	6
Aluminium	5	5	7.5

Notes:

* The maximum gap permitted for openings less than 3m should be 10mm.

** For openings more than 3m, the maximum gap permitted should be 15mm.

For gaps greater than 5mm, a backing strip should be provided behind the sealant and the sealant should have a minimum depth of 6mm.

Please refer to the 'External Windows and Doors' section for further guidance on window and door installations.

Please note, gaps under window and door openings will also need to be provided to cater for differential movement between the LGSF and the external brickwork.

Finishing trims

The use of proprietary surface fixed finishing trims e.g. D-moulds, should be undertaken only as part of a designed junction between window and door framing and the surrounding opening. For further guidance on the use of finishing trims please refer to the 'External Windows and Doors' section.

Please refer to the 'External Windows and Doors' section for further guidance on window and door installations

The Building Control Body should be consulted for guidance on thermal compliance.

Openings

All openings including doors, windows, flues and ventilation ducts, should be designed and constructed to maintain:

Fire performance:

- Internal reveals require equal fire resistance to the rest of the structure.
- Window fixing straps should not compromise the integrity of any fire-resistant reveal linings.
- Cavity barriers should be installed in the external wall cavity around the perimeter of openings.
- If profiled steel lintels are used as cavity barriers, triangular gaps behind lintels, which occur at each end, should be closed with careful positioning of adjacent cavity barriers.
- Cavity barriers should be mechanically fixed back to the LGSF and to rigid construction (for both vertical and horizontal positions).

Acoustic performance:

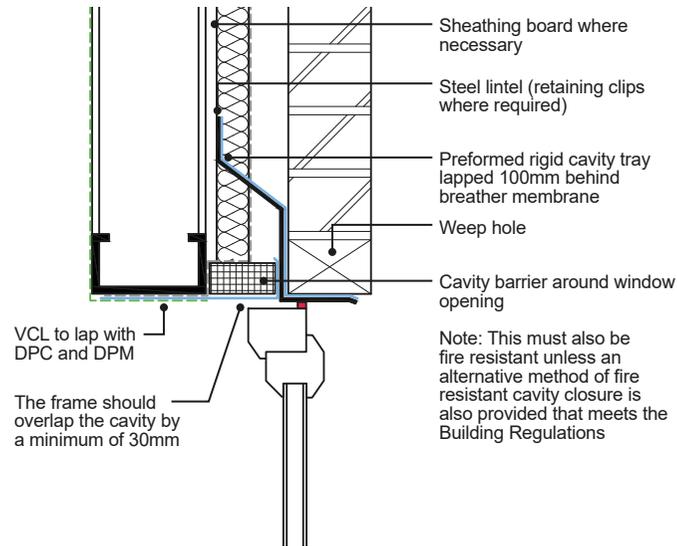
- Seal gaps between steel frame wall and the element being installed into the opening.
- The element being installed into the opening may have a minimum acoustic requirement.

Weather tightness and thermal performance, including thermal bridging and air tightness:

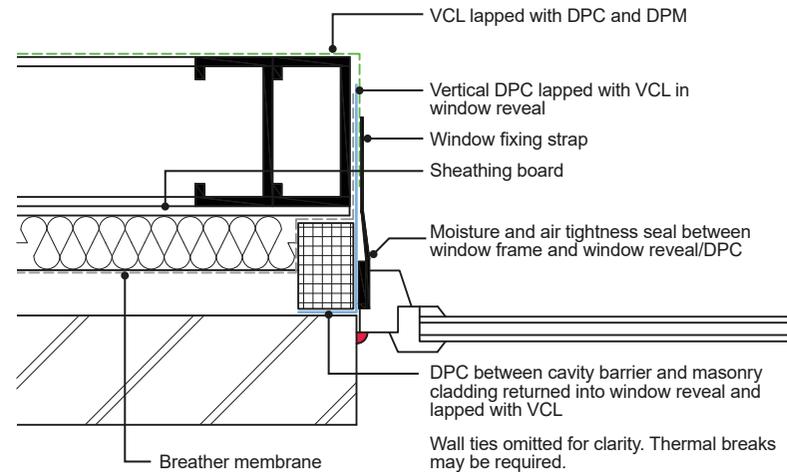
- The element being installed into the opening is likely to have a minimum thermal performance.
- All penetrations in the façade including windows, doors, ductwork etc must be sealed to the structure and external sheathing board with EPDM or suitable alternative. The sealing membrane must have adequate test data suitable for the project specific wind load and proposed substrate compatibility. Evidence must be provided that the sealant meets the requirements of BS EN 13984.
- Seal gaps between the steel frame wall and the element being installed into the opening to provide thermal performance, weather tightness and air tightness.
- Cavity trays should be installed over the heads of all openings, lapped behind the breather membrane by a minimum of 100mm. A flashing may be acceptable for some types of claddings.
- Lap cavity barrier DPC with internal VCL around openings. Where no DPC is used, breather membrane should be lapped with internal VCL.

Further information on the installation of lintels can be found in the 'External Walls - Traditional Masonry Cavity Wall' section.

Typical vertical section through window head



Typical window reveal detail (normal exposure)

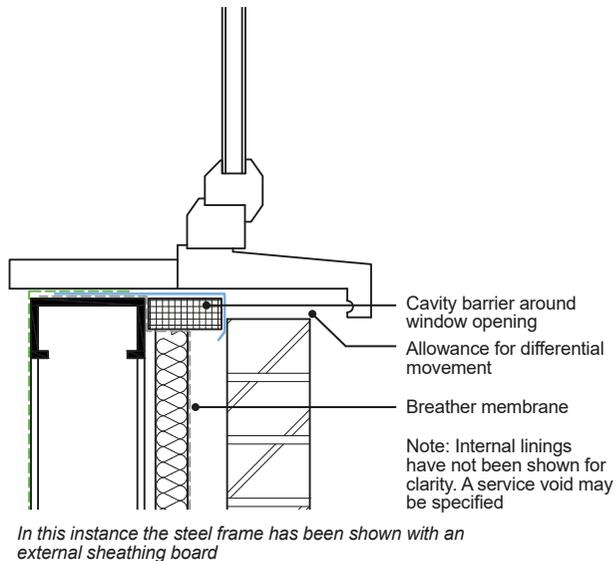


External windows and doors

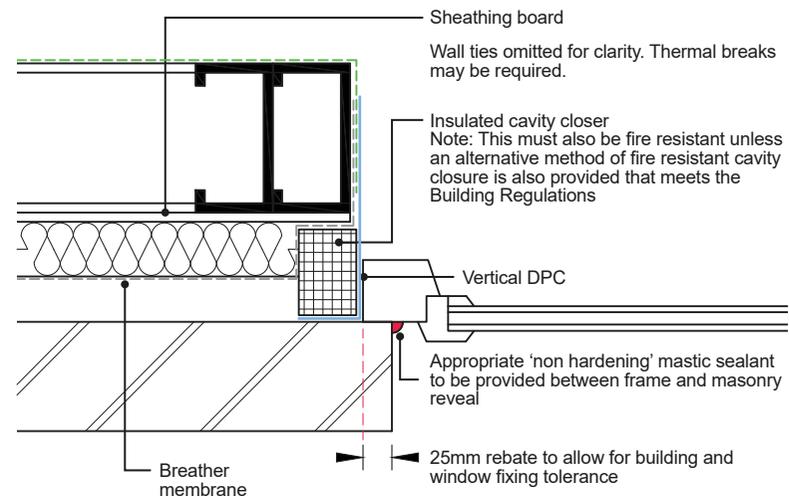
In areas of very severe exposure, checked rebates should be provided. The frame should be set back behind the outer leaf and should overlap.

For further information on windows and doors please refer to the 'External Windows and Doors' section.

Typical vertical section through window sill



Typical rebated window reveal (very severe exposure)



All of the drawings shown in this sub-section are strictly in relation to our Warranty requirements. Please refer to the Building control Body to ensure the detailing achieves compliance with relevant Building Regulations in respect of thermal and fire requirements.

Cavity trays

Cavity trays, associated weep-holes and stop-ends prevent the build-up of water within a cavity wall and allow the water to escape through the outer leaf. They are used in conjunction with lintels above openings, to protect the top surface of cavity insulation at horizontal cavity barriers and where the cavity is bridged.

Preformed ridged self supported cavity trays are recommended for use in famed structures.

Cavity trays must:

- Comply with relevant Building Regulations.
- Have third party certification or be to a relevant BS or BS EN code appropriate for the intended use. Please note: Polyethylene DPC's should not be used as a cavity tray.
- Be provided at all interruptions likely to direct rain water across the cavity, such as rectangular ducts, lintels and recessed meter boxes.
- Be provided above cavity insulation that is not taken to the top of the wall, unless that area of wall is protected by impervious cladding.
- Be provided above lintels in walls in exposure zones 4 and 3, and in zones 2 and 1 where the lintel is not corrosion-resistant and not intended to function as its own cavity tray.
- Be provided continuously above lintels where openings are separated by short piers.
- Be provided above openings where the lintel supports a brick soldier course.
- Be proprietary preformed cavity tray systems at stepped and lower storey abutments and around corners in low rise cavity masonry walls.

Ring beams or floor slabs that partially bridge the cavity, e.g. podium decks or when dimensional accuracy cannot be guaranteed, should be protected by a continuous cavity tray.

Weep-holes

- Weep-holes must be installed at no more than 900mm centres to drain water from cavity trays and from the concrete cavity infill at ground level.
- At least two weep-holes must be provided to drain cavity trays above openings.
- Weep-holes in exposure zones 3 and 4 should be designed to prevent ingress of wind-driven rain (including ground level).
- Weep holes will be required in all external cladding, including rendered claddings.

Stop-ends

Cavity trays should have water tight stop-ends to prevent water from running into the adjacent cavity. Stop-ends need to be bonded to the cavity tray material or clipped to the lintel, so that a stop to the structural cavity of at least 75mm high is provided. Normally, the stop-end is located to coincide with the nearest perpendicular to the end of the cavity tray. Stop-ends can be formed by sufficiently turning up the end of a DPC tray into the perpendicular joint. Surplus mortar should be removed from cavities and wall ties cleared of mortar droppings and debris as the work proceeds.

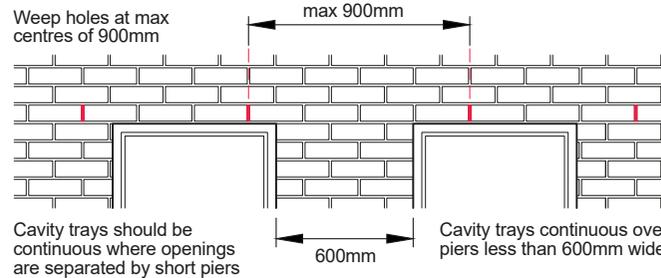
Other perforations of the building envelope

Proprietary elements, such as ventilators, soil pipes, etc. which perforate the building envelope should be installed and sealed to prevent ingress of moisture or vermin in accordance with the manufacturer's instructions. External meter boxes should be of a type approved by the Service Supply Authority and provided with a cavity tray and a vertical DPC between the back of the box and the wall.

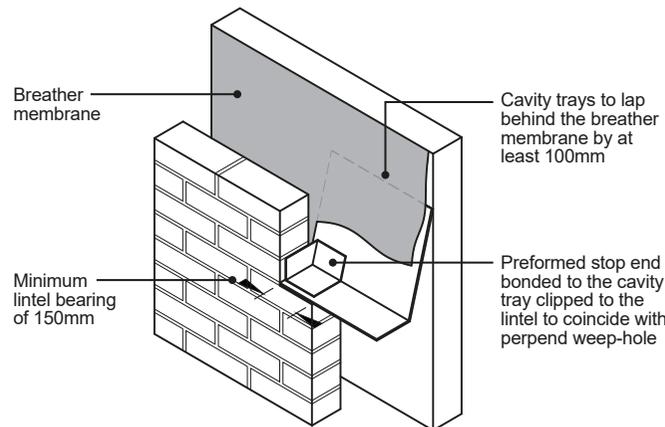
Steps and staggers

Particular care is needed in adequately preventing the ingress of water in a terrace of buildings with steps and staggers. A proprietary cavity tray system should be used. Stepped cavity trays are required at all pitched (stepped) roof abutments with external cavity walls, e.g. attached garages or staggered terraces. The bottom (last) cavity tray must be supplied with two stop-ends and an associated weep-hole, allowing all water to escape over the lower roof covering. For masonry, lead cover flashings should be linked into the cavity tray (lapped in below).

Continuous cavity tray over two openings and a small pier

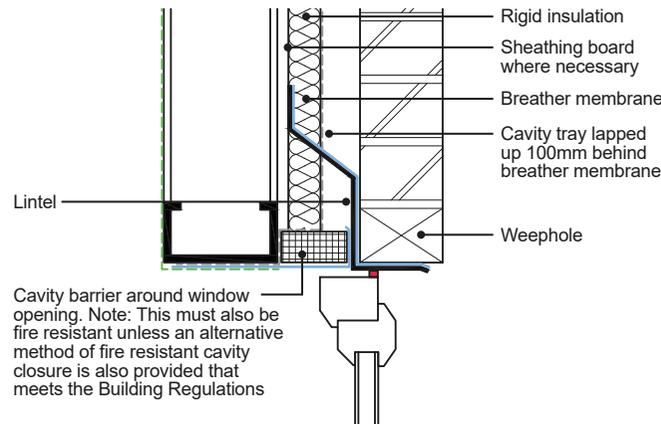


Stop end to cavity tray



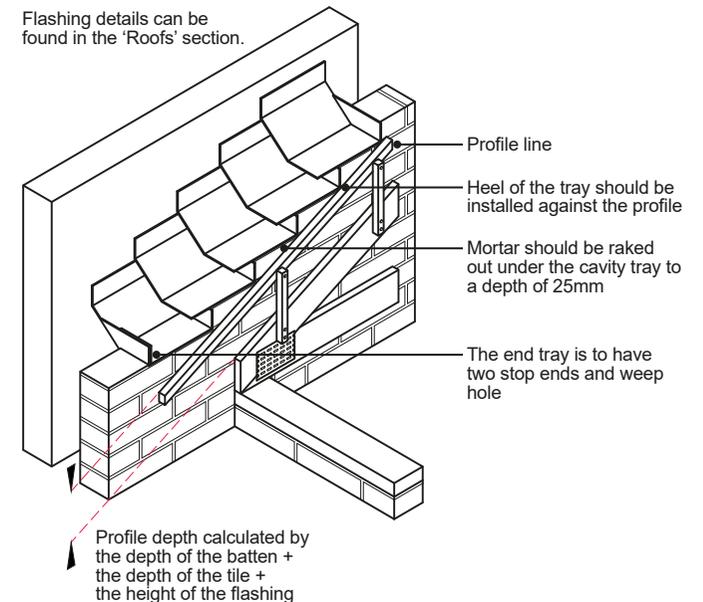
Cavity trays should rise at least 150mm from the outer to the inner leaf, be self-supporting or fully supported and have joints lapped and sealed.

Cavity tray and lintel



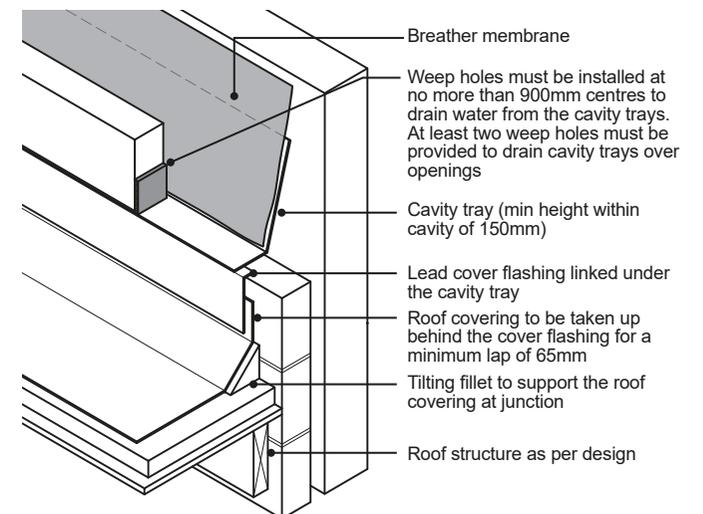
Installation of stepped cavity tray

Flashing details can be found in the 'Roofs' section.



