LABC warranty

TECHNICAL MANUAL

VERSION 10

6: EXTERNAL WALLS

6.

External Walls

Contents

Workmanship

1. Certification / Testing is required for any specialist works and/or systems completed by an approved installer.
2. A suitable quality assurance process is to be provided to evidence the fire stopping and cavity barriers installed within the external walls to meet the Building Regulations for buildings with a floor 4.5m above the lowest external ground level.

Materials

1. Steel frames and lintels should be appropriately treated to prevent corrosion.

Design

1. The materials design and construction of external walls, must meet the requirements of Building Regulations.
2. Framed structures must be supported by structural calculations completed by a suitably qualified engineer. The design and construction must meet the Building Regulations.

6.

External Walls

6.1
Traditional Masonry Cavity Wall

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 a Chartered Structural 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 is not suitable for very severe exposure zones.

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

		Minimum insulation thickness (mm)		
Exposure category	**Suitable wall construction**	**Built-in insulation**	**Retro-fill (other than UF 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	N/A
	Any wall fully rendered (2)	75	75	N/A
	Fair-faced masonry (1)	N/A	N/A	N/A
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	N/A
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 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’ estrine areas where they are within 5km of the general shoreline.

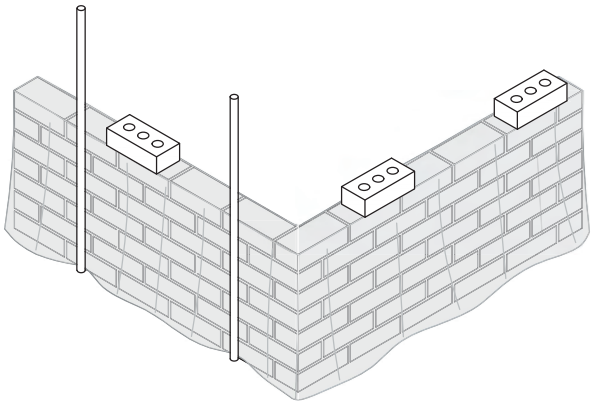
Further information on Warranty requirements within a coastal location can be found in ‘Appendix B - Coastal Locations’.

Masonry walls

Protection
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.

Protection of 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. Further guidance can be found in ‘Appendix C - Material, Products, and Building Systems’.

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

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-resistant bricks should be used in areas that are prone to prolonged periods of frost.

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.

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, mortar should be mixed by machine, or use ready mixed retarded mortars.

Mixing
Mortar should be carefully and consistently proportioned and then thoroughly mixed using a mechanical mixer, except for very small quantities.

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)

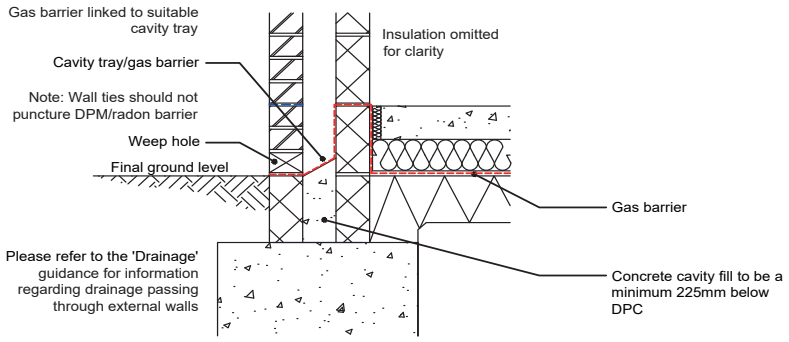
1. DPCs should be of a flexible material, be suitable for the intended use, the DPC should have appropriate 3rd party certification. The installation specification of DPC's should follow good design practice in accordance with BS 8215.
2. Blue bricks or slate will not be accepted as a DPC.
3. DPC's should 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.

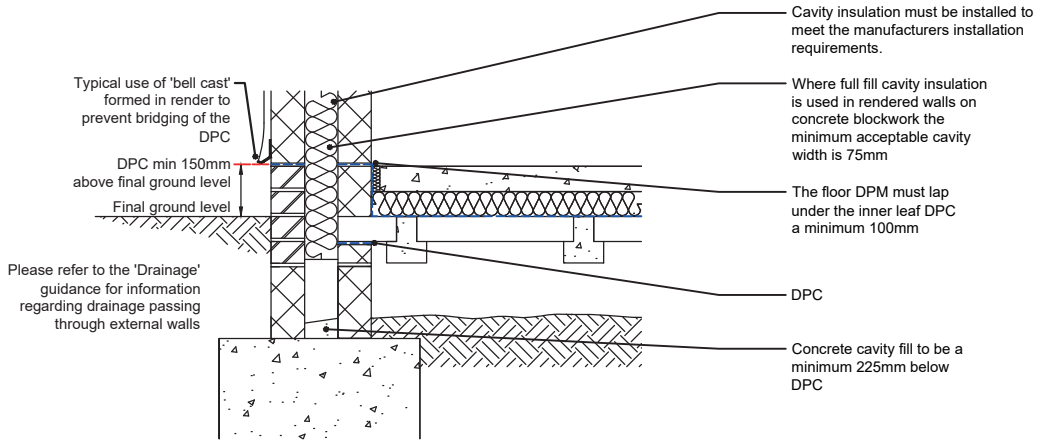
Note: For further guidance on the application of render please see the 'External Walls - Render' section.

Typical gas barrier arrangement: Traditional ground bearing slab

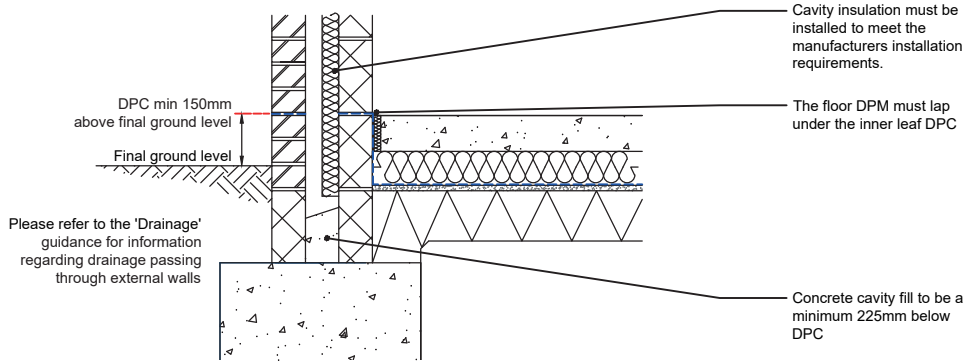


Full fill cavity wall: Beam and block floor

Example shown with a rendered wall



Partial fill cavity wall: 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 snots 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.

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.

Internal skin (blockwork)

- The blockwork should be capable of supporting the proposed loads and achieve the required thermal performance.
- The blockwork should have appropriate compressive strength in accordance with the Building Regulations.
- The blockwork 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.

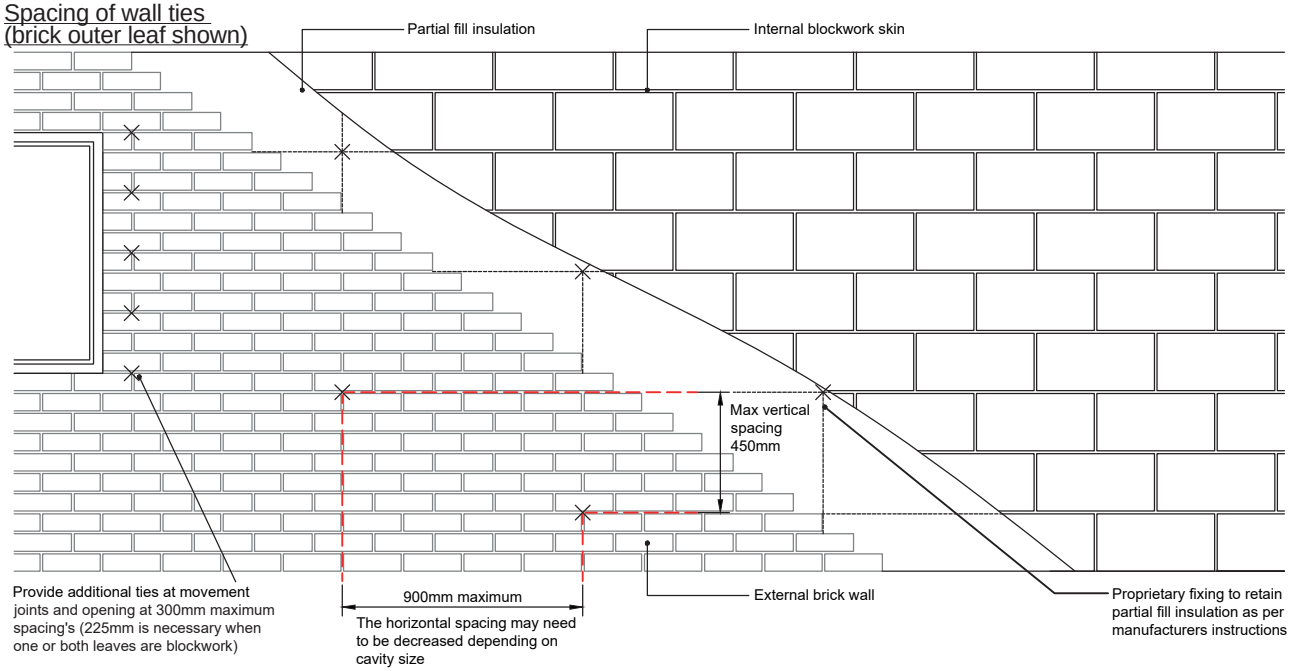
Ensure that all joints are finished flush with the surface to avoid shade variations.

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.

Spacing of wall ties (brick outer leaf shown)

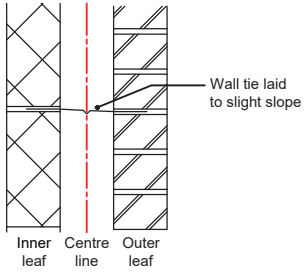


Wall ties

Wall ties should meet the following provisions:

- Wall ties should be to BS EN 845-1 or have appropriate third party certification.
- 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 in a diamond pattern.
- Wall ties should be installed at a minimum density in accordance with BS EN 1996 -1-1: 2015 NA. This should not be less than 2.5 ties per m2 and may increase with cavity width.

Wall tie provision



Thermal insulation

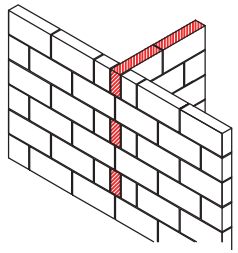
Thermal insulation for cavity walls should be inserted to a high standard of workmanship to avoid poor insulation performance and to prevent dampness migrating to the inside of the building:

- 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.

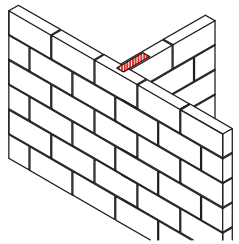
Bonding internal walls to external cavity walls

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 inner leaf



Block bonding internal walls to inner leaf using ties

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.

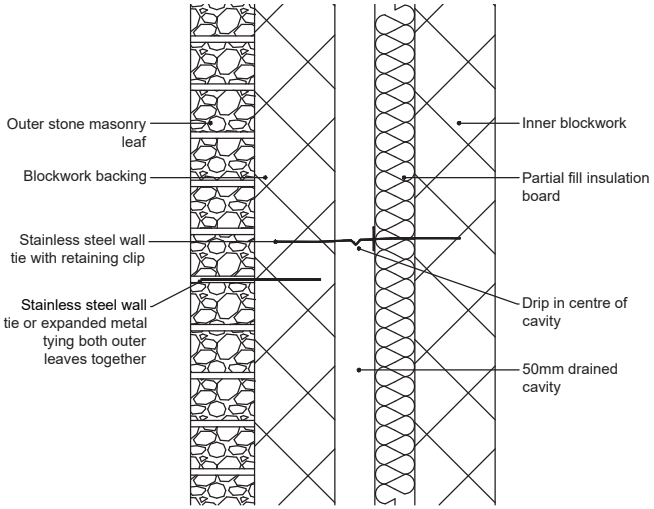
It is not recommended to use a soft, porous-type stone in a severe exposure zone. Consideration should be given to the compatibility of different stone to prevent staining and premature decay. Limestone and sandstone should not be mixed together.

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 90mm 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.

Masonry cavity wall with stone outer leaf



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

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.

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 the previous guidance for cavity trays, 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.

Wall ties

Wall ties should meet the provisions detailed in this section, including the following:

- Stainless steel wall ties should always be used.
- 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.

Suitability and spacing of wall ties

Wall tie spacing

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	750mm	450mm (increased to 300mm at reveals and movement joints)
Greater than 150mm	Wall tie specification and design to be provided by a Chartered Structural Engineer, or in accordance with appropriate third-party certification. Design will be determined by location and site-specific conditions.		

Proprietary ties are to have appropriate third-party certification.

Proprietary insulation retaining clips compatible with the tie should be used where the cavity is partially filled.

Allowing for movement

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 at a maximum of 300mm centres should be provided on each side of movement joints.

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.

The use of bed joint reinforcement may allow the distance between expansion joints to be increased, however this should be designed by a Structural Engineer.

Spacing of expansion 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.

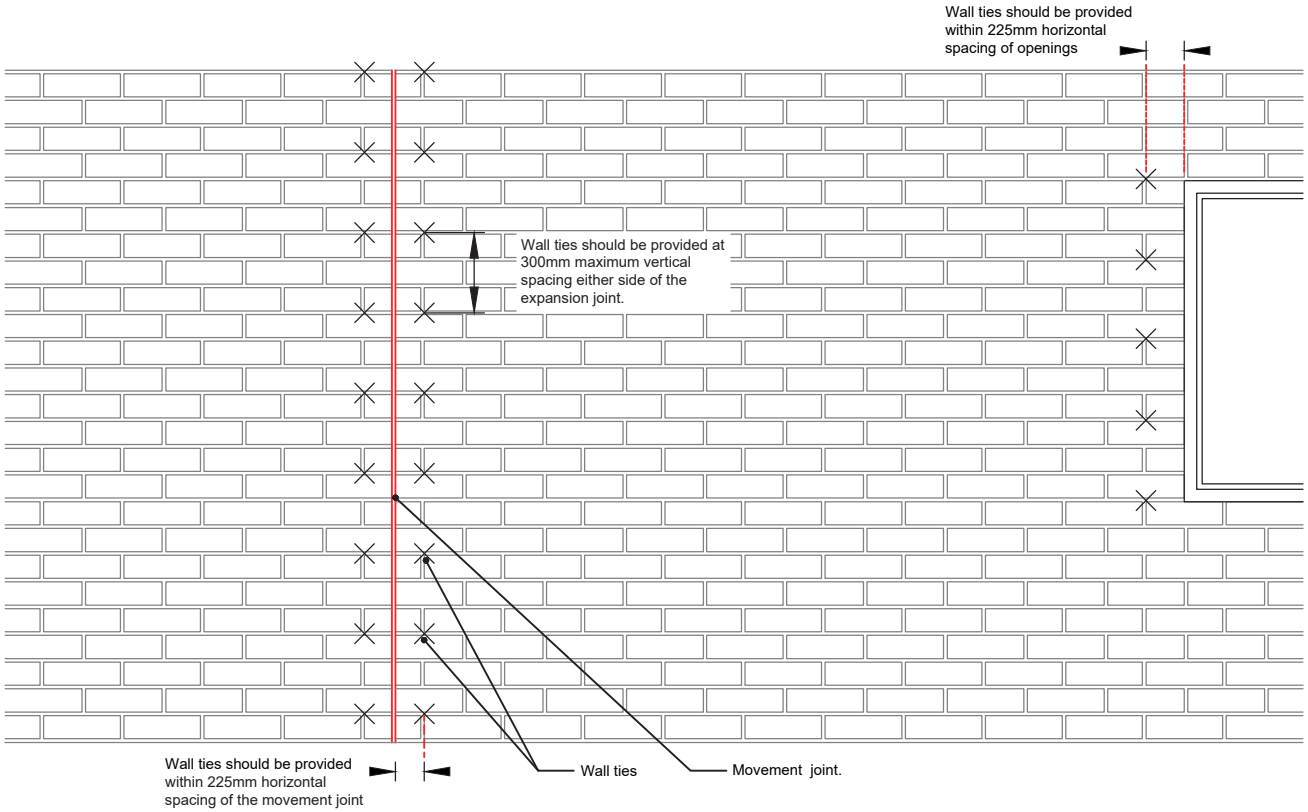
The first joint from a return should be not more than half the dimension indicated in the table. Movement joints are not acceptable in solid party or separating walls; however, where cavity wall construction is adopted, offset movement joints with a solid rubber compressible strip may be acceptable.

(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.

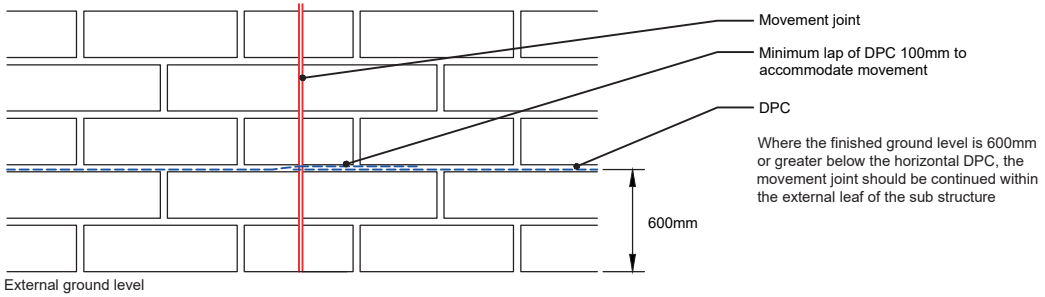
Movement joints

- Vertical movement joints should be provided in accordance with this Technical Manual and the manufacturers guidance.
- 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.
- Compressible filler, such as polyurethane foam, should be used to form the joint.
- Fibre board or cork board are not suitable materials for forming movement joints.
- The joint should be sealed to prevent water penetration.
- It is not normally necessary to provide movement joints to internal leaf of cavity walls, but should be considered where rooms occur with unbroken lengths of wall in excess of 6m.
- The movement joint should continue through the render finish.

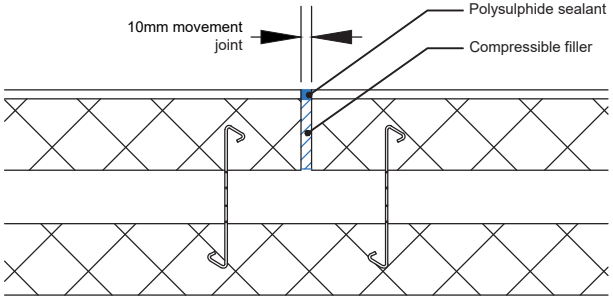
Wall ties in proximity to movement joints and windows (shown with brickwork)



Movement joints below DPC



Typical movement joint detail



Stainless Steel Vertical Twist Ties (or similar) at 225mm centres vertically and within 225mm horizontally.

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 foundations and wall structure 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 a Chartered Structural Engineer should be provided and approved by the Warranty Surveyor prior to work commencing on-site.

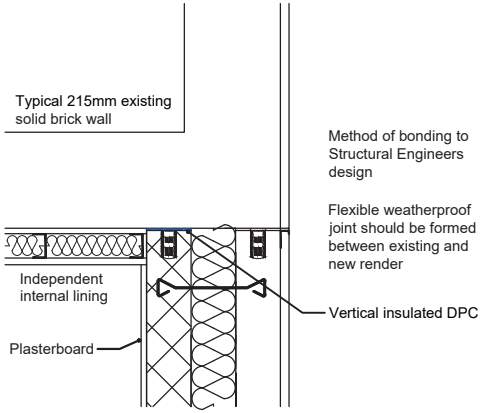
The existing wall should also be appraised to determine whether it is structurally stable and suitable to support additional loadings.

New wall junctions

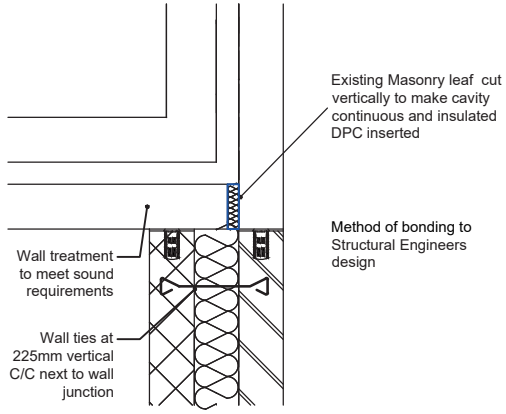
The junction of the new walls to the existing walls must ensure that dampness cannot track back into the new building or the existing building.

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



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 DPCs 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

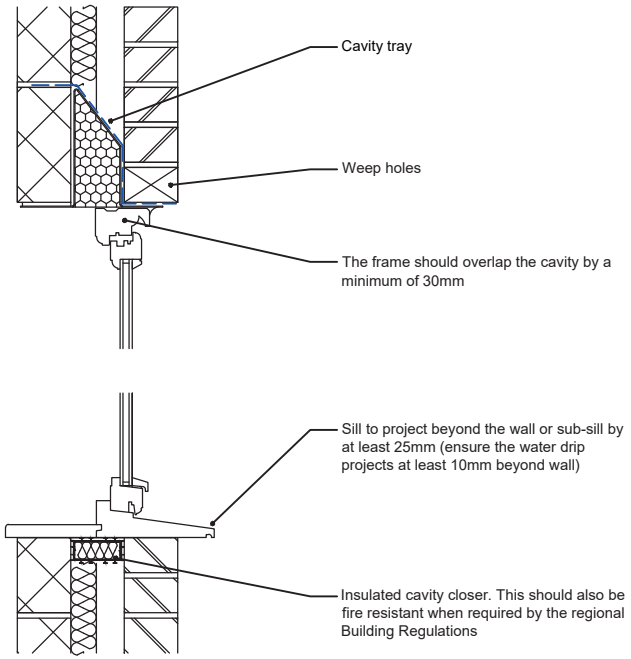
At the junction of the existing and new structures, detailing should allow for differential movement without cracking. Any settlement should be limited to 2mm-3mm, which would not normally adversely affect the roof covering.

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.

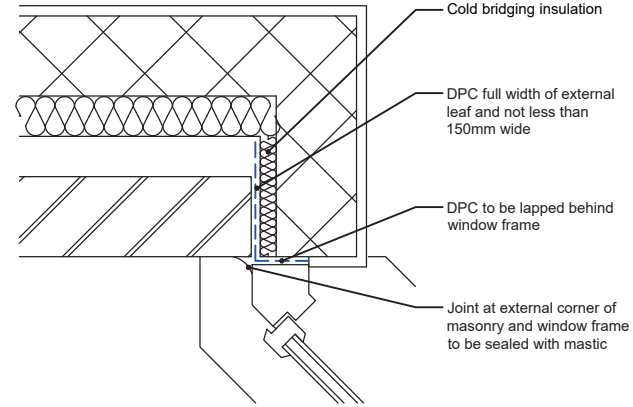
Window and door installations

Please refer to the 'Windows and Doors' section for installation requirements of frames including maximum gaps and fixings.