Preformed rigid cavity trays should be used for stepped cavity tray details. Stepped cavity trays to lap behind breather membrane by at least 100mm. Additional measures may be needed to ensure the breather membrane adequately laps the tray to prevent moisture ingress behind the stepped cavity tray.

Flat roof abutment cavity tray construction



Wall ties

Wall ties should meet the following provisions:

- The wall ties should be tested to BS EN 845-1 and carry a CE marking. The wall tie manufacturer should provide a site specific fixing schedule, which details the centres of the fixings, the type of fixings and the spacing of the wall ties. The wall tie systems should be tested to BS EN 845-1 and carry a CE marking.
- Wall tie density depends on a number of site specific factors and should be considered by an Engineer.
- External skin of brick should be attached to the metal frame with either epoxy coated galvanized ties or austenitic stainless steel ties (to DD140, BS 12, BS 5268, BS 8200).
- Ties are normally fixed in vertical channels, these channels are then fixed through the sheathing board or insulation board to the light gauge steel frame with stand-off screws (screws should be isolated from the channels with neoprene or similar washers).
- The wall tie rails, ties, and fixings, should come as a 'kit' supplied by the manufacturer. Wall tie systems made up from off the shelf products will not be acceptable for Warranty.
- The wall tie system 'channels' should be fixed to ensure the fixings go into the centre line of the steel frame studs.
- If insulation is to be placed on the cavity face of the steel frame it should be rigid insulation and be compatible with the manufactures requirements of the wall tie rail system. Rigid insulation should not be taped.
- The wall tie length should be long enough to achieve the minimum overlap of the external masonry skin as specified by the manufacturer. This should not be less than 50mm.
- For steel frame external masonry walls, a 50mm minimum residual cavity is to be provided.
- Ties should be spaced at jambs of openings, a maximum of 300mm vertically within 225mm of the masonry reveal. Additional studs may be needed to achieve this.
- Ties should be inclined away from the frame.
- Ties should be fixed to the studs, not the sheathing.
- Ties should accommodate differential movement between the frame and the cladding.
- Top row of ties should be 225mm below top of brickwork (at eaves and verge levels).

Cavities

A masonry cladding to a steel frame must have a separating cavity that meets the following provisions:

- The cavity should have a minimum width of 50mm.
- It is to be kept clear from mortar 'snots' to ensure cavity is not bridged.
- An approved wall tie system to tie the masonry leaf to the steel frame must be provided.

Brick suitability

- Facing bricks must have a suitable level of durability and particular attention should be paid to the bricks resistance to frost and moisture.
- Bricks should be capable of supporting proposed loads.
- Bricks should comply with BS EN 771 and PD6697.
- Frost resistant bricks should be used in areas of prolonged frost.

Masonry cladding

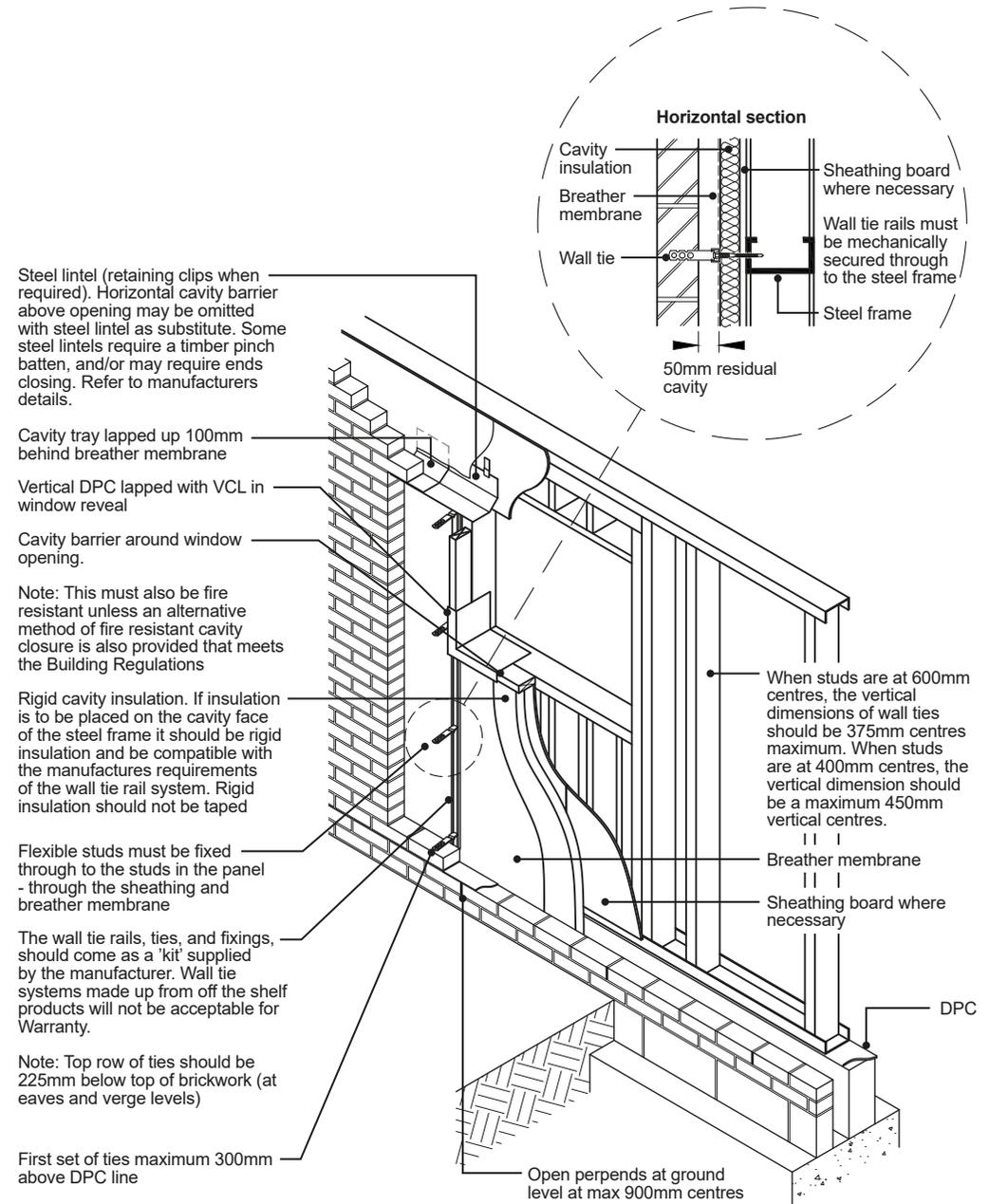
- Cavity trays must be provided above all cavity barriers, windows and door openings, etc.
- Cavity trays should extend 150mm either side of the door or window openings and have stopped-ends.
- A continuous cavity tray should be provided where intermediate floors meet the external wall.
- Soft joints should be provided to allow for differential movement. A gap of 1mm per metre of masonry should be provided at openings and soffits.
- All brick support angles should be installed by the manufacturer or specialist contractor.

For further information on masonry claddings and installation of stone heads within masonry cladding reference should be made to the 'External Walls - Traditional Masonry Cavity Wall' section of the Technical Manual.

Movement joints

Movement joints should be provided in external masonry cladding in accordance with the 'External Walls - Traditional Masonry Cavity Wall' section of the Technical Manual. Additional timber studs may need to be installed within the timber frame to enable the correct installation of wall ties adjacent to movement joints

Wall panel with brick cladding



6.

External Walls

6.4 Render

Provision of information

A full set of design drawings and specifications shall be made available to the Warranty Provider and all other interested parties prior to the associated works starting on site. This may include:

Pre-bagged render:

1. A full set of construction drawings detailing the areas to be rendered, location of movement joints and DPC's and subsequent construction details. Drawings must show presence of weep holes to all elevations.
2. Manufacturer's technical information relating to the application and suitability of render to be used on proposed substrates.
3. Copies of the manufacturer CE/UKCA Marking and declaration of performance relating to the proposed render.
4. Details and classification of render boards where they are proposed (including third party product conformity certificates).
5. Specifications, method statements, etc. relating to the application of renders around services, openings, movement-joints, etc.
6. Ancillary items forming part of the render system (e.g. render beads, stop-ends, etc.).

Site made render*:

1. A specification 'Manual' of the proposed design, preparation and application of the render for the proposed project in accordance with BS EN 13914 – 1. The manual should also provide a specification of the render in accordance with BS EN 13914 – 1.
2. A quality assurance document detailing how quality assurance will be maintained on site in regards to material storage, mixing and application.
3. A full set of construction drawings detailing the areas to be rendered, location of movement joints and DPC's and subsequent construction details. Drawings must show presence of weep holes to all elevations.

* Site made renders are only acceptable on well-prepared masonry substrates where strict control over workmanship can be demonstrated and the correct selection of materials can be assured.

Site made render solutions will not be acceptable on projects where the render is to be applied on the following substrates:

- Render board.
- Render carriers.
- Hollow clay brick /block units.
- Insulated concrete formwork (ICF).
- Backs of parapets.
- Chimneys.

The Warranty Surveyor, at their discretion, may also request supporting information that demonstrates suitability for use of any materials or systems contained within the above.

Introduction

This Section provides guidance on meeting the functional requirements of the 'External Walls' section of the Technical Manual. It provides guidance on site-made renders and factory made renders.

This rendering section should be read in conjunction with the 'External Walls – Traditional Masonry Cavity Walls', the 'External Walls – Timber Frame' and the 'External Walls – Light Gauge Steel Frame' sections. The guidance in this Section covers the suitability of the render system only and additional guidance may need to be followed in regards to the structure.

The majority of render failures can generally be attributed to poor workmanship, inadequate preparation of substrates, poor detailing or inadequately trained personnel applying the render or failing to follow the correct render specification.

Rendering 'specification' and 'application' should be in accordance with BS EN 998-1 and BS EN 13914-1:2005 respectively and workmanship in accordance with BS 8000. Gypsum based renders are not covered by BS EN 13914 (See Section 1 Scope) and should not be used unless the product holds a third party product approval (BBA or BDA) for the intended use and confirms adequate durability will be achieved.

For Warranty purposes render is generally not considered completely 'waterproof' and therefore water seepage can be expected through the render to the substrate / cavity i.e. The render is only considered as contributing to towards the 'weather

resistance' of an external wall and not considered as providing an impermeable cladding. Therefore, all substrates must be constructed to prevent moisture reaching the internal finishes.

Examples of this are:

The rendering applied to:

- Masonry outer leaf of a masonry cavity wall.
- A suitable render board or carrier system with a drained cavity. In certain circumstances (e.g. for framed structures) this would also need to be vented to protect the framed structure.

Identification of the site exposure rating

The design and materials used, should be suitable for the site specific exposure location. For further information on determining the exposure for the site location please see 'Appendix C'.

Rendering onto masonry substrates

For Warranty purposes both site made and factory made renders may be suitable for use on masonry substrates. Although this guidance is mainly focused on traditional masonry cavity wall construction, this would also be applicable to render applied to the external masonry cladding of a timber or steel frame.

For masonry substrates the masonry should be adequately prepared and be of a thickness which would resist damp ingress to the internal finishes based on the recommendations of PD 6697 or BS 5628 Part 3 2005 for the given exposure zone.

Where render is applied to masonry outer leaves to timber frame or light steel frame structures:

- A drained (and vented, if timber/ SIP framed) cavity will be required between the frame and outer leaf and,
- A breather membrane must be provided to protect the main structural frame as a second line of defence.
- A cavity tray will be required over all openings and obstructions in the external wall with weeps and stop ends provided.

Please note: For Warranty purposes weep-holes and a suitable cavity tray should be provided on all rendered masonry cavity walls.

Design of renders onto masonry substrates

In all cases the specification of the render should be in accordance with BS EN 998-1 and the design, preparation and application of renders should be to BS EN 13914- 1. These details should be provided to the Warranty Surveyor upon request. The design should provide detail on:

- Specification of the render.
- Details of the background including compatibility of the render systems with the background including identification dissimilar materials.
- Render thickness in accordance with the exposure zone.
- Movement control within the back ground.
- Bead type (include fixing or adhesion type) and placement.
- Rendering to areas where a specialist render system is required e.g. Back of Parapets or below DPC.
- A full set of construction drawings detailing the areas to be rendered, movement control, reinforcement required (particularly around openings) and subsequent construction details.

The design should identify the areas of the build which may interact with the render e.g. eaves, verge, parapets, sills etc. to ensure the durability of the render system. For example: particular attention should be given to the correct detailing of architectural features which can afford a high degree of protection.

The design should identify if any areas below the DPC level, backs of parapets or chimneys are to be rendered. Rendering below DPC, backs of parapets or chimneys should only be carried out using a specialist render manufacturer's specification (only pre-bagged render should be used). No render system should bridge the DPC and a proprietary uPVC bead or stainless steel bead should be used above and below where the renders meet at the DPC.

The specification should identify any abutments between the render and other cladding materials or components. Any joints should be weather tight and allow for differential movement. These details should be provided to the Warranty Surveyor before rendering commences.

Suitability of the background

The specification should also identify the suitability of the background to support the rendering. The background should provide adequate support for the render and uniform key/suction for adhesion of the rendering.

For the purpose of Warranty:

- Render on an external leaf of clay bricks (F2, S1 or F1, S1 designation bricks BS EN 771) in severe or very severe exposures is not permitted where the cavity is to be fully filled with insulation.
- Direct rendering is not acceptable on high absorption materials e.g. lightweight blockwork, autoclaved aerated concrete blocks, common brick and/or smooth dense substrates e.g. engineering bricks as the moisture can be extracted by the substrate from the wet render which affects its curing and bonding capability.

For both factory made and site made renders the walls which are to be rendered should be examined for excessive moisture content prior to rendering. This is particularly important where the masonry background has no upper limit on its soluble salts content, e.g. N designation clay bricks.

To minimise the potential for differential thermal movement and effects that the different suction that each type of background material may create; the section of walling to receive the render should be constructed using the same type and density of material throughout.

When rendering is required to be applied to wet masonry substrates, a specialist sealer key coat prior to applying the main coat of render should be applied, to control suction and reduce the impact of lime blooming occurring through the render. The key coat should provide a sound substrate and be compatible with the subsequent render system.

To control suction, always apply a specialist sealer key coat or suitable render preparatory coat. Allow a minimum of 48 hours for the key coat to fully dry before applying the next coat.

Movement control within the background

The specification should identify the measures proposed to control movement within the back ground substrate and clearly identify the provision of movement joints and any additional reinforcements. Any movement joints within the background should be carried through to the face of the render.

Note: Where recommend by the blockwork manufacturer, cracking of the substrate could be significantly reduced by introducing a specialist proprietary joint reinforcement within the mortar joints. This should be provided in accordance with the Engineer's specification.

Ensure that the reinforcement is continuous and joints lapped in accordance with the manufacturer's requirements (generally 450 - 500mm laps and continued around corners). Specialist corner units are likely to be required, check with the manufacturer.

Introducing reinforcement at weak points such as above and below window and doors openings will greatly assist in minimising cracking to these areas. Where possible, the reinforcement should project 600mm beyond the opening.