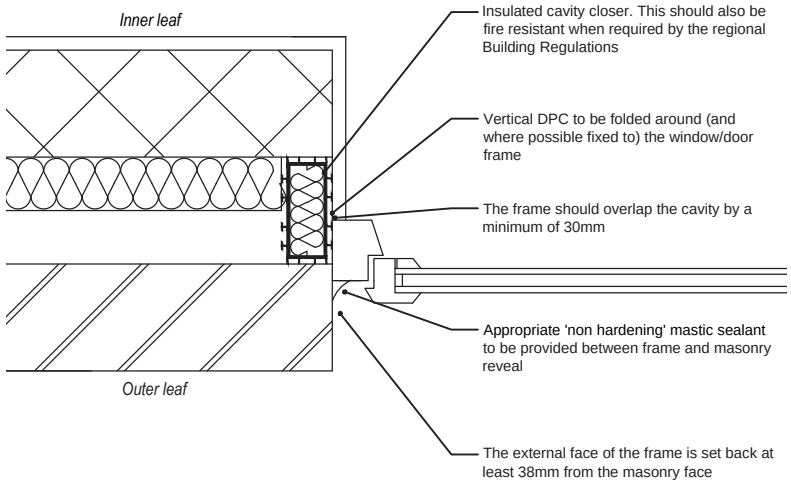
Typical vertical section through window opening



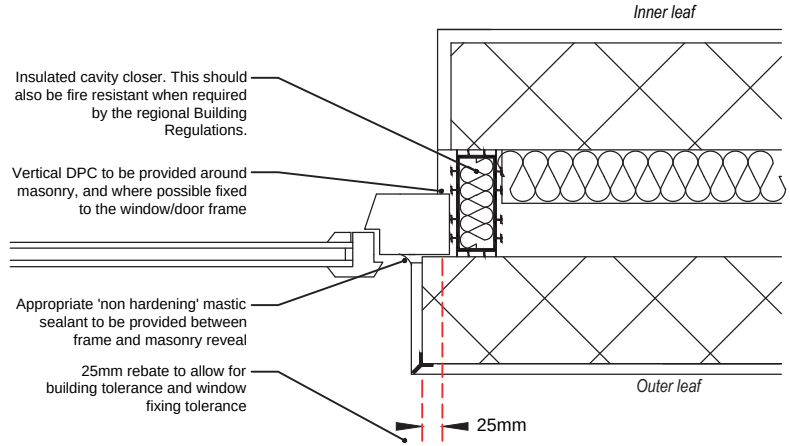
Bay window detail



Typical window reveal detail (normal exposure)



Typical rebated window frame detail for areas of very severe exposure



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

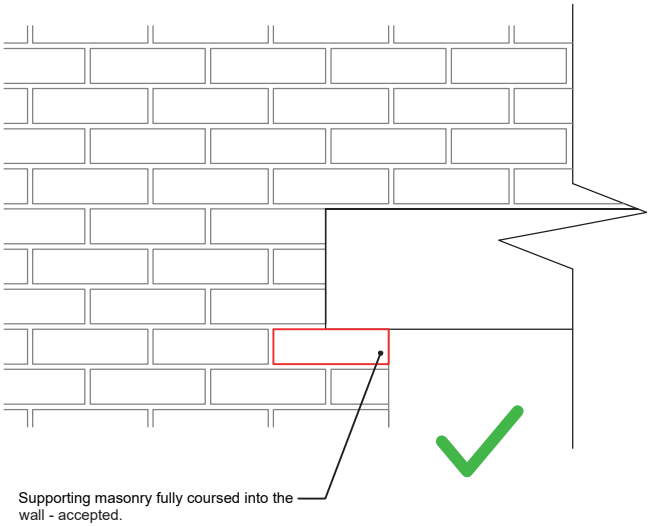
- To allow for opening lights to open clear of the masonry/render, and
- Where rendered, the render will need to extend beyond the 25mm of masonry.

Windows and doors

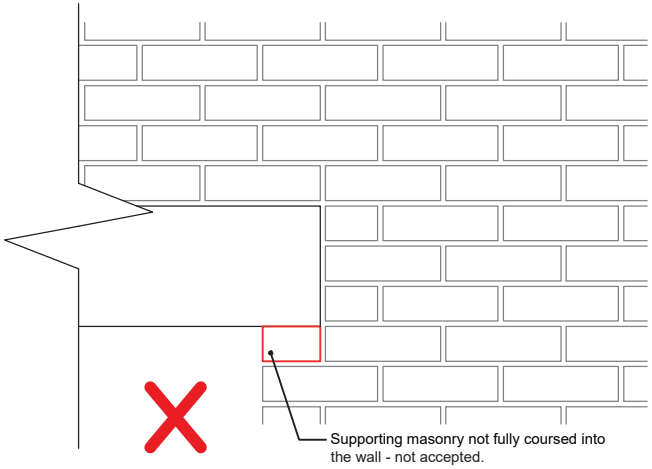
In areas of very severe exposure, checked rebates should be provided. The frame should be set back behind the outer leaf and should overlap.

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.

Correct method of brick bond around lintels



Incorrect method of brick bond around lintels



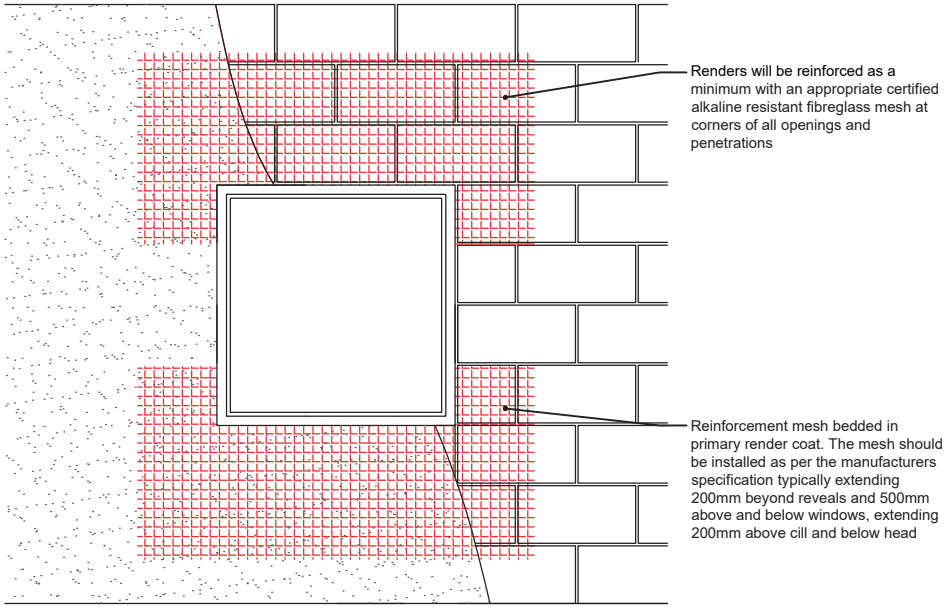
Lintels

- 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).

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.

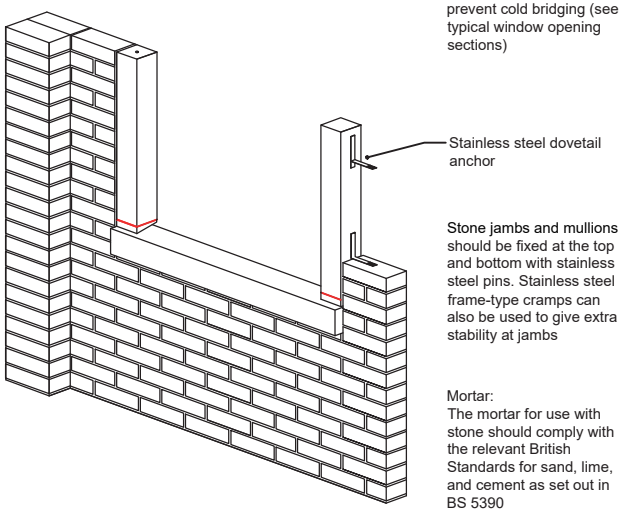
Typical mesh reinforcement around openings



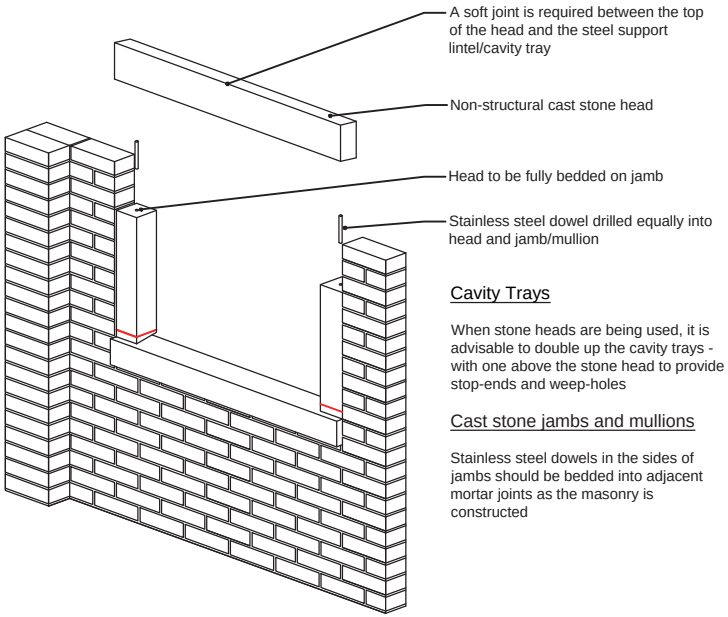
Rendering adjacent to openings·

- 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 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.

Stone jamb mullion fixing to walls



Joining stone jambs to sills and head



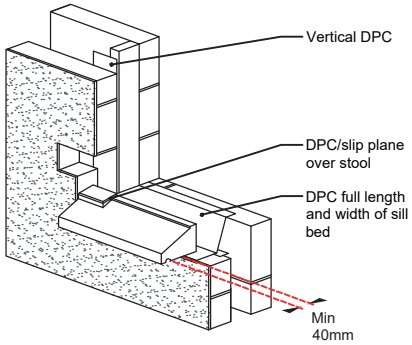
Cavity Trays

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

Cast stone jambs and mullions

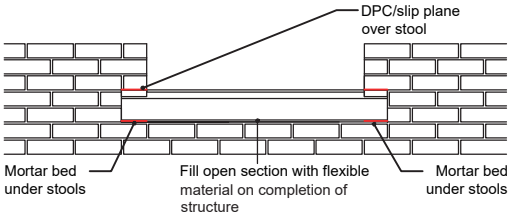
Stainless steel dowels in the sides of jambs should be bedded into adjacent mortar joints as the masonry is constructed

Stone sill with insulated cavity closer



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

Stone sill



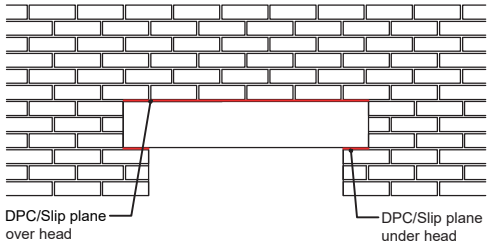
Sills

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 head



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. Rendering around window/door openings to be reinforced with mesh.