For any given wall elevation where there is a mix of masonry e.g. Brickwork external leaf lower level with a rendered block upper level, the requirement of a full height movement joint should be based on the shorter spacing requirement e.g. for the blockwork at 6m not brickwork at 12m.

Pre bagged and blended render on Masonry substrates

Pre bagged factory made renders are the preferred solution as this ensures consistent mix of render components during installation. However it is still important to ensure correct specification, detailing and application. Pre bagged and blended render must be BS EN 13914-1 for the design and application and be CE/UKCA marked in accordance with EN 998-1 or EN 15824 for specification of the render. Evidence of the CE/UKCA marking and declaration of performance should be provided upon request.

Site made render on masonry substrates

Site made renders are only acceptable on well-prepared masonry substrates where strict control over workmanship can be demonstrated and the correct selection of materials can be assured.

Site made render solutions will not be acceptable on projects where the render is to be applied on the following substrates:

- Render board,
- Render carriers,
- Hollow clay brick /block units,
- Insulated concrete formwork (ICF)
- Backs of parapets
- Chimneys

Information to be provided

Where site made renders are proposed, the following information should be provided to the Warranty Surveyor before work begins on site:

- A specification 'Manual' of the proposed design, preparation and application of the render for the proposed project in accordance with BS EN 13914 - 1.
- A specification of the render in accordance with BS EN 13914 – 1 should be provided in the Manual.
- A quality assurance document detailing how quality assurance will be maintained on site in regards to material storage, mixing and application.
- A full set of construction drawings detailing the areas to be rendered, movement control and subsequent construction details.

Design and specification of site made renders

Site made renders are only suitable on masonry substrates. The masonry substrate should be a thickness which should resist damp ingress to the internal finishes based on the recommendations of PD 6697 or BS 5628 item 3 2005.

The exposure zone of the site and proposed build up should be included in the specification. BS 8014 can be used to help identify the exposure zone more accurately. For further information on determining the exposure for the site location please see 'Appendix C - Materials, Products, and Building Systems - Determining the sites exposure to wind driven rain'.

The design and application of the render should be in accordance with BS EN 13914– 1.

The specific render mix should be:

- Appropriate for the intended purpose
- Be compatible with the background
- Designed to minimise the risk of de-bonding, cracking and crazing.
- Note: Ensure the render being used is suitable for the substrate and is not too strong. Avoid applying a thin base coat and a thicker top coat application, as this could cause the render to delaminate from the base coat.

Thickness of site made renders

The render coat thickness should be identified within the specification and should be suitable for the exposure zone of the site. Increased thicknesses maybe required in higher exposure zones. This is generally a minimum depth of 16mm for sheltered and moderate exposure zones, or 20mm for severe and very severe exposure zones.

Quality Assurance of site made renders

Poor mixing ratios and low quality materials is often the reason traditional renders fail. Quality control procedures should be in place on site to ensure that materials are stored correctly and the mixing ratio as specified is consistent. A copy of the quality assurance processes together with the Render specification and application Manual should be provided to the Warranty surveyor.

The on-site quality control of site made renders is an important aspect to prevent premature failure of the render system. This section identifies areas that should be included within the quality assurance (QA) process document should be made available to the Warranty surveyor upon request.

The QA process should identify the following:

- The suitable storage of the materials on site;
- Cement should be stored in a dry location and should be in date at the time of use.
- Sand should be stored on boards to prevent contamination from the ground.
- Sand should be adequately protected from external elements – wet sand should not be used.
- Sand should be separated from other aggregates on site to prevent contamination.

The control of the mixing process on site:

- Only potable water should be used for mixing render.
- Identification of a suitable water source on site, where possible water should be drawn directly from the source on site. Storage of the water should be avoided as this increases the risk of contamination.
- Mix ratio should be controlled by volume or weight – Relying on shovels of sand and cement is not acceptable.
- Mechanical mixing only is acceptable, renders should not be hand mixed.
- Renders should be suitably mixed before use.
- Additives should not be used unless specified – additives should be appropriately measured in accordance with the specification and manufacturer's instructions.
- Only products specifically designed as mortar additives will be acceptable.

Render cladding onto timber/steel framed structures

With Timber and Steel frame constructions a drained (and vented cavity for timber frame) should be provided behind the render system on timber/ steel frame construction and a breather membrane must be provided to protect the main structural frame as a second line of defence.

The minimum size of the cavity should be 25mm for both the render board or metal lathing applications.

When the render board or metal lathing system is unbacked, the minimum cavity should be 50mm.

A vertical dpc should be inserted between the metal render carrier and any vertical rail / batten support.

Suitability of render systems

The 'render system', including the render and render board, should hold suitable current third party certification. For the purpose of this Technical Manual only pre bagged and blended render will be acceptable.

The third party product approval should clearly detail the limitations of the render system and the suitability of the render system for use in the site specific wind driven rain exposure zone. The Third party product approval certificate for the board must demonstrate the render system will achieve a 15 year minimum life expectancy.

A site specific specification should be provided from the render manufacturer and the render system should only be installed by the render manufacturers trained operatives. Evidence of this should be provided to the Warranty Surveyor upon request.

Fixing of render boards

Render boards should be fixed in accordance with the manufacturers recommendations and the site specific location, consideration should be given to:

- Anticipated wind load
- Pull-out strength
- Pull through resistance
- Anticipated movement

When using external render board you should:

- Fix with the manufacturer's recommended non-corrosive fixings and all in accordance with the manufacturer's installation details, ensuring the vertical board joints are staggered and do not follow directly in line with window, door reveals and other openings.
- Gaps between boards should be provided in accordance with the manufacturers recommendations however, care should be taken to ensure there are no excessive gaps between the boards and appropriate weather seals are incorporated against walls and frames.
- Ensure the boards are cut neat and square and the screw heads are recessed just below the surface.
- Take particular note of movement joint requirements and specific application details. Movement joints should be formed in accordance with the manufacturers specification
- Fixing battens and rails should be installed vertically and not block drainage paths. Battens should be either 25mm x 38mm or 50mm x 50mm, preservative treated (BS 8417 or equivalent, hazard class 2). Fixings and preservatives should be compatible.
- Battens on Timber frame structures should be fixed to each stud with annular ring nails of length at least twice the batten thickness plus the sheathing thickness. Nails should be hot dipped galvanised stainless steel or equally durable.

Movement joints

Where renders spans across an intermediate floor zone in timber frame construction, allow for differential movement due to timber shrinkage by incorporating a movement joint.

Vertical movement joints should be provided at the required intervals. The actual spacing and position of the joints will be determined by the shape of the area to be rendered and generally vertical movement joints should be provided at maximum 5m centres.

Metal render carrier systems

- The carrier system must be Stainless steel in accordance with EN 10088-1 (Austenitic steel) or Zinc coated steel in accordance with EN ISO 16120-2 and EN 10346.
- Where sited in a coastal location a higher grade A4 stainless steel should be used. (Please see 'Appendix B' of this Technical Manual).
- For metal lathing, these should be a proprietary BBA, BRE etc. or ETA certified non-corrosive mesh system and must be fully installed in accordance with the mesh system manufacturer to vertical battens at the stud centres.

Movement joints in metal lathing

Large uninterrupted areas of cementitious based rendering on metal lathing should be divided by movement joints into panels at intervals of approximately 5m. The actual spacing and position of the joints will be determined by the shape of the area to be rendered. The panels should have a maximum aspect ratio of 3:1 and maximum intervals of approximately:

- For timber backgrounds, 5m horizontally and every storey height;
- For all other backgrounds, 5m horizontally and vertically.

Cavity barriers

Cavity barriers in external wall voids should be provided in accordance with the relevant Building Regulations. Where cavity barriers are required, they should be correctly fitted without gaps, the cavity filled and fixed with stainless steel staples or equally durable fixings, the settlement joints below the external frames and soffits must be maintained. Cavity barriers should be mechanically fixed to rigid construction (for both vertical and horizontal positions).

Direct rendering onto Insulated Concrete Formwork structures (ICF)

Generally for Warranty purposes a render directly applied to an ICF structure to provide a weather resistant cladding will not be acceptable and alternative solutions must be made.

Typical alternative solutions are:

- A render on a carrier system with a drained cavity behind and a breather membrane provided to provide a second level of defence to the ICF structure, where this solution is required the guidance for render boards should be followed or
- An Impervious cladding system provided (with appropriate cavity provision as required by the Impervious cladding system), or
- An independent masonry external cladding with a 50mm minimum cavity is provided. Where this solution is required the guidance for rendering on masonry should be followed.

The exception to the above where direct render may be acceptable for Warranty cover is as follows:

- The ICF structure must meet the requirements of 'Appendix C' of the Technical Manual and the ICF concrete core should be suitably reinforced to avoid cracking (In accordance with the Engineers design)

The direct render must:

- Have a valid and current third party product approval confirming it has been assessed to provide the weatherproof protection to an Insulated Concrete Formwork substrate consisting of EPS, etc.

OR

- There is a combined named Render and ICF system which jointly hold a valid and current third party product approval.

In addition:

- The third party product approval confirms the render finish will provide the 'weather resistance' to the ICF for a 15 year minimum life expectancy /durability and
- The third party product approval certificate clearly identifies the maximum wind driven rain exposure zone permitted by the assessment and
- The render manufacturer provides a project specific specification for the render installation and
- Installers trained and approved by the render manufacturer should only install the render finish.

Note: If the project location is situated in a Wind driven rain exposure zone exceeding that stated in the third party product approval, the rendering manufacturer must in addition:

- Provide confirmation at completion to the Warranty provider, that the installation meets the project specific specification.

In all other situations, a render directly applied onto an ICF structure to provide a weather resistant cladding will not be acceptable.

Direct rendering on external wall insulation systems (EWI)**General conditions**

These are systems applied to the exterior walls of existing or new buildings, comprising of an insulant and a protective render finish. The Insulation type can vary from Expanded Polystyrene Insulation (EPS), Extruded Polystyrene Insulation (XPS), Phenolic insulation or mineral wool insulation.

A third party product approval is required for the 'combined EWI and render system' and must clarify which Substrate has been assessed for the EWI / EWCS System to be applied too. (I.e. for a masonry or framed substrate) and a full manufacturer's specification suitable for the substrate must be provided.

Please note: ETA documents do not state the maximum exposure zone the system is tested for. The ETA documents usually only say the system (including the render) improves the thermal performance of the wall and contributes towards weather resistance.

Appropriate beads should be provided in accordance with the combined EWI and render system at openings, corners, angles and interfaces etc. Reinforcement mesh should be accommodated throughout the base coat application with additional reinforcement to vulnerable areas and corners of openings etc. If there are any concerns regarding straight line joints or other areas where there are unusual constructions requirements an additional layer of mesh should be installed to these locations.

Movement within the combined EWI and render system should be accommodated without any reduction in performance and should be constructed in accordance with the manufacturer's details. Movement joints in the backing substrate should be mirrored through the combined EWI and render system and formed in accordance with the manufacturer's recommendations.

All external metals must have suitable corrosion protection for the intended environment. Further guidance can be found in 'Appendix C - Materials, Products, and Building Systems'. For further information please see Appendix B of our Technical Manual which provides further guidance on additional requirements for developments within coastal locations.

Allowance must also be made to ensure window cills adequately project beyond the finished surface of the render to ensure any throating is correctly positioned clear of the finish, and that opening lights / ventilators are correctly installed to allow correct opening without being restricted by the EWI system.

Render compatibility

Only the render system stated on the third party product approval certificate can be used, we cannot accept any other render system or site made render to be applied to the EWI system.

Key points during installation

The combined EWI and render system must be installed by an approved installer from the EWI manufacturer. Evidence of the installer being approved should be provided to the Warranty Surveyor before works start on site. When installing a combined EWI and render system, the following should be observed:

- The render (either the finish or the base coats) must not be applied onto saturated substrates as this may affect the bond strength and adhesion.
- Protection must be provided when applying the finish render in rain or other inclement weather; to avoid trapping moisture in the system.
- Render coats must not be applied in temperatures below 5°C.
- Vented cavities should not be blocked, nor should any 'weep holes'.
- Depending on the manufacturer's specifications, the insulation board may require to be keyed to receive the desired render base coat and reinforcement.

For further guidance on EWI systems, please refer to the 'External Walls – Claddings' section.

General rendering requirements in all cases

Weather conditions

- For exposure zones where the wind driven rain is expected to be more than 75 litres per m² (classed as very severe) then checked reveals will be required. The render applied to the reveal must be of the same thickness as the wall render with an appropriate corner beading provided. A suitable non hardening' mastic sealant must also be provided between window / door frame and masonry reveal.
- Protection must be provided when applying renders in rain or other inclement weather.
- Application should cease in temperature below 5°C or where rapid freezing is considered to be a potential threat.
- When applying in hot weather it is advisable that work coincides with the shaded areas of the building. During longer periods of hot and dry weather, it may be appropriate and necessary to apply an even mist spray of clean water to the substrate before application, and to surface finish for a couple of days afterwards subject to site and weather conditions.
- Cement products should not be applied to substrates which are frost laden or which have recently been subject to prolonged rain.
- Do not render onto saturated substrates as this may affect the bond strength and cause lime bloom (discolouration), salts to occur and patchiness due to uneven suction.
- Local weather and site conditions must be taken into account by the applicator before any cement product is applied.
- Care must be taken to protect cement and synthetic products soon after the application from rapid freezing and heavy rainfall. For other drying conditions i.e. where there is direct exposure to sunlight or drying winds, the render may require to be protected from the elements. This process is important to ensure complete hydration of the products can take place.
- Where an application is not covered in these conditions further advice from the render manufacturer must be sought and submit a suitable manufacturer's specification to the Warranty provider for approval.

Application

- 16mm is considered the minimum finished thickness of render applied to a masonry wall, either as a single spray coat or as a two coat hand application. Where structures are located in very severe weather rating locations or within coastal locations, the depth of render may need to be increased to a minimum of 20mm and a specialist manufacturer's specification will be required to support this.
Please note: 5-6mm is considered the minimum finished thickness of render for applications of specialist insulated render systems. The render thickness will need to be increased where structures are located in very severe weather rating locations, or within coastal locations and a specialist manufacturer's specification will be required to support this; approved by the Warranty provider.
- When ashlar detailing is required, it is recommended that a minimum depth to the back of the ashlar cut should be no less than 15mm and 20 - 25mm for applications in very severe exposure zones or within coastal locations. To achieve this depth, it will require the finished thickness of the main render to be increased to accommodate this feature.
- Abutments between cement render and other cladding materials or components should be weather tight and allow for differential movement.
- Any joints in the wall where movement may occur should be continued through the rendering.
- Render should not bridge the Damp Proof Course (DPC) and must be finished onto a durable render stop profile such as a proprietary uPVC bead or stainless steel bead.
- Renders will be reinforced as a minimum with an appropriate certified alkaline resistant fibreglass mesh at corners of all openings and penetrations. For substrates that are prone to movement, an appropriate certified alkaline resistant fibreglass mesh will need to be incorporated throughout the substrate.
- Where different materials are being rendered over, the incorporation of an appropriate certified alkaline resistant fibreglass mesh will be necessary to assist with the possibilities of differential movement. The mesh must extend sufficiently over the different materials to resist against differential movement.
- Renders installed between pedestrian level and 6.0m above ground level will be designed to accommodate higher maintenance and impact loads in accordance with Table 2 of BS 8200.
- All surfaces must be clean, suitably dry and free from anything that may interfere with the adhesion of the material to be applied. The manufacturer's product data sheets should be followed including the manufacturer's surface preparation and suitability checks in full.
- All blockwork mortar joints are to be flush pointed and should be fully cured before the application of the render.
- The quantity of material required for a given area should be of the same batch number or if not the different batches must be thoroughly mixed together to avoid shade variations.
- Full masking must be used to give protection to adjacent areas of work, windows, doors etc. and to give clean straight edges. It should be removed immediately after the finishing coat has dried.
- Carefully remove splashes of material, in particular from glass or aluminium immediately as they may etch the surface and leave a permanent mark.