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

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 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

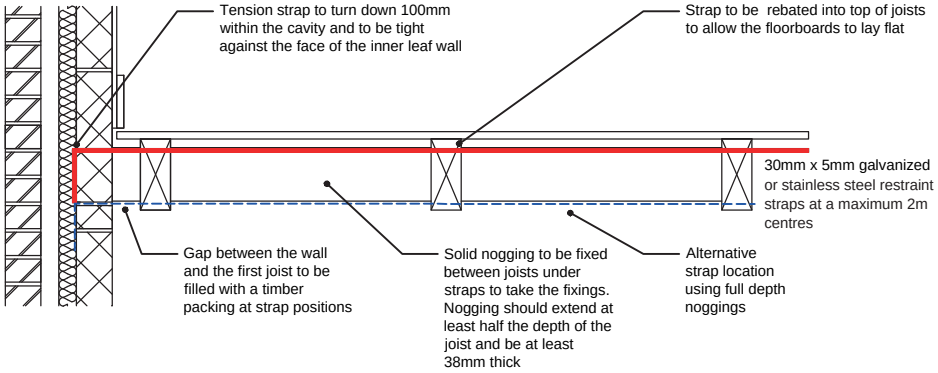
Restraint of walls

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

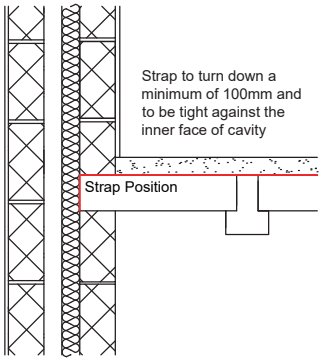
Restraint can be provided by:

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

Lateral restraint of walls (timber floors)



Lateral restraint of walls (beam and block floors)



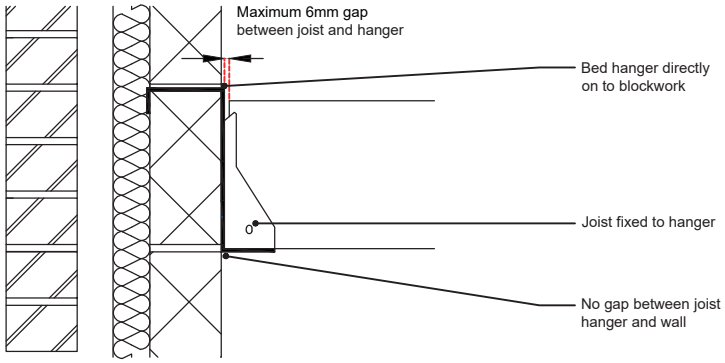
Lateral restraint straps

Floors, including timber, block and beam, 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.

Typical restraint type joist hanger



Restraint type hangers

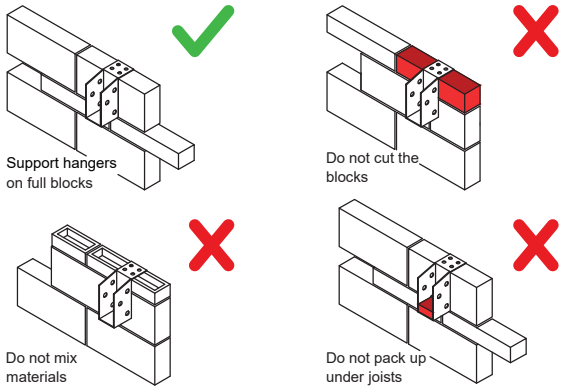
It is necessary to ensure that:

- 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.

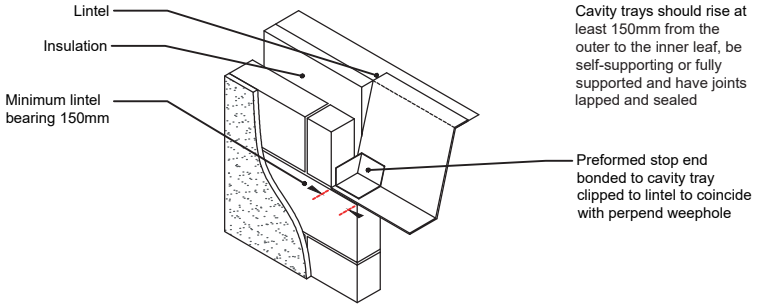
Do not:

- 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.

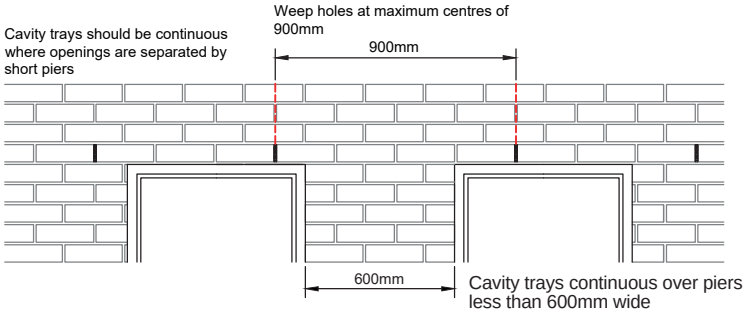
Correct use of hangers



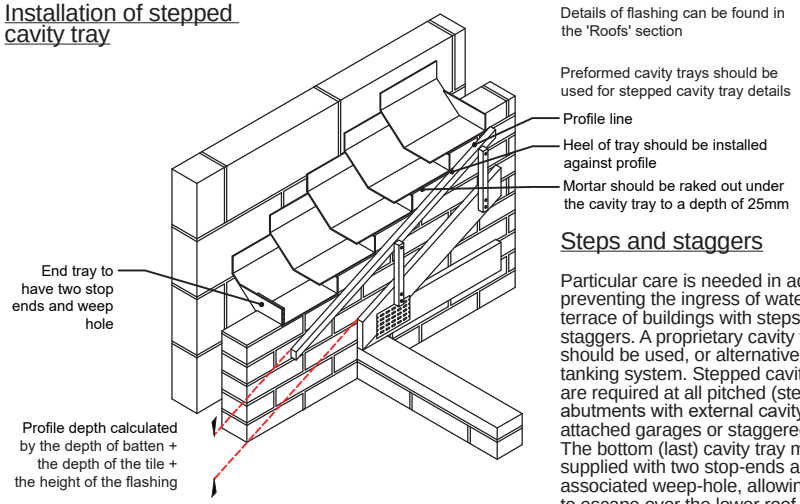
Stop end to cavity tray



Continuous cavity tray over two openings and a small pier



Installation of stepped cavity tray



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 flashings should be linked into the cavity tray (lapped in below).

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 are to be provided:

- Cavity trays are to be provided to comply with relevant regional Building Regulations.
- At all interruptions likely to direct rain water across the cavity, such as rectangular ducts, lintels and recessed meter boxes.
- Above cavity insulation that is not taken to the top of the wall, unless that area of wall is protected by impervious cladding.
- 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.
- Continuously above lintels where openings are separated by short piers.
- Above openings where the lintel supports a brick soldier course.

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.
- Weepholes 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 (including ground level).

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 perpend to the end of the cavity tray. Stop-ends can be formed by sufficiently turning up the end of a DPC tray into the perpend joint. Surplus mortar should be removed from cavities and wall ties cleared of mortar droppings and debris as the work proceeds.

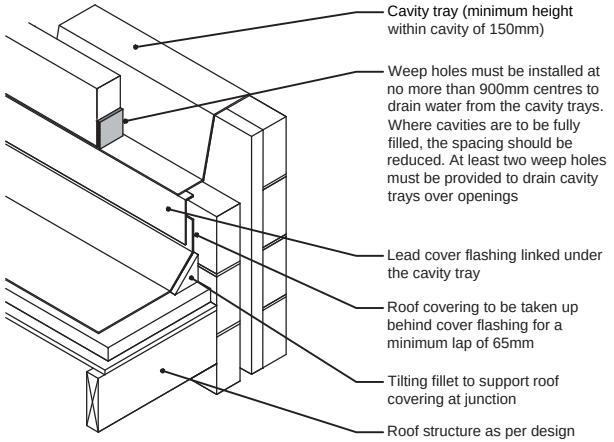
Other perforations of the building envelope

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.

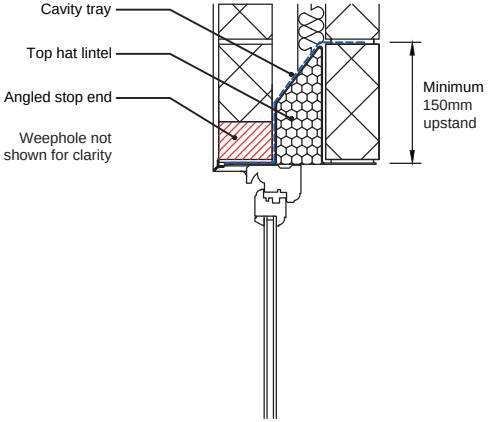
Proprietary cavity wall systems

At stepped and lower storey abutments and around corners in low rise cavity masonry walls a proprietary cavity tray system should be used.

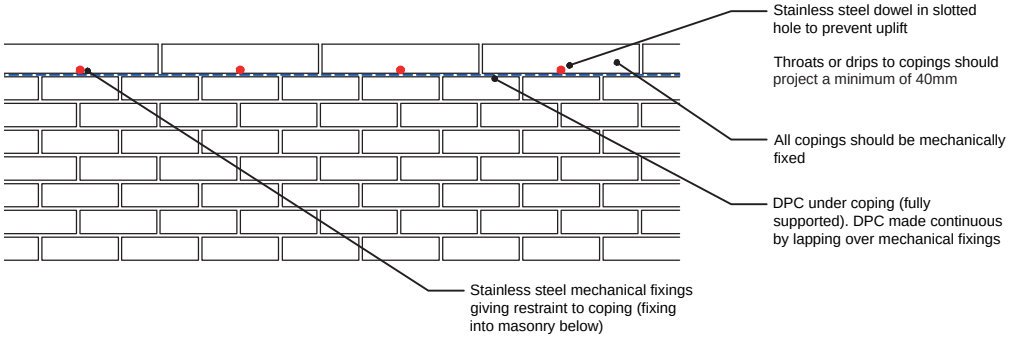
Flat roof abutment cavity tray construction



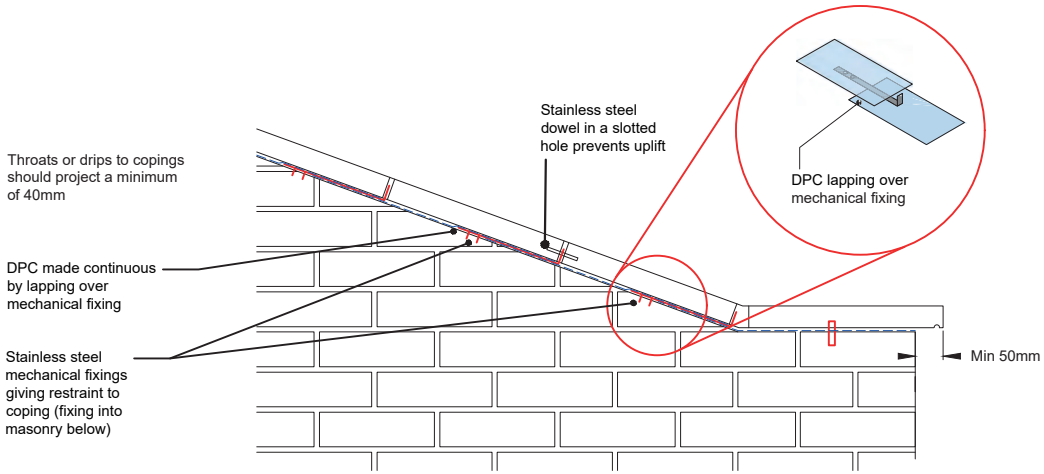
Stop end in relation to cavity tray and lintel



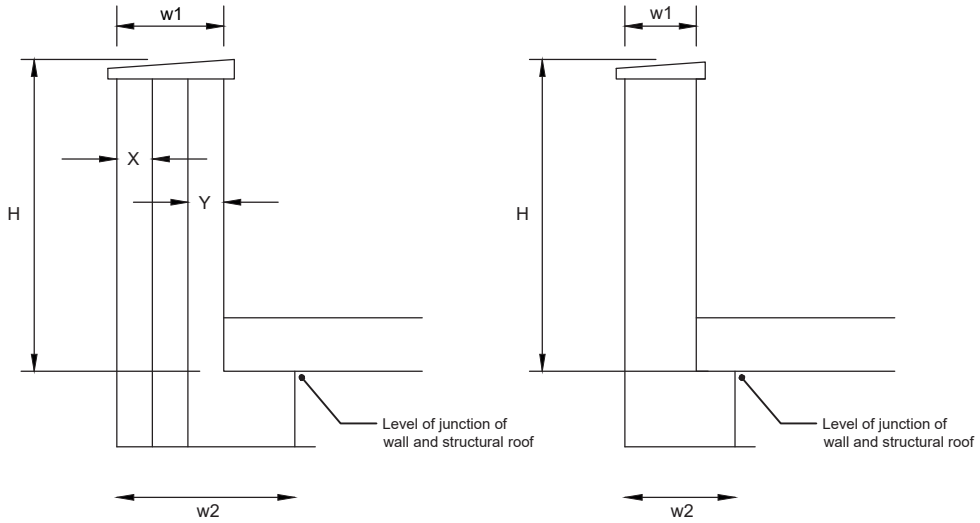
Fixing of copings onto horizontal parapets



Fixing of copings to sloping parapets



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 x + y greater than 200 equal or less than 250	600 860
Solid wall	w1 = 150 w1 = 190 w1 = 215	600 760 860
Note: w1 should be less than w2 - as shown above		

Parapets

- The materials used in construction of the parapets details should be suitable for the location and exposure.
- Where possible, the use of raking parapets should be avoided due to need for high standards of detailing and workmanship required to prevent the ingress of moisture.
- In very severe exposure zones, it is recommended that parapet construction is avoided altogether.
- 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.

Render in highly exposed areas of construction

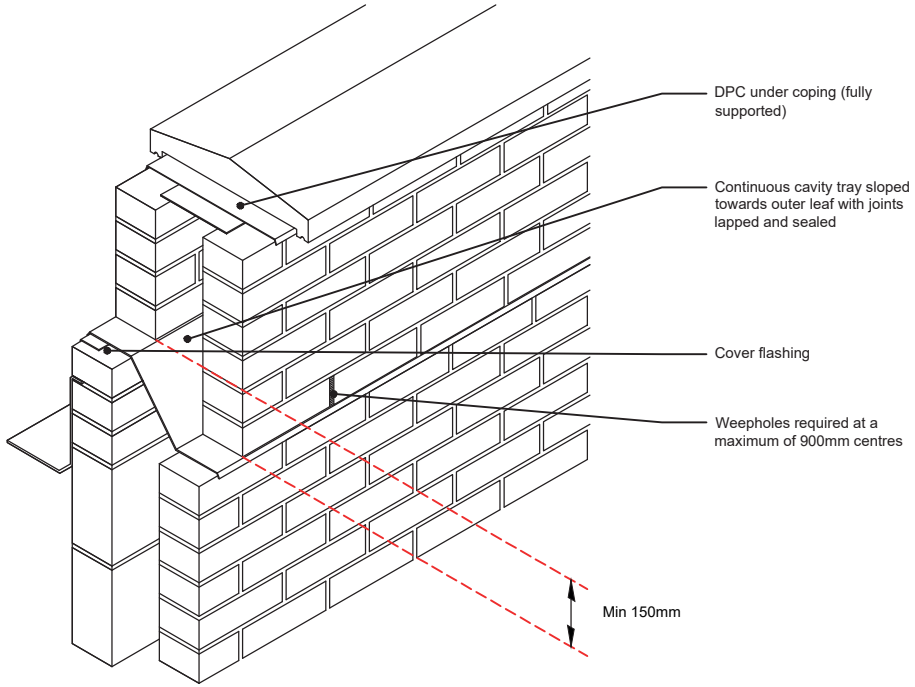
A specialist render system and mortar should be employed for parapets, chimneys, retaining walls and walls below DPC level with this masonry background type.

It is recommended that:

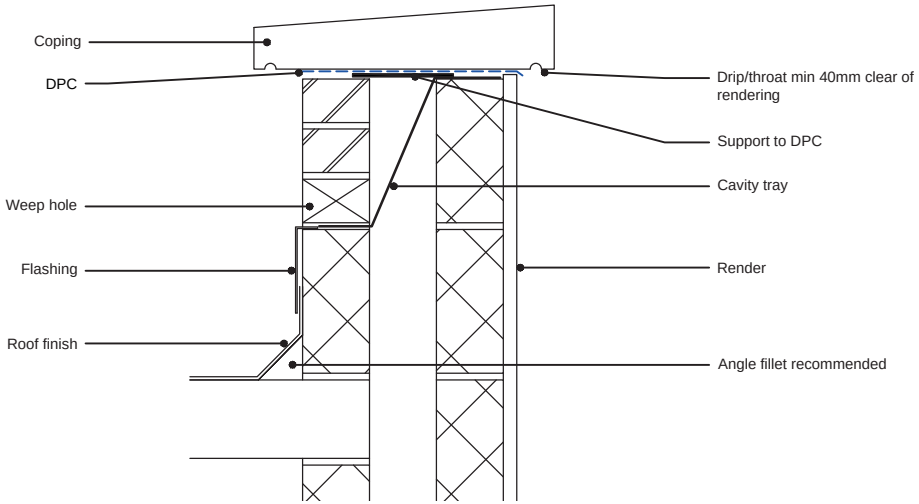
- The backs and exposed horizontal surfaces of parapets are not rendered using a standard render system. Use a specialist render system designed to combat movement and provide robust weatherproofing.
- Throats or drips to copings of parapets and chimneys should project beyond the finished faces by a minimum of 40mm distance to throw water clear.
- Rendering to chimneys should only be carried out where the masonry contains little or no sulphates. An appropriate specialist sealer/bonding key coat should be applied prior to applying the main coat of render. A proprietary alkaline resistant mesh should be embedded throughout the render, the key coat should provide a sound substrate and be compatible with the subsequent render system.

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

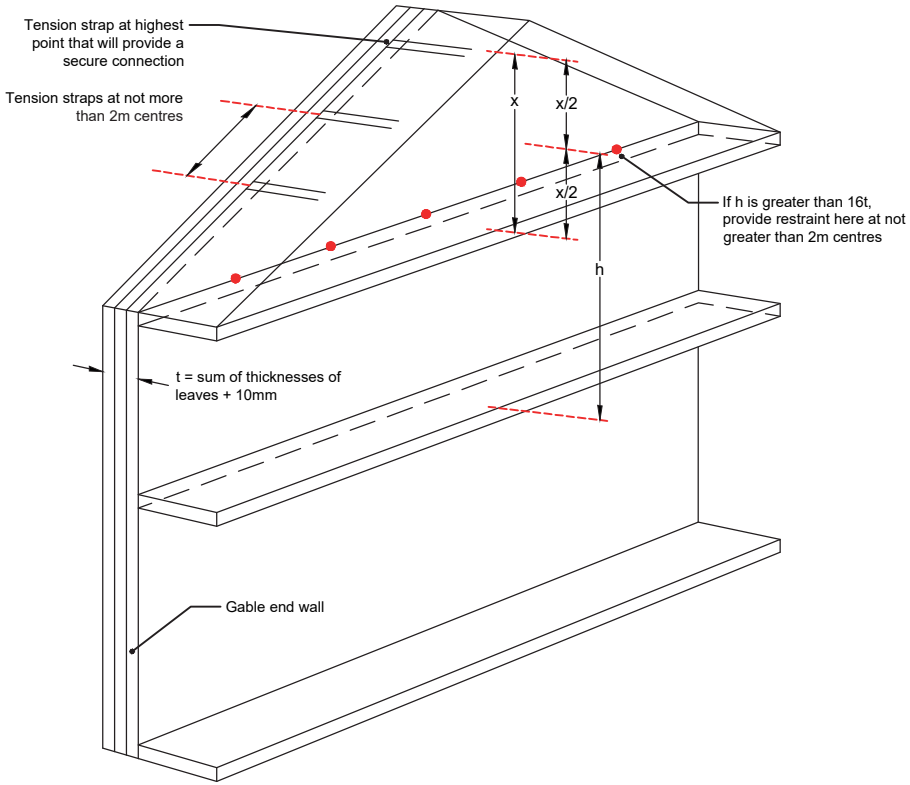
Parapet wall detail



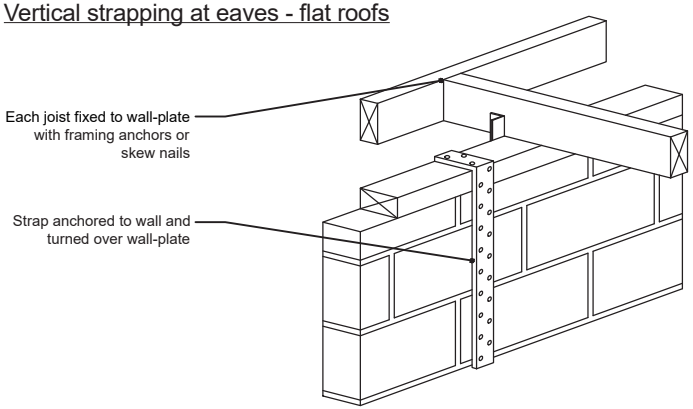
Parapet wall detail (render clad)



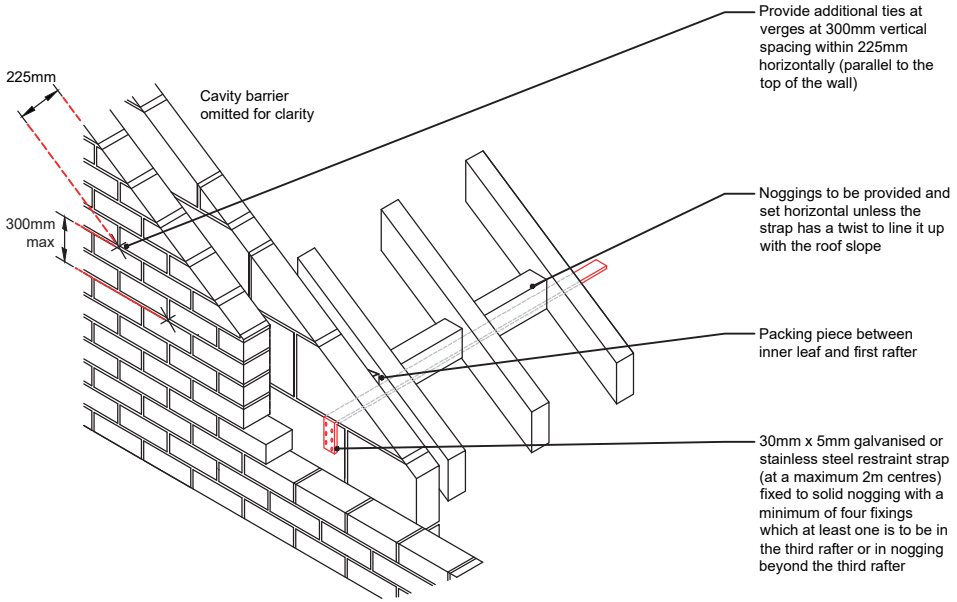
Tension strap location



Vertical strapping at eaves - flat roofs

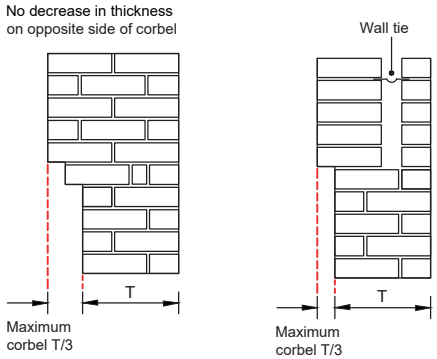


Rafter/gable wall detail



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 a Charted Structural Engineer.



Restraint of Walls

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

Restraints can be provided by:

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

Insulation

Insulation should extend to the full height of the gable wall.

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.

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.

6.

External Walls

6.2
Timber Frame

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 registered 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 shall be designed in accordance with Eurocode 5.

Quality assurance

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

- BM TRADA QMark for timber frame.
- Gold or Silver member of the Structural Timber Association.
- ISO 9001 to cover the manufacture of the timber frame panels.
- CE Marking when EN 14732 is published.
- 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 1995-1-1:2004+A1:2008), 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.