Materials

- Ensure the render being used is suitable for the substrate and is not too strong. Due to shrinkage differentials, avoid applying a thin base coat and a thicker top coat application, as the shrinkage values of a thicker top coat could cause the render to delaminate from the base coat. The same effect is also caused by applying a very hard render over a softer base coat.
- Rendering 'specification' and 'application' should be in accordance with BS EN 998-1 and BS EN 13914-1:2005 respectively and workmanship in accordance with BS 8000.
- Rendering products should be stored separately from other building and concreting sands.
- For bellcasts, other beads, and stops; uPVC bead or stainless steel bead is acceptable. Angles, stop beads and jointing sections should be secured with drilled or shot-fired fixings, and not with gypsum plaster. In coastal locations UPVC

- or marine grade stainless steel must be specified. (See 'Appendix B – Coastal Locations: Additional requirements for developments within coastal locations' for further guidance).
- Only clean water should be used for mixing.

Vertical and horizontal flatness

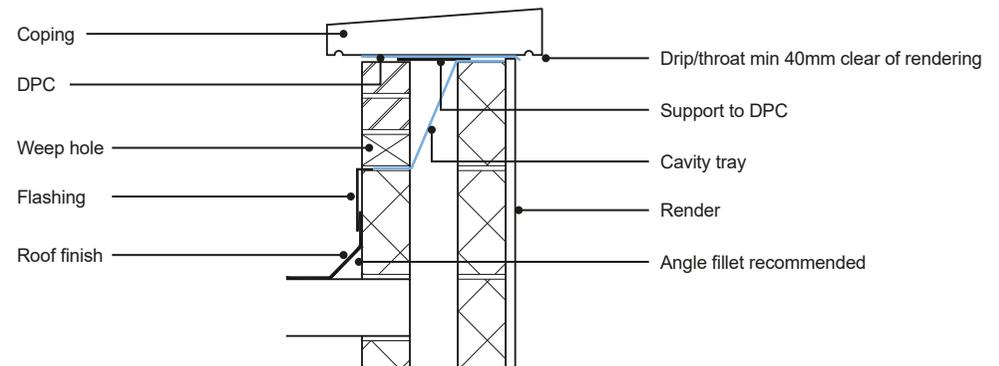
Rendering should have a maximum vertical and horizontal deviation from flatness of +/-10mm in 5m, and is measured in a similar way to straightness on plan and plumb of masonry. See the 'Tolerances' section for further information.

Render below DPC, backs of parapets or chimneys - ALL Cases

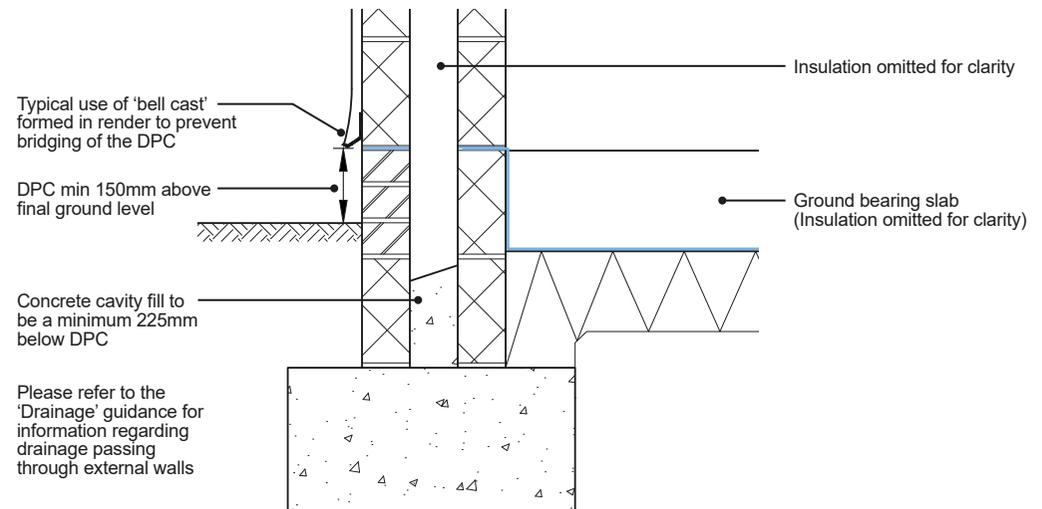
(i.e. within 150mm of the adjacent ground level)

- The horizontal dpc must form a break in the render system.
- Renders used Render below DPC, backs of parapets or chimneys must only be considered if the Render Manufacturer provides a site-specific specification for this.
- Renders / boards to be used within 150mm of the adjacent ground level, to have third party approval for use in this location.

Parapet wall detail



Partial fill cavity wall: Traditional ground bearing slab



Construction detailing

Render failures are often associated with poor detailing; this can be from:

- Inadequate weatherproofing of the substrate above allowing excessive moisture to permeate behind the render system.
- Insufficient weathering details e.g. insufficient overhangs allowing a high concentration of moisture to saturate the render.

It is important that these intersecting details be suitably considered to ensure the longevity of the render system. The specification should identify the areas of the build which may interact with the render e.g. eaves, verge, parapets, cills etc. In order to ensure the durability of the render system particular attention should be given to the correct detailing of architectural features which can afford a high degree of protection.

Other construction detailing

- Renders should be protected by capping's or copings. Where a render finish is specified a minimum of 40mm over hang should be provided to all throating to cills, copings, capping's etc.
- Notwithstanding wind loadings, the larger the eaves overhang the better. This will provide protection to the top joint and prevent rain water percolating behind the render.
- Consideration should be given on how the waterproof integrity of the waterproof fabric is maintained at abutments with other cladding systems and types.
- Any joints in the wall where movement may occur should be continued through the rendering.
- Introducing reinforcement at weak points such as above and below window and door openings is strongly recommended as a minimum requirement in all applications, as it will greatly assist in minimising cracking to these areas
- Angles, stop beads and jointing sections should be secured with drilled or shot-fired fixings, and not with gypsum plaster. Fixing of external render beads on masonry backgrounds with an adhesive is also acceptable, providing the render manufacturer can provide a full specification on fixing the beads including:
 - The adhesive to be used.
 - Type of fixing e.g. dabs or continuous bead.
 - Curing times.
 - Specification of the beads used.

Under no circumstances should the beads or profiles be bonded using a solvent based adhesive.

6.

External Walls

6.5 Claddings

Provision of information

A full set of design drawings and specifications shall be made available to the Warranty Provider and all other interested parties prior to the associated works starting on site. This may include:

1. Full set of drawings including locations of curtain walling and cladding applications for each elevation and section details showing the external wall makeup.
2. Façade specification and/or full manufacturer's specification
3. Manufacturer, Engineer or façade contractor must provide site specific structural calculations of the curtain wall or cladding system for the project and specified design loads (live and dead load).
4. Fixing specification for the cladding system including the fixing type, size, spacing and method of fixing to the substrate. Details of corrosion protection and how bi-metallic corrosion is to be mitigated should also be provided.
5. Details of any technical assessment (third party product conformity certificates) and/or test data.
6. Details of proposed cavity barriers to be used including materials, period of fire resistance (in compliance with the project fire strategy), locations and vertical and horizontal design details at all interfaces.
7. Details of proposed on site testing regimes.

The Warranty Surveyor, at their discretion, may also request supporting information that demonstrates suitability for use of any materials or systems contained within the above.

Identification of the site exposure rating

The design and materials used, should be suitable for the site specific exposure location. For further information on determining the exposure for the site location please see 'Appendix C'.

Introduction

This section discusses a range of requirements for different cladding types. It provides information on the cladding only, and additional requirements may be applicable depending on site specific substrate. This section should be read in conjunction with the other sections within the 'External Walls' section.

Curtain Walling

Curtain walling systems should have third-party certification confirming satisfactory assessment and comply with the requirements of the CWCT Standard for Systemised Building Envelopes, including the following sections:

- Part 1: Scope, terminology, testing and classification.
- Part 2: Loadings, fixings and movement.
- Part 3: Air, water and wind resistance.
- Part 4: Operable components, additional elements and means of access.
- Part 5: Thermal, moisture and acoustic performance.
- Part 6: Fire performance.
- Part 7: Robustness, durability, tolerances and workmanship.
- Part 8: Testing.

The CWCT Standard provides detailed guidance on performance and testing.

Dead and live loads should be transferred safely to the building structure without undue permanent deformation or deflection of any component.

Imposed loads should be calculated in accordance with BS EN 1991. Movement should be accommodated without any reduction in performance.

Fixings and supports should be designed to accommodate specified loads. This must take into account the structure it is being fixed to and the product manufacturer's recommendations.

CE/UKCA marking is to be provided for all curtain walling covered by EN 13830 in buildings constructed after July 2013, and will therefore include the following curtain wall types:

- Stick construction.
- Unitised construction.
- Double skin walls.
- Structural sealant glazing.
- Bolted glazing.

The completed system should incorporate cavity barriers and firestops and resist the spread of fire in accordance with the

relevant Building Regulations and project fire strategy requirements.

The completed curtain wall system should resist the passage of water to the inside of the building allowing free drainage, not trapping water and should have:

- External and internal air and water seals.
- Drained and ventilated glazing rebates.

Sealants should be specified in accordance with BS 6213 or BS EN 15651 and the performance determined by BS EN 11600 and the manufacturer's recommendations.

The system should be designed to minimise the risk of surface and interstitial condensation by the use of thermal breaks and a continuous vapour control layer. It should be designed to resist the passage of airborne and impact sound within the building with particular attention given to through wall, vertical and horizontal flanking transmission at:

- The edges of separating floors and the interface with the facade.
- The outer edges of separating walls and the interface with the facade.
- The outer edges of partition walls and the interface with the facade.
- The junctions with roof constructions and parapets and the interface with the facade.

Where curtain wall members run uninterrupted past floor slabs and partition walls, consideration must be given to structure-borne sound (impact sound) through the system.

The system should comply with BS 7671 requirements for electrical installations for electrical continuity and earth bonding, where it is required to form part of a lightning protection system it must be designed to comply with the requirements of BS 6651.

The risk of bimetallic corrosion should be checked and avoided by the isolation of dissimilar metals. Fixings and finishes to curtain walling must take into account the location and corrosion category to ensure corrosion is avoided. Aluminium components must be robustly isolated from cementitious products to mitigate corrosion.

The curtain wall system should not include materials liable to infestation attack by micro-organisms, fungi, insects or vermin.

Packing of brackets to achieve surface tolerance is only permitted in accordance with the manufacturer's recommendations, and shall not exceed the maximum depth stated in the designer's calculations.

All packers for brackets supporting or restraining the curtain wall must be metal.

Testing

The curtain wall system will have either been tested and provided with a classification given in BS EN 13830, or if the curtain walling, including stacked windows (please see 'External Windows and Doors – Stacked Windows' for further guidance) is of a custom design, it would be tested to an appropriate standard of CWCT sequence A or B testing by an independent UKAS accredited test facility to ensure that the system meets or exceeds the weather performance classification for the building taking into account the design parameters and project location.

Pull-out or destructive testing of anchors should be carried out in accordance with BS 5080 and the Construction Fixings Association Guidance Note, Procedure for Site Testing Construction Fixings.

The number of fixings to be assessed must be agreed on a project by project basis, as an understanding of the scope and size of the project would determine the number of fixings tested. In addition, if there are varying types of fixings then each type should be tested. If the fixing is the same but the structure varies, then each type of structure should be tested.

BS 5080 requires 5 tests per type, however if a very large project is proposed, this could be increased to give more assurance on installation, e.g. every floor, one per side (e.g. North / East/ South/West). The scope and number of tests must be agreed with the Warranty Surveyor at the commencement of the project, to allow sufficient time for testing to be planned in advance and made available to the Warranty Surveyor when completed.

Site water testing of penetrations to critical joints should be carried out by a UKAS accredited testing company in accordance with CWCT test methods. This is required to check to site workmanship of the building envelope as constructed. Areas and method of testing is to be agreed prior to construction. See CWCT Technical Note 41 for guidance. Where testing fails, the cause and remedial action should be implemented and advised to the Warranty Surveyor and additional checks to be carried out to determine whether the failure is local or a system issue. If it is a system issue, remedial work to the façade must be carried out prior to further testing is carried out, to demonstrate the remedial solution is effective.

Tolerances

Design should allow for the line, level, plumb and plane of the completed curtain wall to be within the acceptable tolerances of:

- Line: +/-2mm in any one storey height or structural bay width, and +/-5mm overall.
- Level: +/-2mm of horizontal in any one structural bay width, and +/-5mm overall.
- Plumb: +/-2mm of vertical in any one structural bay width, and +/-5mm overall.
- Plane: +/-2mm of the principle plane in any one storey height or structural bay width, and +/-5mm overall.

Rainscreen cladding systems

A rainscreen cladding system consists of a multi-layer construction of materials which is designed to provide a barrier to the weather on new or existing buildings. The typical build-up would consist of a supporting airtight and water tight backing wall and rainscreen system.

The rainscreen should comprise of supporting brackets fixed to the backing wall, insulation between the brackets, a breather membrane, carrier support rails fixed to the brackets, a ventilated and drained cavity and the rainscreen panels.

Rainscreen systems should have third-party certification confirming satisfactory assessment and comply with the requirements of the CWCT Standard for Systemised Building Envelopes. The collation of individual testing of components does not provide an overall performance of the rainscreen system or backing wall.

Dead and live loads should be transferred safely to the building structure without undue permanent deformation or deflection of any component. Imposed loads (live and dead load) of the backing wall and rainscreen including the external sheathing board should be calculated in accordance with BS EN 1991 and movement (structural and thermal) should be accommodated without any reduction in performance to satisfy the project requirements. Fixings and supports should be designed to accommodate specified loads and take account of the product manufacturer's recommendations.

Rainscreen systems require adequate drainage and ventilation in accordance with CWCT standards for systemised building envelopes. At the head and base of a rainscreen cavity a minimum of 5000mm² of ventilation must be provided per linear meter run. Ventilation gap must not be less than 10mm high (a continuous 10mm gap will provide 10,000mm² ventilation). Drainage must be provided at the base of the rainscreen system. The functional drainage gap must not be less than 10mm.

Rainscreen panels are generally lightweight and vulnerable to impact damage. The rainscreen must be able to resist impacts without causing safety hazards. Testing and classification to CWCT Technical Note 75 and 76 may be required to demonstrate the rainscreen's material impact performance.

Design should allow for the line, level, plumb and plane of the completed rainscreen cladding to be within the acceptable tolerances of:

- Line: +/-2mm in any one storey height or structural bay width, and +/-5mm overall.
- Level: +/-2mm of horizontal in any one structural bay width, and +/-5mm overall.
- Plumb: +/-2mm of vertical in any one structural bay width, and +/-5mm overall.
- Plane: +/-2mm of the principle plane in any one storey height or structural bay width, and +/-5mm overall.

Cavity barriers within a ventilated rainscreen system must be appropriately selected, suitable for use and be aligned with the compartment wall and floor. The cavity behind a rainscreen is deemed to be a moist zone and materials selected must not corrode, deteriorate or affect the performance of the cavity barrier during its design life. The minimum design width of the cavity wall will be determined by the panel joint type, i.e. whether it is sealed, closed, labyrinth, baffled or open. Horizontal cavity barriers must allow for drainage and ventilation in the rainscreen cavity and a gap of 50% of the cavity width must be retained in front of the open state cavity barrier.

Minimum cavity widths

Cavity widths are determined by the joint type:

- Sealed / closed = 25mm
- Open = 50mm
- Baffled = 38mm
- Labyrinth = 38mm

Rainscreen systems and their materials must comply with the relevant Building Regulations.

The risk of bimetallic corrosion should be checked and avoided through the isolation of dissimilar metals. Fixings and finishes to curtain walling must consider the location and corrosion category to ensure corrosion is avoided. Aluminium components must be robustly isolated from cementitious products to mitigate corrosion.

Cavity barriers should be mechanically fixed to rigid construction (for both vertical and horizontal positions) in accordance with the manufacturer's recommendations.

Sheathing boards

External Sheathing boards being fixed to Light Gauge Steel Frame Systems (LGSF) must hold suitable third party accreditation and be assessed by calculation to withstand the design wind loads. This is to ensure the LGSF stud spacings and board fixing centres satisfy the project requirements.

A breather membrane must always be installed irrespective of the external sheathing board product.

Seals

All penetrations in the façade including windows, doors, ductwork etc. must be sealed to the structure and external sheathing board with EPDM or suitable alternative. The sealing membrane must have adequate test data suitable for the project specific wind load and proposed substrate compatibility.

Timber cladding

Timber and boards for exterior use should be of a durable species, with sapwood excluded, or preservative treated by pressure impregnation using preservatives suitable for use in hazard Class 3 in compliance with BS 8417, or equivalent. Further guidance on the durability of timber is provided in 'Appendix C - Materials, Products, and Building Systems'.

Where timber boarding or plywood spans across an intermediate floor zone in a timber frame construction, allow for differential movement caused through timber shrinkage by incorporating a movement joint.

Where cavity barriers are required, they shall be appropriately tested and approved for their intended purpose, this should include all fixings. Cavity barriers are also required behind decorative cladding such as timber boarding which is constructed on the outside of an external cavity masonry wall.

Abutments between cladding and other weather-resisting elements should be neatly made, weather tight and allow for differential movement. Workmanship should comply with BS 8000:5.

Timber boarding

Timber boarding should be at least 16mm thick, and allowance for moisture movement in boarding should be achieved by making tongues, joints or overlaps at 10% of the board width or 20mm, whichever is greater.

Timber boarding should be battened off the supporting background to provide a minimum 19mm cavity for draining and venting board.

Battens should be a minimum of 38mm wide, preservative treated and at maximum 600mm centres. A breather membrane should always be installed. Battens on timber frame should be fixed to each stud (and not to the sheathing) with annular ring nails of length at least twice the batten thickness plus the sheathing thickness (or plain shank nails of length 2.5 times the batten thickness plus the sheathing thickness).

Boards should be fixed to battens by face or secret nailing with annular ring nails at least 2.5 times the board thickness. In addition, all of the following conditions should be satisfied:

- Use double battens to support abutting boards. Batten should extend the full width of the boards either side.
- Pre-drill fixing points at board ends to prevent splitting.
- For boards 100mm and wider, use two fixings per board at every batten.
- On boards under 100mm in width, use one centrally placed fixing.
- Use two fixing points per board where they cross a support batten.
- Position fixing 25% in from each side and a minimum of 20mm in at board ends and pre-drill to avoid splitting where necessary.
- All fixings should finish flush with the surface and should not be punched or countersunk.

All metal fixings must be from corrosion resistant materials such as stainless steel (austenitic grade), hot dipped galvanised (BS7371:6 min) copper, silicon bronze or high performance coated steel. The following should not be used for any metal fixings: aluminium, electro plated steel or brass. Galvanised nails should not be used with Western Red Cedar.

The use of dissimilar materials in the same fixing point should be avoided to minimise the risk of galvanic corrosion.

When using timber species with high tannin or corrosive oil content such as Western Red Cedar, Douglas Fir and some hardwoods, stainless steel fixings should be used.

Mock Tudor cladding

Where mock Tudor cladding is proposed over a rendered substrate, the wall should be rendered in its entirety and the timber planted onto the render.

Render between mock Tudor cladding panels will not be acceptable for Warranty purposes.

Where mock Tudor cladding is proposed the following recommendations should be followed:

- To minimise movement all timber, used for mock tudor cladding, regardless of species should be kiln dried.
- It is recommended that the timber is not sealed against the render, as the likely hood is that this can lead to moisture being trapped behind the structure, e.g. where horizontal timbers are against the wall the top more exposed mastic seal may fail first allowing moisture in, whilst the bottom mastic seal remains intact trapping the moisture behind.
- To reduce the effects of warping it is better to fix the timber 'Pith out' which means any warping across the width of the timber the edges will be in the direction of the backing wall. Using only Quarter sawn timber will also help reduce this.
- Depending on the desired visual effect, timber thickness can range from 19-40mm max. 40mm is generally the maximum, as thicker timbers can exert higher forces when warping which can pull the fixings out.
- Due to the limited access, the back of the timber should be decorated/stained before it is fixed to the wall.
- The timber species selected should have a minimum natural durability of 15 years unless treated.
- When jointing mock Tudor cladding a butt joint is sufficient. Halved joints should be avoided, due to the potential to trap moisture and biscuit joints also avoided, as often the biscuit is also not durable enough.

Specific to Oak

Where oak is specified, the fixings should not react with the timber or timber treatment, therefore stainless steel fixings are recommended.

Please note: With oak, there is a risk of extractive staining, where moisture will remove tannings from the oak and stain the render (particularly where light renders are used).

Please refer to 'Appendix C' for further guidance on the use of oak.

Vertical tiling and slating

Vertical slating with fibre cement slates
Fibre cement slates can be fixed to vertical surfaces and provides an attractive and weatherproof cladding on both timber frame and masonry constructions.

The following guidance notes apply to this detail:

- Use counter battens over masonry construction (38mm x 25mm minimum) to reduce direct fixing. Special masonry fixings may be required.
- Slate-and-a-half should be used in alternate courses at internal and external corners and adjacent to openings.
- Use Code 3 lead soakers to weather internal and external corners.
- Fix slates by two nails and one rivet, and slate-and-a-half by three nails and two rivets.
- Code 4 lead cover flashings should be used above and below openings, in accordance with Lead Sheet Training Academy recommendations.

Vertical tiling with plain tiles

Plain tiling is an excellent, weather proof and attractive cladding to the vertical walls of any building.

Feature and ornamental tiles may also be used with normal plain tiles to create decorative patterns. Fibre cement slates can also be used for vertical cladding.

- Use counter battens over masonry construction (38mm x 25mm minimum) to reduce direct fixing. Special masonry fixings may be required.
- Ensure tiling details do not interfere with the opening of windows and doors.
- Lead flashings and soakers should be used around openings, in accordance with Lead Sheet Association details.
- Use double course of tiles at eaves, by laying first course of eaves/tops tiles with course of full tiles laid over.
- At the top of a wall or under a sill, use a course of eaves/tops tile laid over a course of full tiles. Dress a Code 4 lead cover flashing over by 100mm.
- Use internal and external angle tiles at all 90° corners. Purpose-made 135° angle tiles are also available. For other angles, close mitre tiles and use Code 3 lead soakers.
- All tiles should be twice nailed.

Please note: Cavity barriers are required behind decorative cladding such as vertical tiling and slating which is constructed on the outside of an external cavity masonry wall and where counter battens are used.

Further guidance on tiles and slates can be found in the 'Roofs' section.

Material specification

Brickslips facings can be adhered to a variety of materials and substrates, where they are specified, the brick slips should meet the following requirements:

- Clay masonry units must conform to BS EN 771-1 and have UKCA Marking.
- Calcium silicate masonry units must conform to BS EN 771-2 and have UKCA Marking.
- Concrete brick slips (Aggregate concrete masonry units) must have UKCA Marking and conform to BS EN 771-3.
- Agglomerated stone - slabs and tiles for wall finishes to BS EN 15286 and have UKCA Marking (Artificial stone).
- Natural stone masonry units must conform to BS EN 771-6 and have UKCA Marking.
- Accelerated weathering test data for the specific brick proposed must be provided. The full brick (prior to cutting to 25-28mm) must be tested by UKAS test laboratory for Hygrothermal testing, conditioning to ETAG 034, Freeze/thaw to EN 772-22 and tensile testing to BS EN 1015-12.
- In all circumstances, we can only accept F2/S2 bricks complying with EN 771.

Installation on different substrates

Masonry cavity walls

Where slips are to be bonded onto masonry walls, the following must be met:

- The cladding system i.e. slip, adhesive and associated ancillary products such as clips, strapping etc. must hold a valid third party product conformity certificate.
- The design and fixing of the slip system must be in strict accordance with the third party product conformity certificate with any adhesion tests, pull out tests completed satisfactorily as per the requirements of the certificate.
- Any slip is considered to provide a 'decorative' finish only to a wall, therefore the design of the external wall (to meet weather resistance requirements) must be in strict accordance with Building Regulations for the wind driven rain exposure zone location, as if the slip was not to be installed.
- The backing wall to which the slips are to be adhered is typically blockwork and therefore the blockwork is considered to be 'C2 - High risk of saturation' and must be of the correct classification i.e. classified as MX3.2, MX4 or MX5 built in M4 mortar. Please refer to 'Appendix C' for further guidance. Please also see PD6697 for further information.
- Where adhesive is used, the brickslip must have a full bond that covers the entire surface area of the brickslip. Spot bonding must be avoided.
- The substrate must be appropriately prepared as per the brickslip manufacturer's instructions.
- The cavity width must be correct and comply with Building Standards for a 'facing masonry' wall type not 'rendered finish' or 'impervious cladding' finish.
- Slips should not be applied to render, unless covered by a valid third party product conformity certificate which is deemed acceptable as meeting our requirements. Any third party product conformity certificate for such construction must confirm the permitted maximum exposure zone the system can be used, if reliance is to be placed on the system to provide weather resistance.
- Slips must not bridge the damp proof course. The damp proof course must extend through the slip to the outside face of the slip cladding.
- Movement joints in the substrate must be installed in strict accordance with the Technical Manual and extend through the decorative slip cladding.
- Cavity trays must be present, as per the requirements of the Technical Manual.
- Weep holes must be installed, as per the requirements of the Technical Manual and extend through the decorative slip cladding.
- Where checked reveals are required (very severe exposure zone), the design must be assessed and deemed compliant. The check must be formed by the masonry substrate not slips or render. Windows must be sealed prior to the slip installation.
- Any mortar pointing of the slips, must be full depth, with the mortar suitable for the environment. Please refer to 'Appendix C' of the for further guidance.
- Any systems utilising clips, strapping, screws, etc. must used in a coastal location within 500m of the shoreline must be Grade A4 stainless steel.
- Any fixings of ancillary rainwater goods, satellite dishes, clothes lines, hanging baskets and similar items must go through the slips and into the substrate to ensure adequate fixing.

Brickslip cladding on framed construction with a backing board or as a rainscreen cladding system

- Where slip's are to be used in conjunction with a framed structure and bonded onto a board, the 'cladding system' i.e. slip, adhesive, board and associated ancillary products such as clips, must all be covered by a valid third party product conformity certificate for the system as a whole.
- Where adhesive is used, the brickslip must have a full bond that covers the entire surface area of the brickslip. Spot bonding must be avoided.
- The substrate must be appropriately prepared as per the brickslip manufacturer's instructions.
- The framed structure (backing wall) must be water tight and protected with a suitable breather membrane.
- A drained cavity, ventilated where required, must be provided in accordance with the Technical Manual.
- MgO boards are not acceptable for Warranty use.

Insulated Concrete Formwork

Where slips are to be installed either A) directly onto the ICF or B) onto render which is directly applied to the ICF, then the slip cladding system must:

- There is a combined named Slip, Render and ICF system which jointly holds a valid and current third party product approval, which is deemed acceptable to ourselves OR,
- Have a valid and current third party product approval confirming it has been assessed to provide the weatherproof protection to an Insulated Concrete Formwork substrate consisting of EPS, EPX, etc.
- The third party product approval certificate clearly identifies the maximum wind driven rain exposure zone** permitted by the assessment, and
- Where a brickslip and render combined system is specified, the certificate holder provides a project specific specification for the installation, and
- Installers trained and approved by the certificate holder should only install the direct render finish.
- Where adhesive is used, the brickslip must have a full bond that covers the entire surface area of the brickslip. Spot bonding must be avoided.
- The substrate must be appropriately prepared as per the brickslip manufacturer's instructions.
- Where slips are to an outer independent leaf, please refer to the 'External Walls' section.

** Note: If the project location is situated in a wind driven rain exposure zone exceeding that stated in the third party accreditation, the certificate holder must seek agreement with the Warranty provider prior to any installation.

Brickslips external wall insulation (EWI)

Please refer to the 'External Walls – Cladding' section for further guidance on EWI systems:

- The EWI system, must hold a valid third party product conformity certificate, which is deemed acceptable as meeting our insurance requirements. The third party accreditation approval must be for the substrate construction proposed.
- The backing wall behind the EWI system must be watertight, protected with a breather membrane which has appropriate third party product conformity certificate
- A drained cavity must be provided.

Brickslips on lintels

- Slips used in conjunction with either concrete, steel or lightweight (SIP) lintels, must hold a valid third party product conformity certificate covering the lintels, adhesive and slip system as a whole.

Brickslips on chimneys

All GRP chimneys must either:

- Hold a valid third party product conformity certificate confirming a minimum service life of 25 years and be deemed acceptable to the Warranty provider, OR
- The GRP chimney manufacturer must be a current 'Accredited Member for the Production of GRP Brick Slip Chimneys' from the 'Construction Glass fibre Manufacturers Association'. Please refer to the 'Chimneys and Flues' section for further guidance.

Brickslips on soffits

- Where slips are used in conjunction with horizontal soffits, the product must hold a valid third party product conformity certificate for use in this situation.

Please note the following in all circumstances:

- Where adhesive is used the brickslip must have a full bond that covers the entire surface area of the brickslip. Spot bonding should be avoided.
- The substrate must be appropriately prepared as per the system manufacturer's instructions.
- Pointing mortars should be chosen and installed as per the system manufacturer's instructions. Traditional sand and cement mortar should be avoided. Lime based mortars should be used instead to aid in thermal expansion and settlement.

Provision of information

A full set of design drawings and specifications shall be made available to the Warranty Provider and all other interested parties prior to the associated works starting on site. This may include:

1. Details of any technical assessment (third party product conformity certificate) for the entire EWI system including the cladding or render to be used on the external face. The certificate must clarify which type of wall substrate the EWI system has been assessed.
Note: For coastal environments and areas of severe and very severe wind driven rain exposures, the technical assessment for the EWI system must explicitly confirm the system is suitable for use in a coastal environment or severe/very severe wind driven rain exposure.
2. A full manufacturer's specification for the installation of the system to the substrate must be provided.
3. The manufacturer or Engineer should provide a fixing specification for the insulation boards. This should be site specific and must detail type, spacing and method of fixing to the substrate. A pull out test report confirming fixing type and length will be required in accordance with the Construction Fixings Association.
4. Where adhesive is used to fix insulation boards back to the substrate, a technical assessment (third party product conformity certificate) must be provided for the adhesive.
5. Specification and detailing of:
 - a) How external fixtures (such as downpipes, satellite dishes and other ancillary fittings) are to be fixed back to the substrate (not just the EWI system).
 - b) Details of materials to be used for sleeving of service penetrations where required.
 - c) Interface detailing for window and door reveals to avoid interstitial condensation.
6. Detailing around DPC's, cavity trays, flashings etc.
7. Details of proposed cavity barriers including location, materials and technical assessments (third party product conformity certificate).
8. A condensation risk analysis should be provided for the external wall makeup.