The use of oak in the external wall construction

Green oak, air dried (seasoned)/kin dried oak is not acceptable in the external wall construction, frame, window/door construction, internal wall or roof constructions, regardless of whether it forms part of the weather proof envelope or not. Projects incorporating such oak will not be acceptable for Warranty cover except where described in 'Appendix C - Materials, Products, and Building Systems' of this Manual.

SIP panel 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 see 'Appendix C' for further guidance.

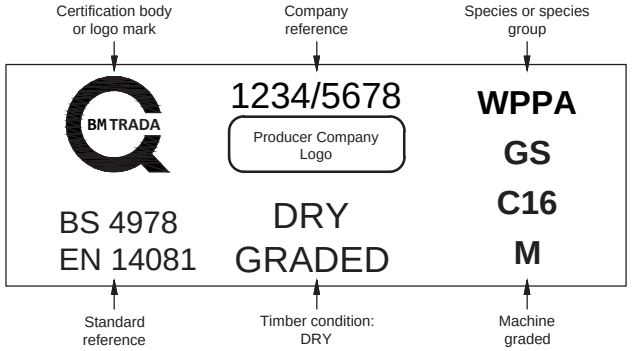
Timber specifications

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



Treatment of structural timber

All load-bearing timber components shall be either naturally durable or 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.

Panel 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

Based on the tolerances given in the draft prEN 14732 (dated 17/12/2013) wall panels shall be manufactured to the following tolerances:

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

Studs

Wall panels should be designed to minimise thermal bridging. Gaps between studs within the wall panel and at wall panel junctions should be large enough to allow the installation of insulation.

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.

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.

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 regional 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, DPM, and VCL by a minimum overlap of 100mm.

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.

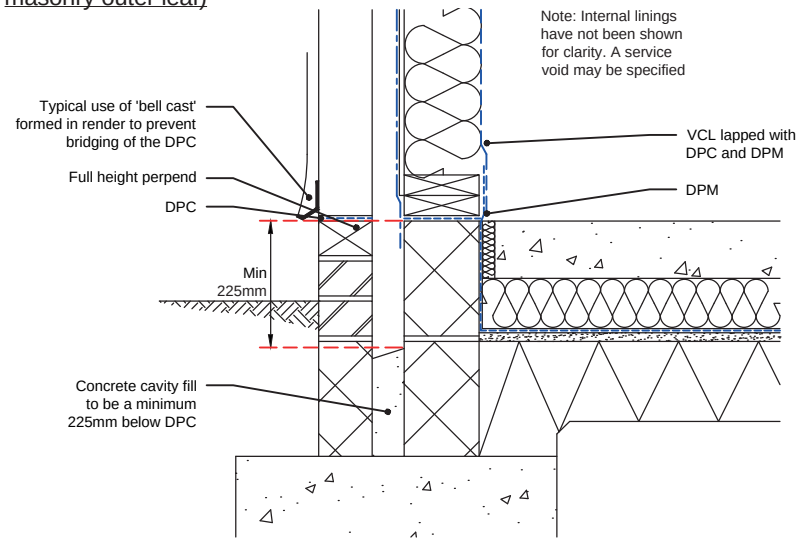
Drainage and ventilation

Cavity drainage and ventilation in masonry cladding should:

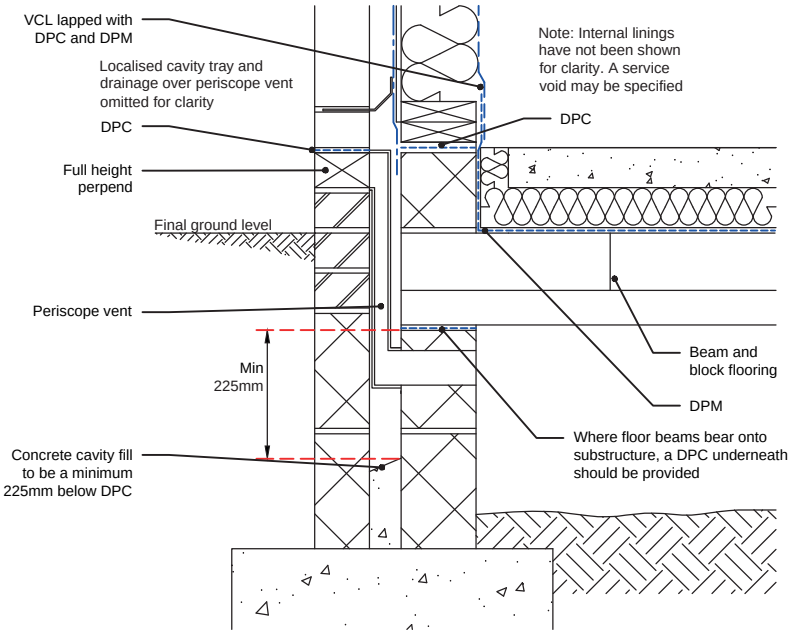
- Be provided with the use of full height open perpends at a maximum of 1350mm centres or equivalent open area.
- Be fitted in the brick or block course below the lowest timber sole plate above external finished ground level and below DPC.
- Maintain a clear cavity with care taken to reduce mortar droppings at the base of the wall.

Weep-holes alone are unsuitable for timber frame construction, and open perpends should be used. Proprietary open perpends should be used. Proprietary open perpend inserts are available with insect screening incorporated. Their equivalent open area must be considered and installation centres reduced accordingly.

Ground supported floor - no sub-floor ventilation (shown with rendered masonry outer leaf)



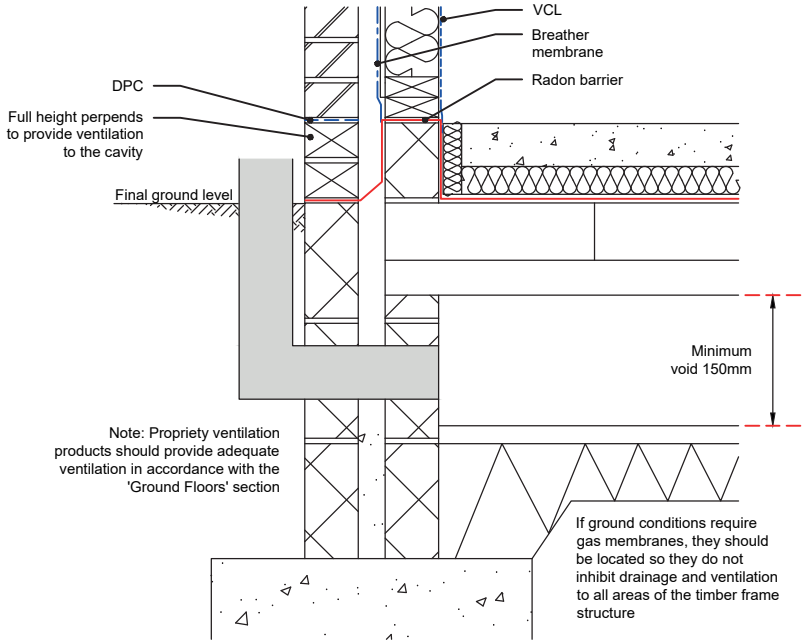
Suspended floor with ventilation provision



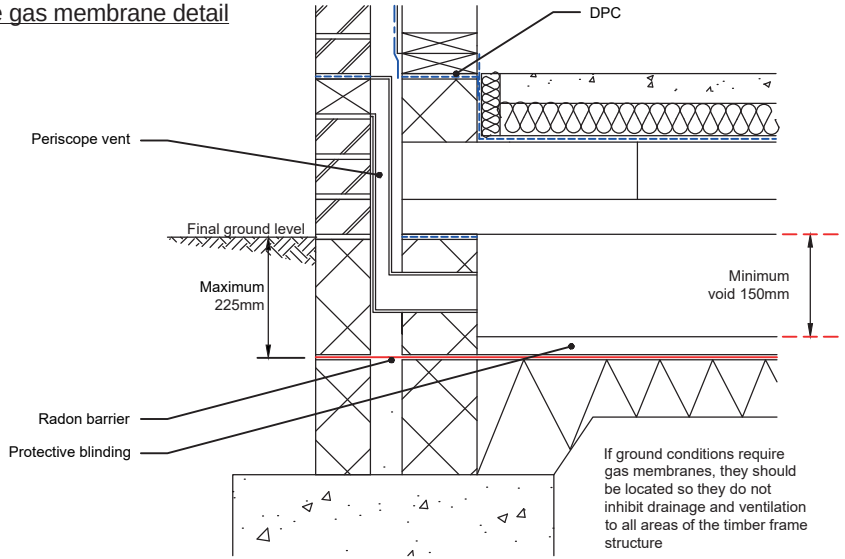
Ventilation for timber frame structures

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 regional 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.

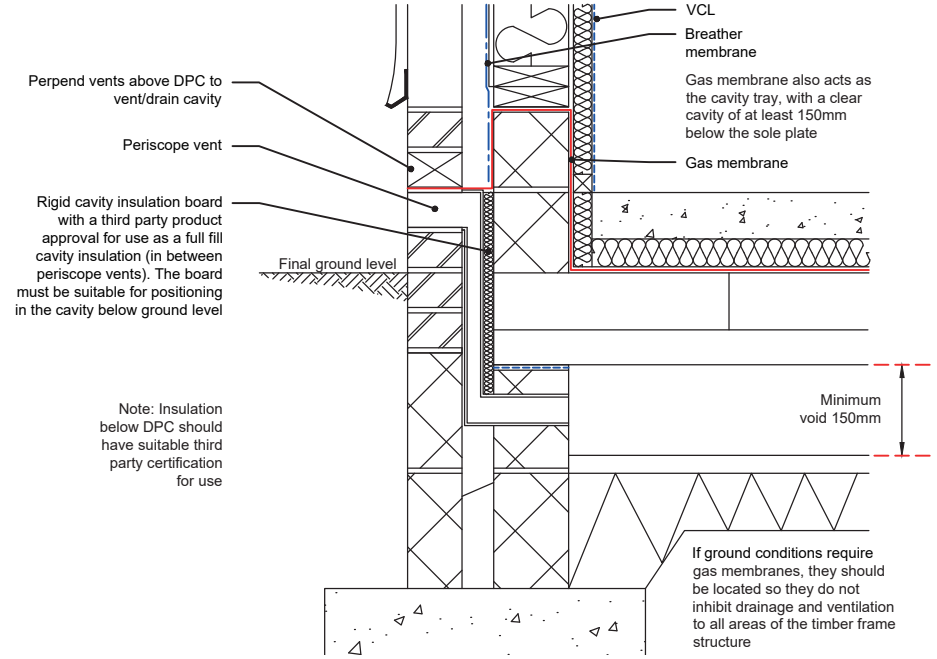
Possible gas membrane detail



Possible gas membrane detail



Possible gas membrane detail with raised sole plate



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 Structural 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 +/-5mm from datum.
- Not overhang or be set back from the foundation edge by more than 10mm.
- Be set out within +/-10mm in length and in line within +/-5mm, as defined by the timber frame drawings.
- Diagonals should be within +/-5mm 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 Structural 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 a Structural Engineer.
- If stainless steel holding down straps are used, they should be grade 1.4301 steel to BS EN 10088 and isolated from the studs with neoprene gaskets or similar.

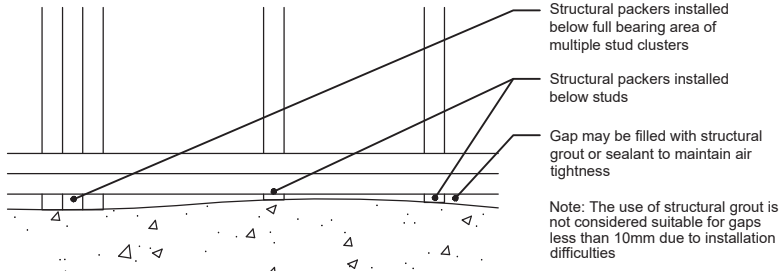
Ventilation to sole plate area

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.