The Warranty Surveyor, at their discretion, may also request supporting information that demonstrates suitability for use of any materials or systems contained within the above.

General conditions

These are systems applied to the exterior walls of existing or new buildings, comprising of an insulant and a protective cladding or render finish. The Insulation type can vary from Expanded Polystyrene Insulation (EPS), Extruded Polystyrene Insulation (XPS), Phenolic insulation or mineral wool insulation.

A third party product approval certificate is required for the entire EWI build up including the cladding or render on the external face.

For further guidance for rendering on EWI systems, see the 'External Walls - Render' section.

Please Note: ETA documents do not state the maximum exposure zone the system is tested for. The ETA documents usually only say the system (including the render) improves the thermal performance of the wall and contributes towards weather resistance.

Therefore for Warranty purposes:

For installing on a masonry substrate:

- The masonry wall should be thick enough to meet PD6697

For installing on a framed structure:

- A drained (and vented) cavity will be required AND a breather membrane installed to protect the framed structure.

It should be noted that most third party product approvals will state the EWI system will only 'contribute towards' the weather resistance of the wall i.e. not give full weather resistance. Therefore the substrate must also be constructed to provide adequate resistance to water penetration. This can be identified by reference to either BS 5628-3 Table 11 or PPD 6697, depending on the wall thickness and site exposure.

Also, the certificate will say the EWI provides a means to 'improve' the thermal performance of the external wall construction. Therefore any proposed installation must account for the overall thermal performance of the wall construction and the provision of a cavity to meet our Warranty requirements.

Please note: EWI / EWCS: May not be acceptable for use in external walls in buildings over 11m / 18m high (Scotland / England-Wales).

The design and installation of EWI systems should ensure all building functions are maintained, e.g. vented cavities should not be blocked. Ensure all fixtures and fittings which penetrate the insulation system e.g. flues, ventilation pipes, water pipes

etc. are appropriately sleeved and fully weather sealed in accordance with the system manufacturer's recommendations.

The dead and live loads should be transferred safely to the buildings structure without deformation or deflection of any component. Ensure the insulation continues around openings and other penetrations to maintain the thermal benefits.

Movement within the EWI system should be accommodated without any reduction in performance and should be constructed in accordance with the manufacturer's details. Movement joints in the backing substrate should be mirrored through the insulated render system and formed in accordance with the manufacturer's recommendations.

Fixing requirements

Insulation boards should be fixed in accordance with the manufacturers requirements. The density of proprietary fixings should be designed on a site specific basis by an Engineer.

This generally consists of a minimum of 5 fixings per full insulation board / 8/m² with additional fixings to corners and reveals. A pull out test report confirming fixing type and length will be required in accordance with the Construction Fixings Association and made available to the Warranty Surveyor. If the fixing for the insulation boards are to pierce a breather membrane, a site specific installation guide must be provided from either the EWI manufacturer, breather membrane manufacturer or frame manufacturer (timber or light gauge steel frame) detailing how this should be completed without compromising the effectiveness of the breather membrane.

For Warranty purposes; Dot and dab method of fixing using adhesives is not acceptable on masonry substrates. A full coat of approved adhesive (often the manufacturer's adhesive base coat) must be applied across the full face of the substrate with a tuted finish as per the manufacturer's specifications.

For coastal environments and areas of severe and very severe wind driven rain exposures the third party product approval for the EWI system must explicitly confirm the complete system is suitable for use in a coastal environment or severe/very severe wind driven rain exposure. Furthermore, all external metals must have suitable corrosion protection for the intended environment. Further guidance can be found in 'Appendix C - Materials, Products, and Building Systems'. For further information please see 'Appendix B' of our Technical Manual which provides further guidance on additional requirements for developments within coastal locations.

Window and door reveals

Insulation is used in all construction projects to ensure buildings are kept warm and in turn reduce energy loss, however any break in the insulation line can often lead to interstitial condensation; with EWI systems, insulation is often missed around window and door reveals leading to condensation issues around the reveals.

The design for the EWI system should be carefully reviewed to ensure the insulation boards are present around the window and door reveals and there are no breaks in the insulation line. The design review should be aided by regular checks by the site management team to ensure the workmanship for the EWI system meets the requirements of the Warranty provider, EWI manufacturer and third party product approval certificate.

A continuation of the breather membrane and Vapour Control Layer (VCL) must be catered for around the window and door reveals where the EWI is applied to a framed substrate.

Allowance must also be made to ensure window cills adequately project beyond the finished surface of the EWI system to ensure any throating is correctly positioned clear of the finish, and that opening lights / ventilators are correctly installed to allow correct opening without being restricted by the EWI system.

Drainage deflection beads should be incorporated into the system to deflect water present in the drainage cavity around openings, other penetrations or items that block the drainage cavity.

Condensation risk analysis

EWI systems have an inherent risk interstitial condensation, therefore a condensation risk analysis should be carried out in accordance with BS 5250 to ensure the building fabric meets the required performance standard. If a vapour control layer is required then this must be installed to the warm side of the insulation and the type must be approved and suitable for the application.

Please note, providing a condensation risk analysis doesn't negate the need for thorough and robust checks on the design, workmanship and materials by the site management team and installers.

Particular attention should also be given to detailing around DPC level to ensure that there are no thermal breaks between the wall and floor construction and that any products used below DPC are suitable and accredited for use in that location.

Movement joints

Movement joints in the backing substrate should be mirrored through the insulated render system and formed in accordance with the EWI and timber frame/LGSF manufacturer's recommendations.

DPCs, cavity trays, flashings and weep holes

- The EWI system must not bridge any horizontal damp proof course.
- Where cavity trays are installed e.g. over openings or roof abutments, provision for draining the cavity tray will be required through the system as well as the correct construction of any flashing.
- Weep holes should be clear and functioning correctly (i.e. not blocked by the EWI system).

External fixtures

All fixings, down pipes, rainwater pipes, cables, fence posts, external light fittings, satellite dishes and other ancillary fittings and fixtures should be temporarily removed to enable the easy application of the insulated render system. Once the EWI system has been installed, the external fixtures can be installed into the substrate construction (not solely fixed to the EWI).

In addition the following should be observed:

- Temporary downpipes should be provided. Avoid allowing the temporary downpipes to spill water over the render system.
- If required reset all drainage gully's to accommodate the insulation system thickness.
- If required ensure that any gap around the window and door frames is correctly sealed against rain penetration before application of the insulated render system.

Risks associated with framed structures

Where an insulated render system is used as a cladding to a timber framed structure a drained and vented cavity will be required. A suitable breather membrane must also be provided to protect the sheathing board and framing system from water penetration reaching the internal finishes. The EWI system must have a third party product approval certificate confirming it can be used on the outside of a timber frame or light gauged steel framed structure.

EWI systems applied to Light Gauge Steel Frame should have a drained cavity only with limited ventilation. Cavity ventilation might decrease U-Value and introduce additional condensation/corrosion risk – please make sure installation is carried out in accordance with the design and condensation risk analysis provided.

Key points during Installation of the EWI system

The EWI system must be installed by an approved installer from the EWI manufacturer. Evidence of the installer being approved should be provided to the Warranty Surveyor before works start on site. When installing the EWI system, the following should be observed:

- Protection must be provided when applying the insulation boards in rain or other inclement weather; to avoid trapping moisture in the system.
- Vented cavities should not be blocked, nor should any 'weep holes'.
- The use of timber supports and blocks within the EWI system should not be used.
- Ensure all fixtures and fittings which penetrate the insulation system e.g. flues, ventilation pipes, water pipes etc. are appropriately sleeved and fully sealed in accordance with the system manufacturer's recommendations.
- The installation of EWI's at window / door reveals often fail due to poor detailing or support (often by wooden boards). The manufacturer's details must be followed and appropriate trims should be provided at openings, corners, angles and interfaces etc.

General

The following additional guidance for natural stone shall be used in conjunction with any other information in the Technical Manual. When selecting stone for cavity wall house building, it is important to consider the exposure rating for the area.

It is not recommended to use a soft, porous-type stone in a severe or very severe exposure zone. Consideration should be given to the compatibility of different stone to prevent staining and premature decay. Limestone and sandstone should not be mixed together.

It is advisable to use a stone that has been quarried within a reasonable vicinity of the development, ensuring both weathering qualities and visual blending with existing buildings. Natural stone has a grain or natural bed that is determined during its formation in the strata of the quarry.

It is important that the stone is laid with the grain running horizontal to the bed. In the case of jambs and mullions, the grain should be vertical.

A sawn bed of 100mm minimum thickness is to be used as the outer leaf of a cavity wall, although 150mm is recommended. Where dressed stone is used and the sawn bed width falls below 100mm due to the irregularities of the stone, the stone should be backed with a standard brick or block wall to maintain structural stability. It is not acceptable for the stone to be packed or wedged to maintain line and level without the backing wall being in place.

Mortar

The mortar for use with stone should comply with the relevant British Standards for sand, lime and cement, as set out in BS EN 1996 or PD 6697.

This can vary in strength from 1:1:6 to 1:3:12 depending on the softness of the stone. It is important to use the correct mortar to allow for movement and associated shrinkage. Ensure that wall ties are stainless steel and of sufficient length to maintain a 50mm embedment. It may be necessary to double up the wall ties where the coursing is out of line due to the varying thickness of natural stone at the reveals, i.e. every other course, and to ensure that wall ties do not slope inwards.

Insulation (applicable to masonry cavity walls only)

Full fill cavity insulation should only be considered where the outer leaf is backed by brick/blockwork, although this is still dependent on exposure, i.e. either partial fill, leaving a residual cavity of 50mm, or a clear cavity should always be the preferred options.

For guidance on insulation for framed structures, please see either the 'External Walls - Timber Frame' or 'External Walls - Light Gauge Steel Frame' sections.

Movement joints

In movement control where sealants are used, it is important to select a non-oil-based sealant to help prevent any staining to the stone.

Cavity trays

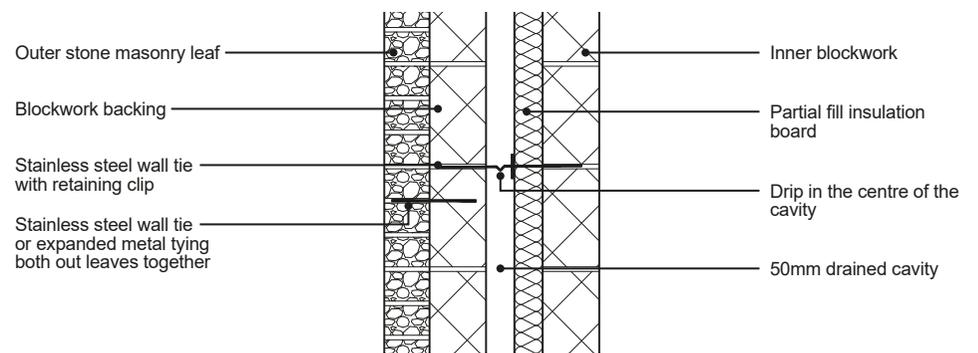
In addition to our guidance on cavity trays in this section, the following shall apply:

When stone heads are being used, it is advisable to double up the cavity trays, one below and one above the stone head, and to provide stop-ends and weep-holes. Please see 'External Walls - Traditional Masonry Cavity Wall: Feature stone surrounds to openings' for further information.

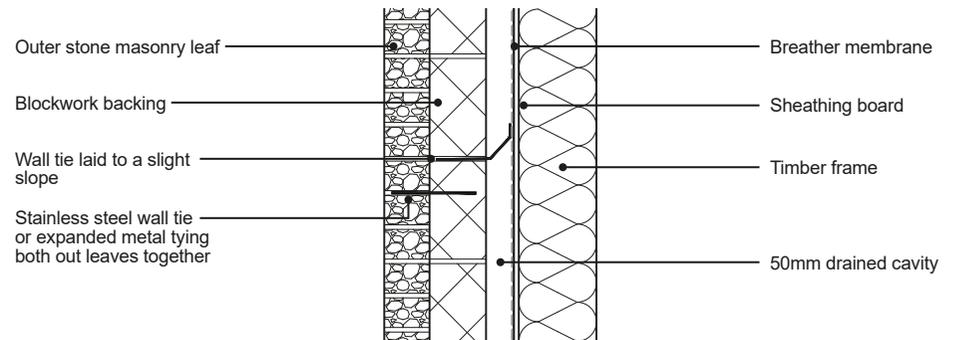
Jambs and mullions

Stone jambs and mullions should be fixed at the top and bottom with stainless steel pins. Stainless steel frame-type cramps can also be used to give extra stability at jambs.

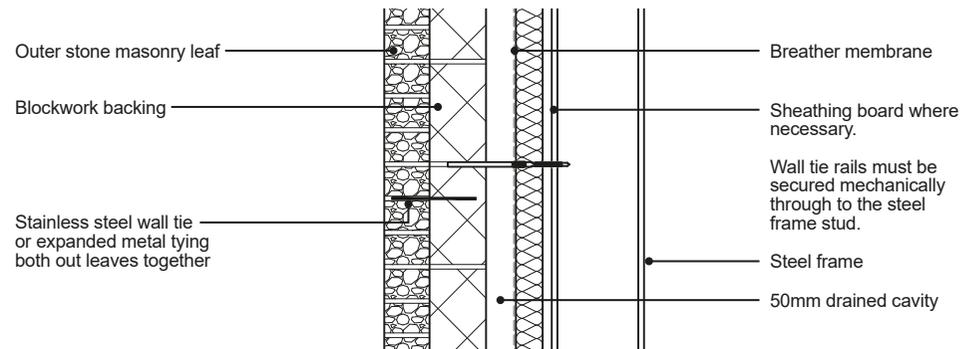
Masonry cavity wall with stone outer leaf



Timber frame with blockwork backing wall and stone outer leaf



Light Gauge Steel Frame with blockwork backing wall and stone outer leaf



Wind-driven rain

In all situations, external walls and cladding systems must be suitable for the wind driven rain rating specific to the project.

To ascertain the risk relating to wind-driven rain, the following should be determined:

- The exposure to wind-driven rain, using the wind driven rain exposure map.
- The correct type of construction, including the correct application of insulation.
- The correct level of workmanship and design detailing, particularly around window and door openings.

Exposure zones		Exposure to wind driven rain (litres/m ² per spell)
Very severe		100 or more
Severe		56.5 to less than 100
Moderate		33 to less than 56.5
Sheltered		less than 33

Note:
Variations to the exposure shown on the map can only be made by site-specific calculations using BS 8104 "Assessing exposure of walls to wind driven rain" and the table above.



6.