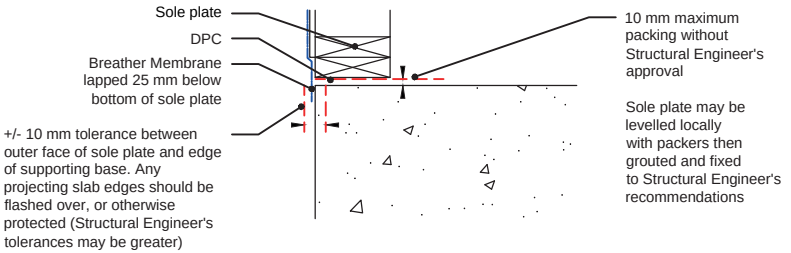
Packing

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.

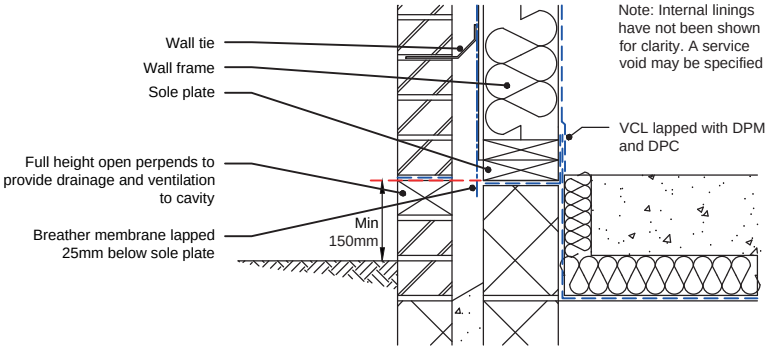
Packing of sole plates



Locating sole plates



Sole plate/foundation junctions



Timber frame wall panels

Timber frame external wall panels shall:
- Be manufactured in accordance with the Structural Engineer's design.
- Consist of solid timber studs and rails.
- Have studs at a maximum of 600mm centres.
- Be braced with a structural sheathing board.

Fixings and junctions

All fixings are to be installed to the Structural 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 must be installed to the full width of point load-bearings.
- Point loads must be transferred down through wall panels and floor zones to foundations.
- Walls manufactured off-site must be fixed together as specified.
- 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.

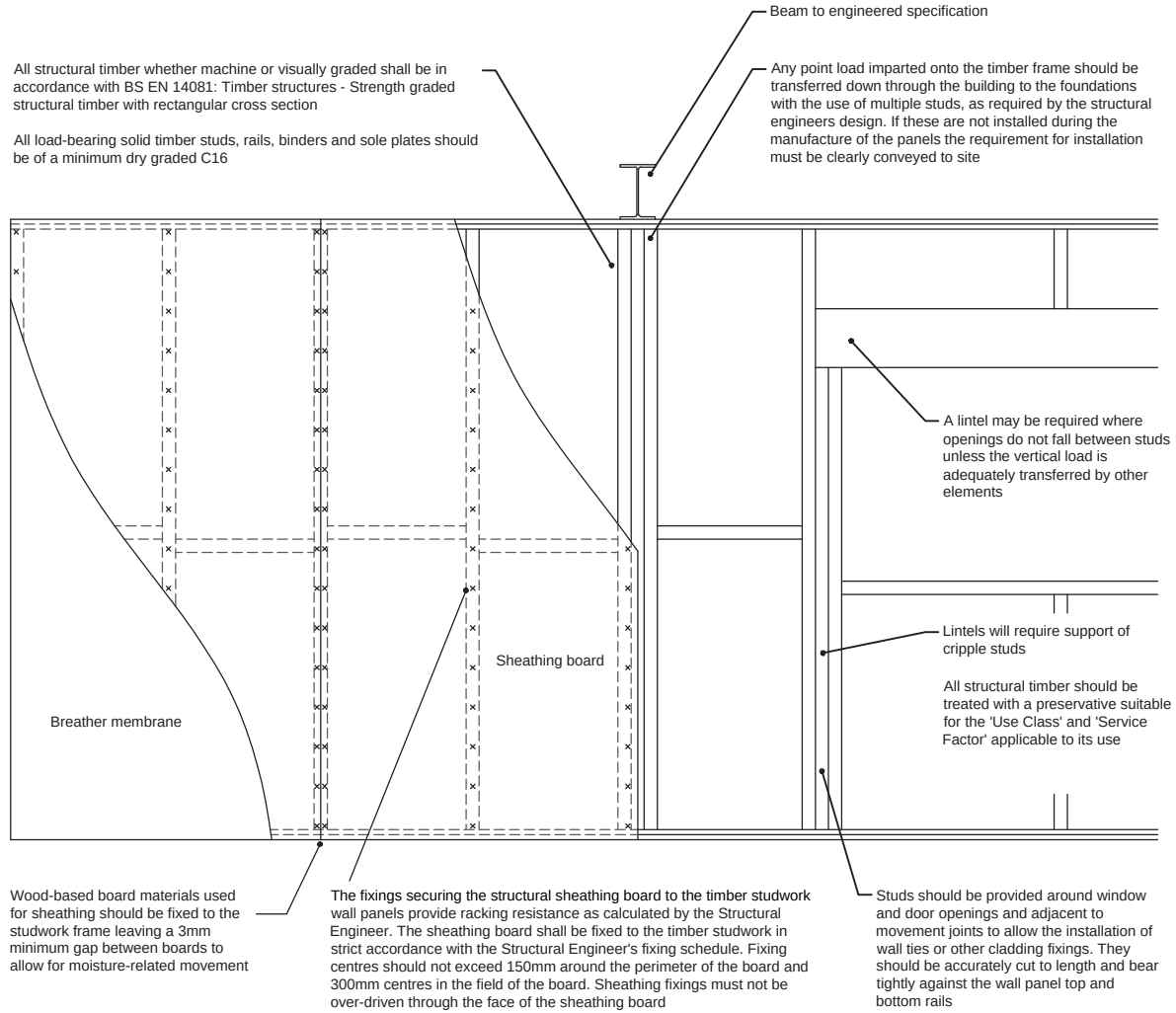
Vapour Control Layer (VCL)

A continuous VCL with a minimum vapour resistance of 250 MNs/g should be located on or near the warm side of the thermal insulation.

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.

Typical wall panel



Breather membrane

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

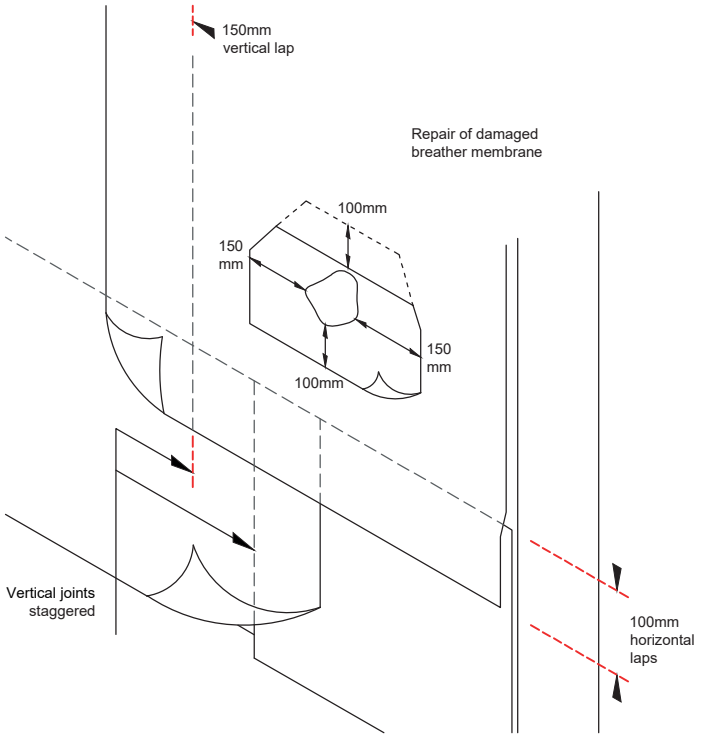
The timber frame structure should always be protected by a breather membrane facing the external wall cavity.

Breather membranes should be:

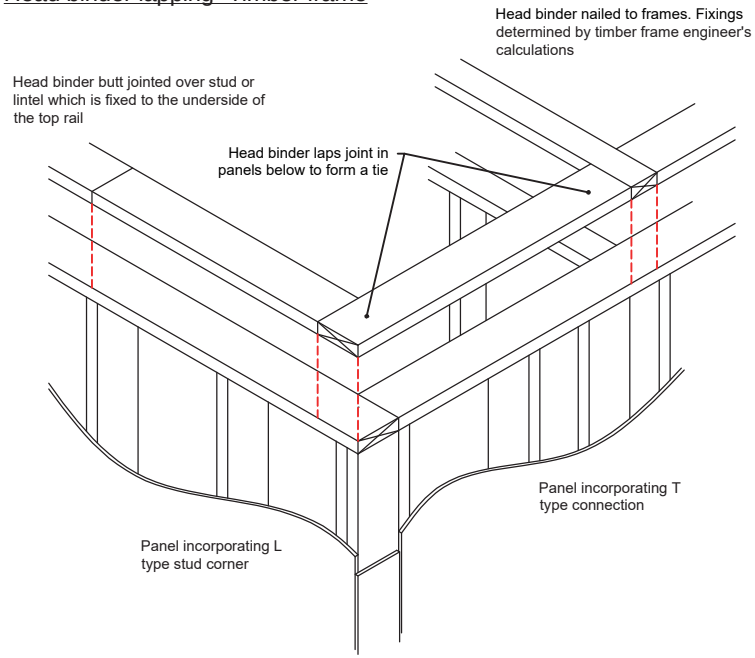
- All breather membranes should have appropriate third party product approval.
- Minimum Class W2 or better in accordance with BS EN 13859: Flexible sheets for waterproofing - Definitions and characteristics of underlays.
- Securely fixed to protect the outside face of the timber frame structure with 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.

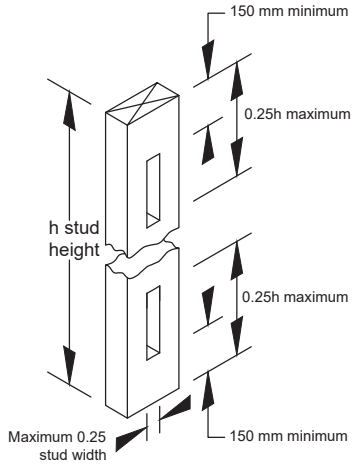
Lapping and repair of breather membrane



Head binder lapping -Timber frame



Drilling of studs



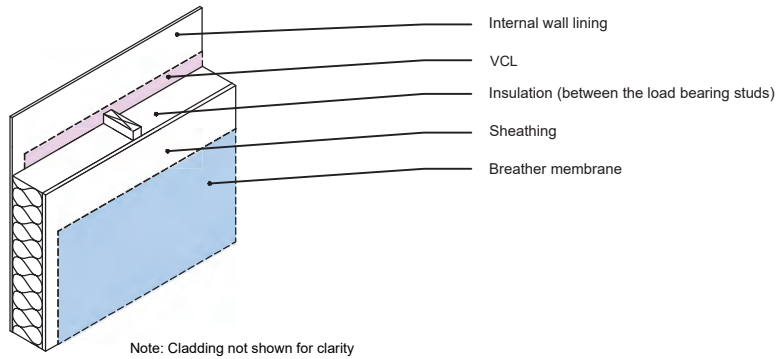
Drilling on centre line only. Hole diameters not greater than 0.25 stud width and hole centres not closer than 4d (d = hole diameter)

Services

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

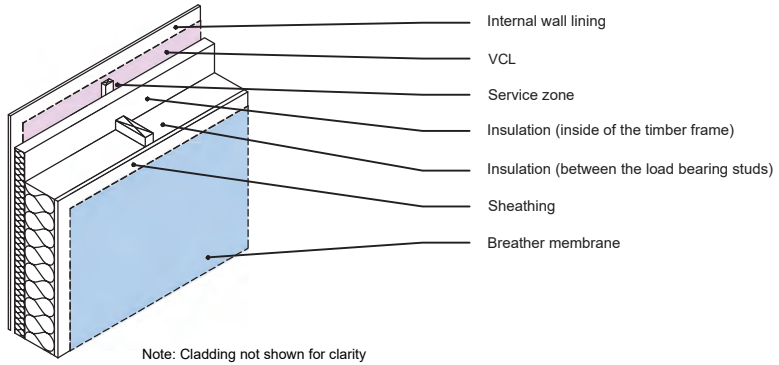
- The routing and termination of services should not affect the fire resistance of the structure.
- Electrical services are to be rated for their location with consideration for insulation.
- Wet services are not to be installed on the cold side of the insulation.
- Service penetrations through the VCL 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.