External Walls

6.6 Parapets

Provision of information

A full set of design drawings and specifications shall be made available to the Warranty Provider and all other interested parties prior to the associated works starting on site. This may include:

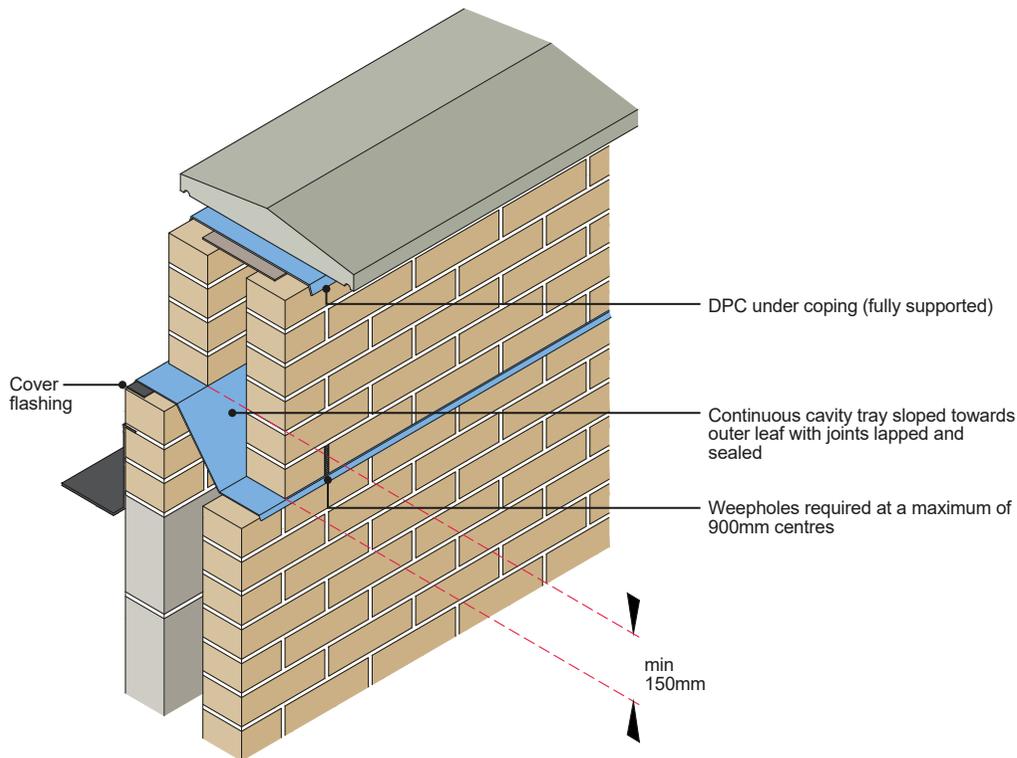
1. Details of all proposed materials to be used in the construction of the parapet wall, including but not limited to:
 - a) Details of proposed coping or capping.
 - b) Details of DPC material to be used under coping or capping.
 - c) Details of material to be used for supporting the DPC under the coping or capping.
 - d) Details of cavity tray to be used.
2. A full set of detailed drawings including section details and the dimensions of the parapet wall.
3. Manufacturer or Engineer should provide a site specific fixing specification for the coping or capping. This should detail type, size, spacing and method of fixing to the substrate. Details of corrosion protection should also be provided where applicable.
4. Details of any technical assessment (third party product conformity certificates) for any components used for the construction of the parapet wall.

The Warranty surveyor, at their discretion, may also request supporting information that demonstrates suitability for use of any materials or systems contained within the above.

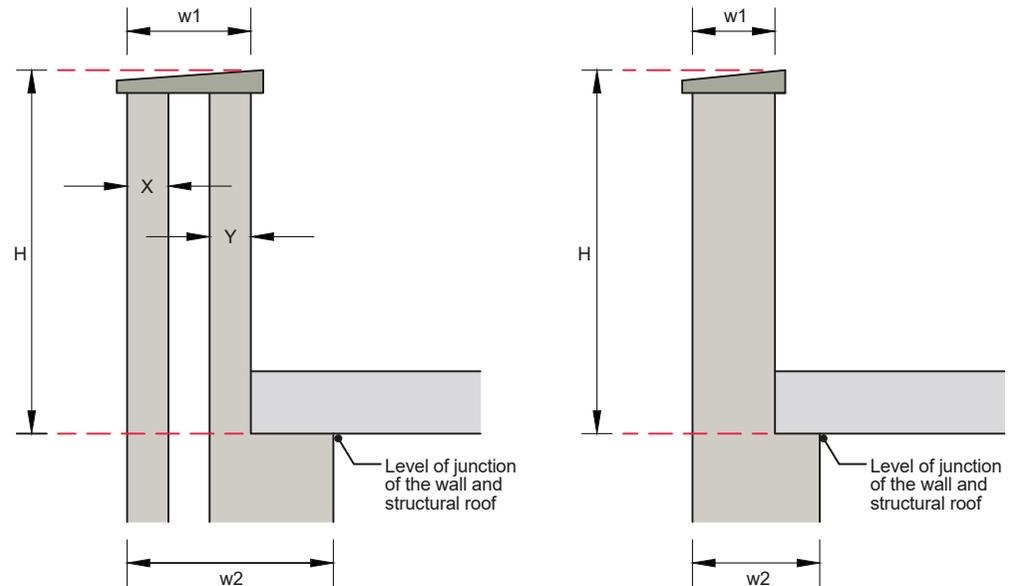
Typical details

The materials used in construction of the parapets details should be suitable for the location and exposure. In very severe exposure zones, it is recommended that parapet construction is avoided altogether.

Parapet wall detail



Maximum height of parapet walls (to be read in conjunction with the table below)



Wall type	Thickness (mm)	Parapet height to be no more than (mm)
Cavity wall	$x + y$ equal or less than 200	600
	$x + y$ greater than 200 equal or less than 250	860
Solid wall	$w1 = 150$	600
	$w1 = 190$	760
	$w1 = 215$	860

Note: $w1$ should be less than $w2$, as shown above

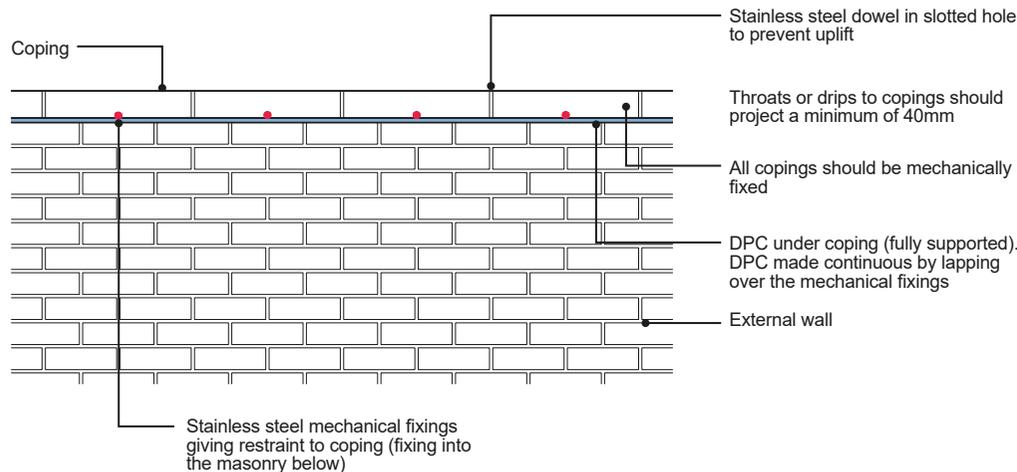
Copings

Copings can be defined as construction that protects the top of a wall, balustrade, or parapet and sheds rainwater clear of the surfaces beneath (BS 5642).

For Warranty purposes, the coping should:

- Be capable of shedding water – a minimum 2 degrees fall from horizontal is required at the top surface of a coping. A coping without a fall is not permitted.
- Have a robust and durable jointing procedure.
- Have stainless steel mechanical fixings that restrain and fix the coping to the structure below and neighbouring units. All specified fixings should be subject to an appropriate design.
- Incorporates weather tight detailing to junctions with other elements of structure e.g. coping terminations abutting perpendicular walls.
- Be frost resistant.
- Be bedded and pointed using an appropriate high durability mortar, subject to the supporting masonry type (see 'Appendix C – Materials, Products, and Building Systems'). The mortar specification will be dependent upon the type of masonry unit being installed.
- Have throats or drips which project beyond the finished faces by a minimum of 40mm distance to throw water clear. They should typically set back 10-15mm from the outer edge, and typically sized at 12mm wide x 8mm deep.
- Project a minimum of 50mm beyond the external wall.
- Transfer any construction or movement joint in the supporting structure below, through the masonry coping stone.
- Any horizontal DPC and cavity tray arrangement must be continuous at the movement joint. In addition, the coping manufacturer's requirements for the provision of movement of the coping itself (e.g. thermal expansion) must also be met.
- Masonry copings should not be used in conjunction with timber frame/SIP construction due to concerns over maintaining weather tightness and allowance for differential settlement in the timber frame.

Fixing of copings onto horizontal parapets



Pressed metal cappings

Cappings can be defined as construction that protects the top of a wall, but does not shed rainwater clear of the surfaces of the wall beneath.

For Warranty purposes, pressed metal cappings should:

- Be suitably durable for the exposure conditions on site and will achieve a minimum 25 year service life, inclusive of fixing elements e.g. screws, cleats, fixing bracketry.
- Bi-metallic corrosion must be considered between the fixing and any pressed metal system. Consideration must be given to any aggressive environment affecting the site e.g. coastal locations, industrial zones, etc.
- Aluminium capping systems must not be installed in contact with copper or its alloys, or the runoff from them – notably, attention should be given to the effect of any lightning conducting fittings attached to or in proximity to pressed metal copings.
- Aluminium capping should not be bedded into mortar or concrete.
- Be 'once weathered' and incorporate pre-formed drip provision within their profile. Flat copings are not acceptable for Warranty purposes. Typically, the coping will discharge water to the inside e.g. towards the balcony, terrace or flat roof.
- Incorporate robust and durable joints, completed in strict accordance with the system manufacturers' guidance. For the

purpose of Warranty provision, reliance on site applied sealants is not permitted.

- Manufacturers must confirm the life expectancy of the gasket achieves a minimum 25 year service life. Any maintenance of gaskets should be relayed within any 'Operations & Maintenance Manual' for the property, in order to ensure the required maintenance regime is met.
- Where the specified system relies on overlapping sections or joints that utilise an anti-capillary methodology e.g. drainage gaps at joints, the developer must prove and demonstrate through testing that sufficient weather tightness can be achieved.
- Be secured to the wall - the preferred method is the use of concealed bracketry, fixings and gaskets which avoids the need for penetrations through the capping. Where this approach is not adopted e.g. where fixings are taken through the top or side of the capping, all fixing techniques used must prove and demonstrate to the Warranty Surveyor that the risk of water penetration has been mitigated. For the purpose of Warranty provision, reliance on site applied sealants is not permitted and system specific manufacturer approved techniques must be used.
- The pull-out resistance of the fixings must be checked for wind uplift by an Engineer. Adhesive bonding of pressed metal copings alone is not considered acceptable for Warranty purposes.
- Be designed to accommodate movement e.g. thermal expansion and contraction – notably at external and internal corners. Typically, aluminium requires an allowance of approximately 1mm per linear meter for movement.
- Achieve a minimum overlap of 75mm at any lead soaker, lead upstand or secret gutter location. Consideration must be given to bi-metallic corrosion occurring between the pressed metal work, lead work and associated fixings.

Horizontal DPCs

The horizontal DPCs should:

- Be formed via a single length of DPC as far as practicable. Where joints and laps are unavoidable, horizontal DPC must have a minimum 150mm lap (300mm lap is preferable) with the laps at corners formed to the full width of the wall it protects.
- Sealed at overlaps in the material. Sealing of joints should be in accordance with the DPC manufacturers requirements. Typically the bonding materials used to create the seal may be solvent contact adhesive or butyl rubber tapes.
- The horizontal DPC must be fully supported across any cavity in the structure below, for the continuous length of parapet.
- Be of suitable material specification. Typically bedding mortar and masonry coping stones are reliant on the bonds achieved with the DPC. Incorrect selection can adversely affect structural performance of the parapet wall e.g. increased risk of lateral shifting of masonry coping stones in service. DPC materials attaining the correct bond performance should be specified and this should be checked against 3rd party accreditation as suitable in situations of minimal load. (For further guidance on DPC selection, refer to BS 8215).
- Have a width that creates an overhang to the wall below. It should cover the full width of the wall, extending and terminating to a position at least 5mm beyond each face of the parapet wall.
- Be laid on a full bed of mortar onto the head of the parapet wall and support board using the same mortar specification used to bed the masonry coping stones. The coping stones must be immediately laid above the DPC in fresh mortar in order to maximize the bond between the coping and the wall beneath.
- For pressed metal cappings, the horizontal DPC should be laid and secured in line with the guidance issued by the pressed metal coping system manufacturer.
- Any penetrations through the horizontal DPC e.g. from coping stone fixings, balustrades, balcony guarding, etc., must be fully sealed to prevent penetrating moisture, using working practices and suitably durable sealant material recognized by the manufacturer of the DPC system as acceptable and compatible.

Note: Manufactured DPC pre-formed cloaks are preferred where complex shapes are created by penetrations such as wind post penetrations, etc.

Cavity trays

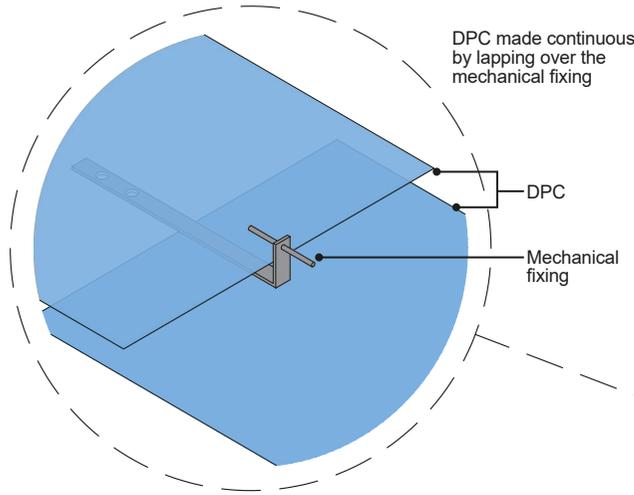
The cavity tray must:

- Be of suitable material specification. Materials attaining the correct bond performance should be specified and this should be checked against 3rd party accreditation as suitable in situations of minimal load.
- Be continuously supported - for Warranty purposes, the preferred method is to use proprietary self-supporting cavity tray systems to prevent potential water ingress through parapet walls due to poor installation of flexible cavity trays. Where proprietary self-supporting cavity trays are not used, evidence of how support is to be provided is required (this guidance applies to both masonry and framed construction).
- Be securely fixed to maintain their position, achieving a minimum 150mm rise, measured vertically within the residual cavity. Where cavity tray material passes through any masonry leaf, it must be sandwiched between even beds of wet mortar, receiving at least one further course of masonry units on mortar to achieve the required bond. When securing to framed construction e.g. timber frame, surface fixing must be done in strict accordance with manufacturers guidance and materials e.g. bonding materials, fixing strips.
- Fixing to insulation boards alone must be avoided and the cavity tray will require to lap with any breather membrane on the frame construction.
- Be formed with minimal joints, as far as practicable. Where joints and laps are unavoidable, laps should be formed and fully sealed in accordance with the manufacturers' guidance. For complex geometry e.g. internal and external corners, wind post obstructions, the use of pre-formed cloaks are recommended.
- Weep holes must be incorporated at a maximum 900mm centres.

Raking parapets

In addition to the other guidance in this section, the following should be considered for raking parapets:

- Joints in the DPC are not permitted on raking parapets. Where dual pitched roofs are encountered, an allowable overlap will occur at the transfer from one plane to another e.g. the ridge. This exception must have a minimum 150mm sealed overlap (300mm lap is preferable).
- Where the wall upstand above the roof line is relatively short e.g. 150-300mm, any lead flashings used to weatherproof the junction must dress underneath the DPC arrangement and be secured in place prior to the horizontal DPC installation. The lead flashing must sit on the horizontal portion of the wall by 25-30mm.
- As an alternative to a DPC material being used, a lead detail could be adopted. In such a cases installation must be in accordance with the Lead Sheet Training Academy (LSTA) guidance and the guidance within the 'Roofs' section with regards the execution of flashing details.
- Where pressed metal capping sections are being used, the DPC must:
 - Hold a valid 3rd Party Accreditation where horizontal DPCs do not form part of the installation. This documentation must prove and demonstrate weather tightness of the installed system to a point deemed acceptable to the Warranty provider.



The coping should project a minimum of 50mm beyond the external wall.

Throating or drips to copings should project a minimum of 40mm beyond the external wall.

Stainless steel mechanical fixings giving restraint to coping (fixing into masonry below)

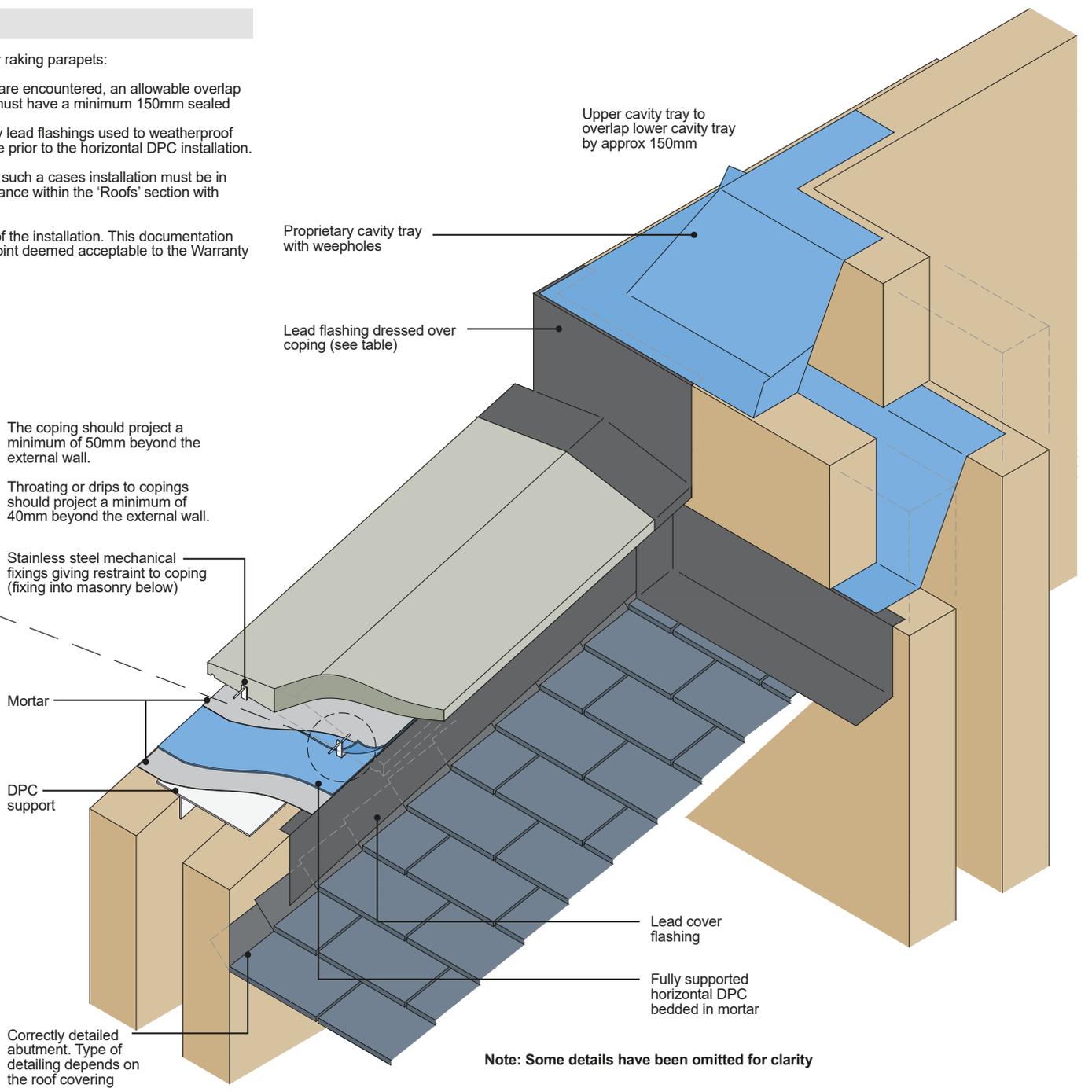
The amount of lead lapping on to the coping should be in accordance with the table shown below.

Minimum lap of the flashing with the coping/roof covering	
Pitch of rood (degrees)	Cover of lead flashing on coping/roof (mm)
30	150
20	220
15	290

Note:

- For pitches over 30°, a min lap of 150mm should be provided.
- In areas of severe/very severe exposure the vertical upstand should increase to 100mm

Correctly detailed abutment. Type of detailing depends on the roof covering



Capping detail for up to 1100mm from roof

Max height of parapet from roof surface to capping is limited to 1100mm. Stud and masonry must be designed to be structurally stable to resist horizontal forces.

Lightweight proprietary capping. Stone copings on timber frames are not recommended.

The vertical down stand of the capping should extend past the brickwork.

Timber cavity closer

Water boiled plywood plate

Allowance for movement. The gap size will be dependent on the anticipated differential movement between the timber frame and the masonry. The void should be filled with compressible material

Min 40mm overhang required

Drained and vented cavity to be provided, cavity width is dependent on the cladding type

Breather membrane

Wall tie

Angle fillet recommended

Open perp vents

Cavity tray

Cavity barrier - Cavity barriers should be mechanically fixed to rigid construction (for both vertical and horizontal positions).

Capping to be mechanically fixed into timber frame. It is important to ensure the coping system is installed as per manufacturers specification including all ancillary components e.g. gaskets. The mechanical fixings where penetrating the DPC should either be shot fired (instant seal - as timber frame sole plates) or carefully sealed to avoid moisture penetration to the structure below. The DPC should be made continuous by lapping over fixings. The pitch of the capping must be a minimum of 5°

DPC must be continuous for the length of the parapet and joints suitably lapped

Full width damp proof courses should be provided and be fully supported to avoid drooping and gaps forming at joints

Vertical batten

Breather membrane

Impervious cladding (not render)

Breather membrane is to lap the waterproof membrane by a minimum 75mm

Minimum air/drainage gap of 15mm at this location

Insect mesh

Waterproof membrane. Minimum membrane upstand of 150mm

max 200mm

Capping detail for up to 300mm from roof

Lightweight proprietary capping. Stone copings on timber frames are not permitted.

The vertical down stand of the capping should extend past the brickwork.

Roof covering to extend over parapet

Timber cavity closer

Water boiled plywood plate

Allowance for movement. The gap size will be dependent on the anticipated differential movement between the timber frame and the masonry. The void should be filled with compressible material

Min 40mm overhang required

Breather membrane

Wall tie

Open perp vents

Cavity tray

Cavity barrier - Cavity barriers should be mechanically fixed to rigid construction (for both vertical and horizontal positions).

Capping to be mechanically fixed into timber frame. It is important to ensure system is installed as per manufacturers specification including all ancillary components e.g. gaskets. The mechanical fixings where penetrating the DPC should either be shot fired (instant seal - as timber frame sole plates) or carefully sealed to avoid moisture penetration to the structure below. The DPC should be made continuous by lapping over fixings. The pitch of the capping must be a minimum of 5°

DPC must be a minimum of 150mm above the roof finish

Full width damp proof courses should be provided and be fully supported to avoid drooping and gaps forming at joints

Waterproof membrane. Minimum membrane upstand of 150mm

max 300mm

Angle fillet recommended

VCL

Parapets

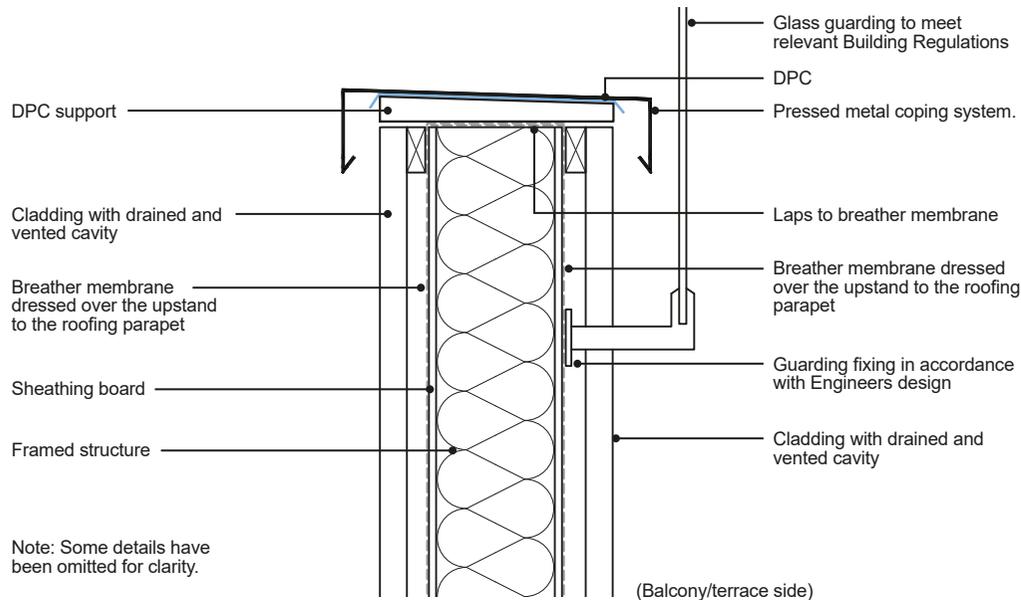
- The parapet should be designed to accommodate differential movement, remain structurally stable, and allow suitable structural support of the lightweight coping.
- The coping should be mechanically fixed to the timber frame and the fixings should be suitable for the exposure and anticipated wind loadings.
- If the capping is secret fixed, each capping piece should be provided with at least 2 security fixings.

General guidance

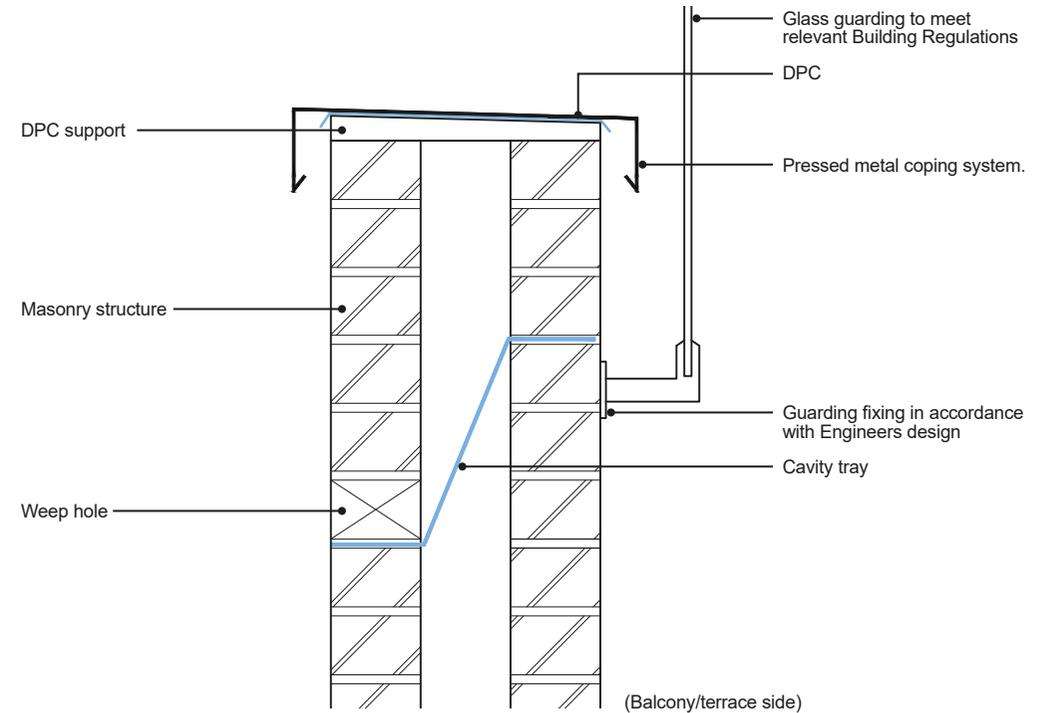
Where terrace guarding or balustrade systems are specified, the following should be taken into account:

- Any guarding should ideally be mounted to the sides of the parapets, either internally or externally via face fixings into the parapet wall and not through the coping. This should be the preferred method as it prevents creating weak spots for water ingress.
- The copings weathered upper surface, projection and drainage function must be uninterrupted and unhindered by guarding provisions e.g. glazing channels which are recessed into and divide coping provisions should be avoided.
- Where this cannot be avoided, and any guarding over a coping arrangement is in continuous contact, the free drainage of the coping should not be impeded. In such instances, coping arrangements must incorporate a fall away from the obstruction to any outside edge.
- Where the guarding incorporates proprietary glazing and framing profiles, drainage provisions from glazing channels must be provided and kept free from obstruction. Particular attention should be paid to sealant pointing used where such profiles are in continuous contact with the upper surface of a coping system, as this area can often restrict drainage when incorrectly executed.
- Where the guarding, over a coping arrangement, is in continuous contact with the coping fixings which penetrate the coping arrangement, the fixings must only pass through a self-sealing butyl tape. Reliance on silicone is not acceptable.
- Guarding incorporating elements of glazing may need to be heat soak tested to BS EN 14179-1.

Framed structure



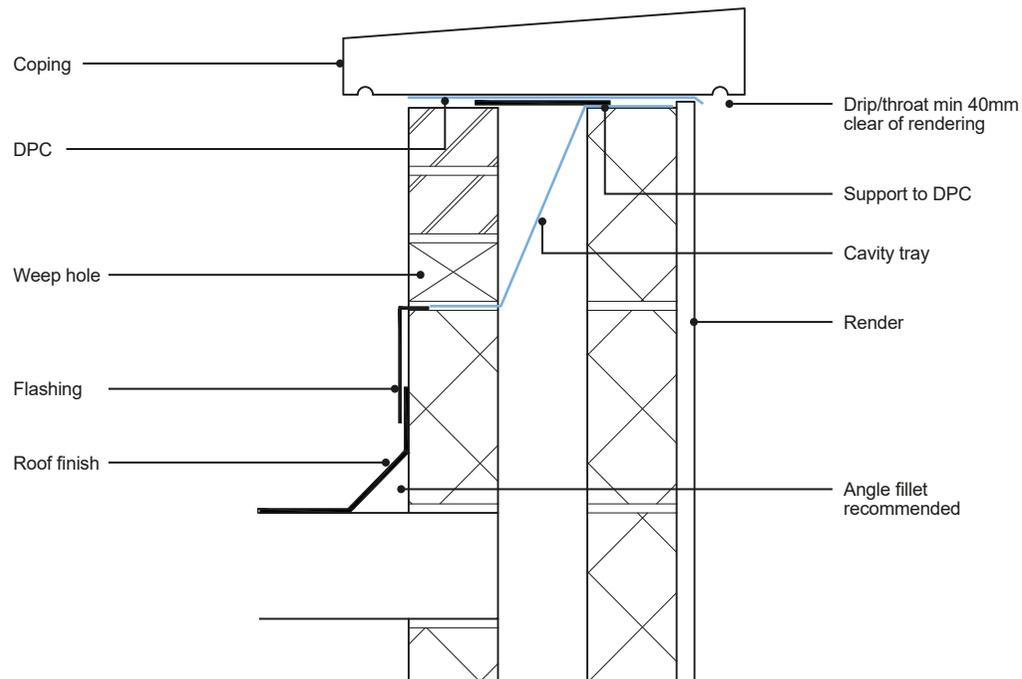
Masonry structure



General guidance

A specialist render system and mortar should be employed for parapets with this masonry background type. It is recommended that:

- The backs and exposed horizontal surfaces of parapets are not rendered using a standard render system. Use a specialist render system designed to combat movement and provide robust weatherproofing.
- Throats or drips to copings of parapets and chimneys should project beyond the finished faces by a minimum of 40mm distance to throw water clear.

Parapet wall detail (render clad)

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