Conventional wall with insulation between studs



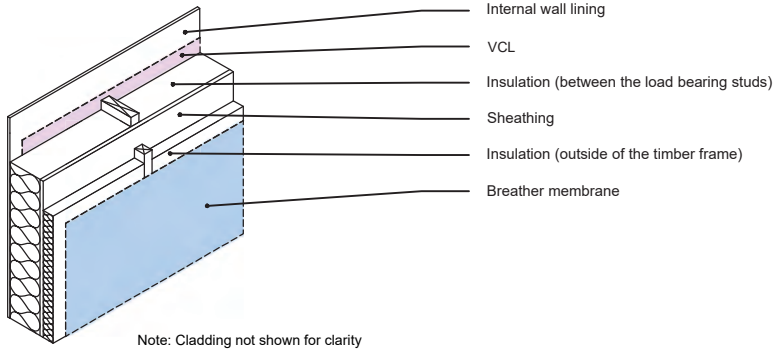
Note: Cladding not shown for clarity

Continuous internal insulation



Note: Cladding not shown for clarity

Continuous external insulation



Note: Cladding not shown for clarity

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.

Insulation

If insulation is specified between external walls studs all voids shall be filled with insulation to maintain the thermal envelope of the building. When noggins 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.

Insulation installed within the 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.
- Installation 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 over the cavity facing breather membrane 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 and 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 should have a minimum vapour resistance of 250 MNs/g. It is also typically used as an air tightness layer.

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.

*Vapour control plasterboard should only be used subject to a condensation risk analysis demonstrating the suitability of the wall build up.

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.

Plasterboard

Installation

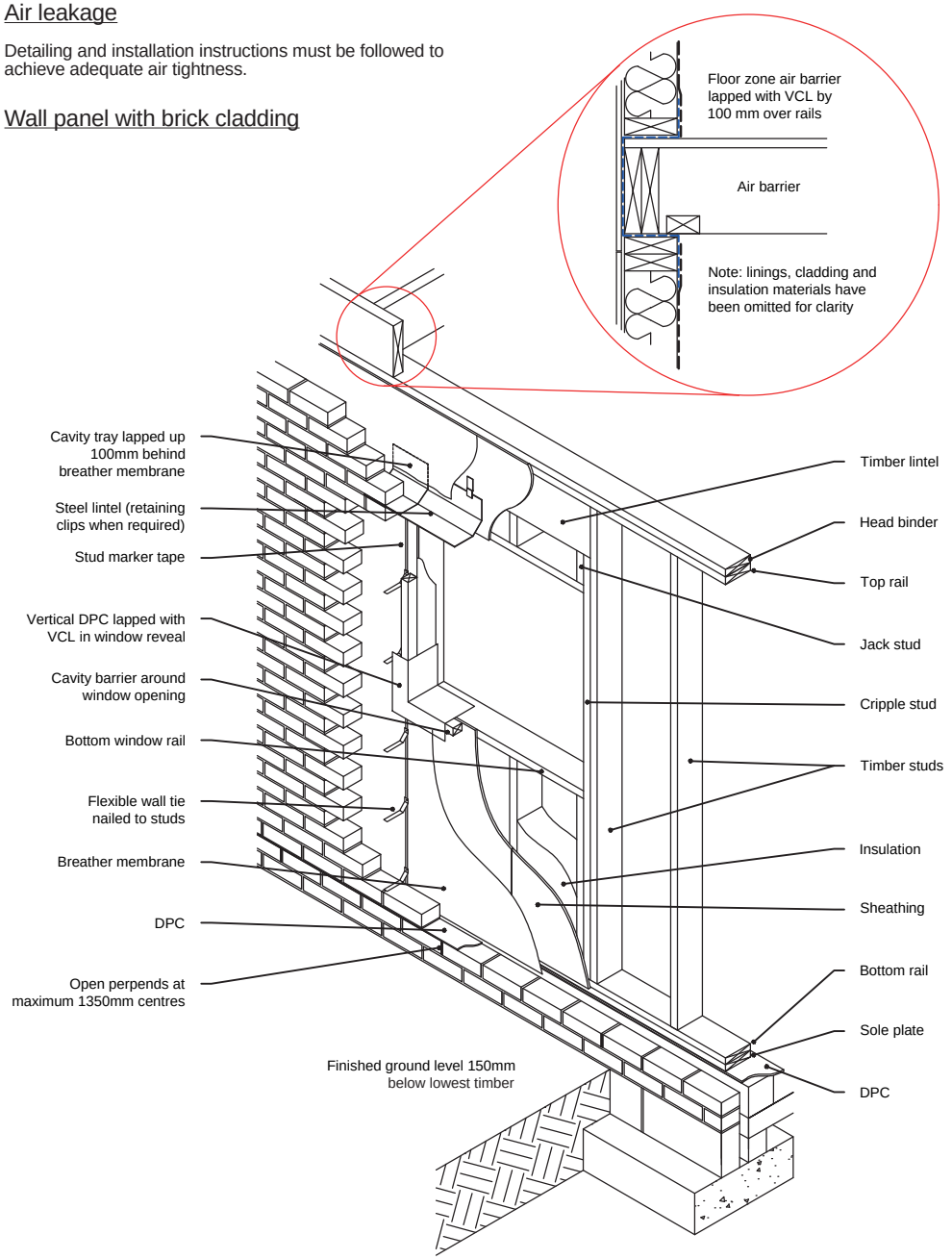
In order to provide the specified period of fire resistance, the plasterboard must:
- Protect all areas of the timber frame structure.
- Have all edges supported by timber studs or rails.
- Be fixed in accordance with the plasterboard manufacturer's guidance.
- Be cut and tightly fit around service penetrations.
- 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 Structural Engineer's specification or the plasterboard manufacturer's specification, whichever is more onerous.

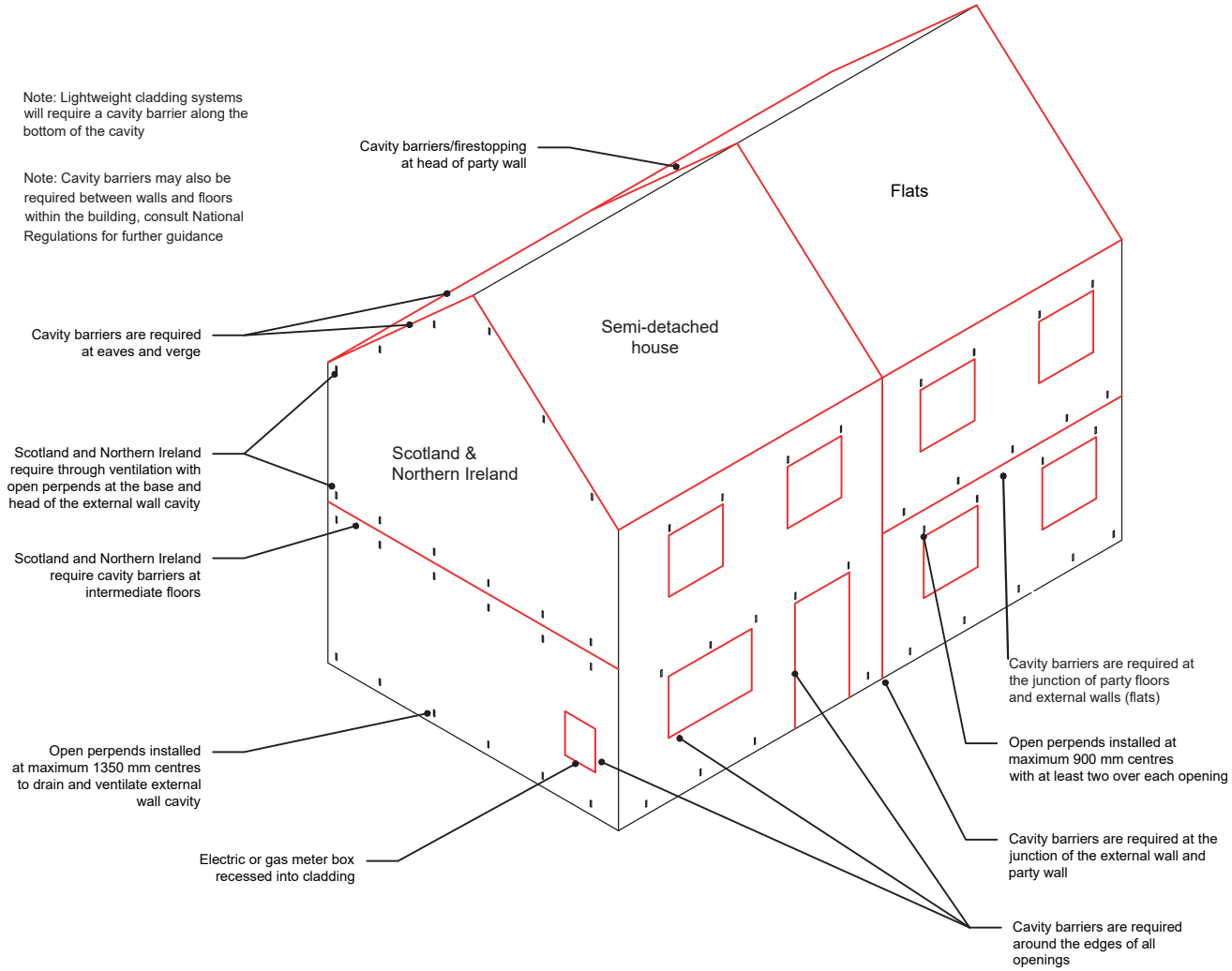
Air leakage

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

Wall panel with brick cladding



Locations of cavity barriers and open perpends



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.
- 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 manufacturers 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.

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

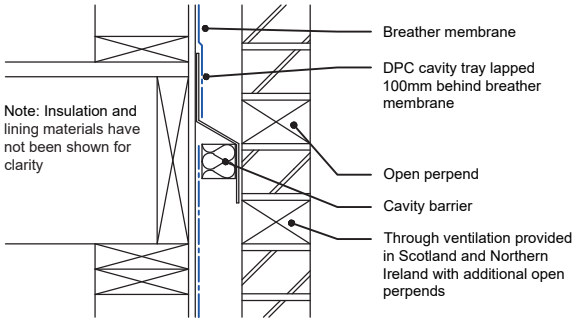
Cavity barriers are required to prevent the spread of smoke and flame within concealed spaces.

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 walls 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 and ensure there is at least a 62.5mm overlap onto the leaf of the masonry so that it will achieve a 50mm minimum length of bedding on the mortar.
- 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 a suitably qualified Structural Engineer.

Cavity drainage and ventilation in masonry cladding should:

- Be provided with full height open perpends 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 perpends should be used. Proprietary open perpend inserts are available with insect screening incorporated. Their equivalent open area must be considered and installation centres 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

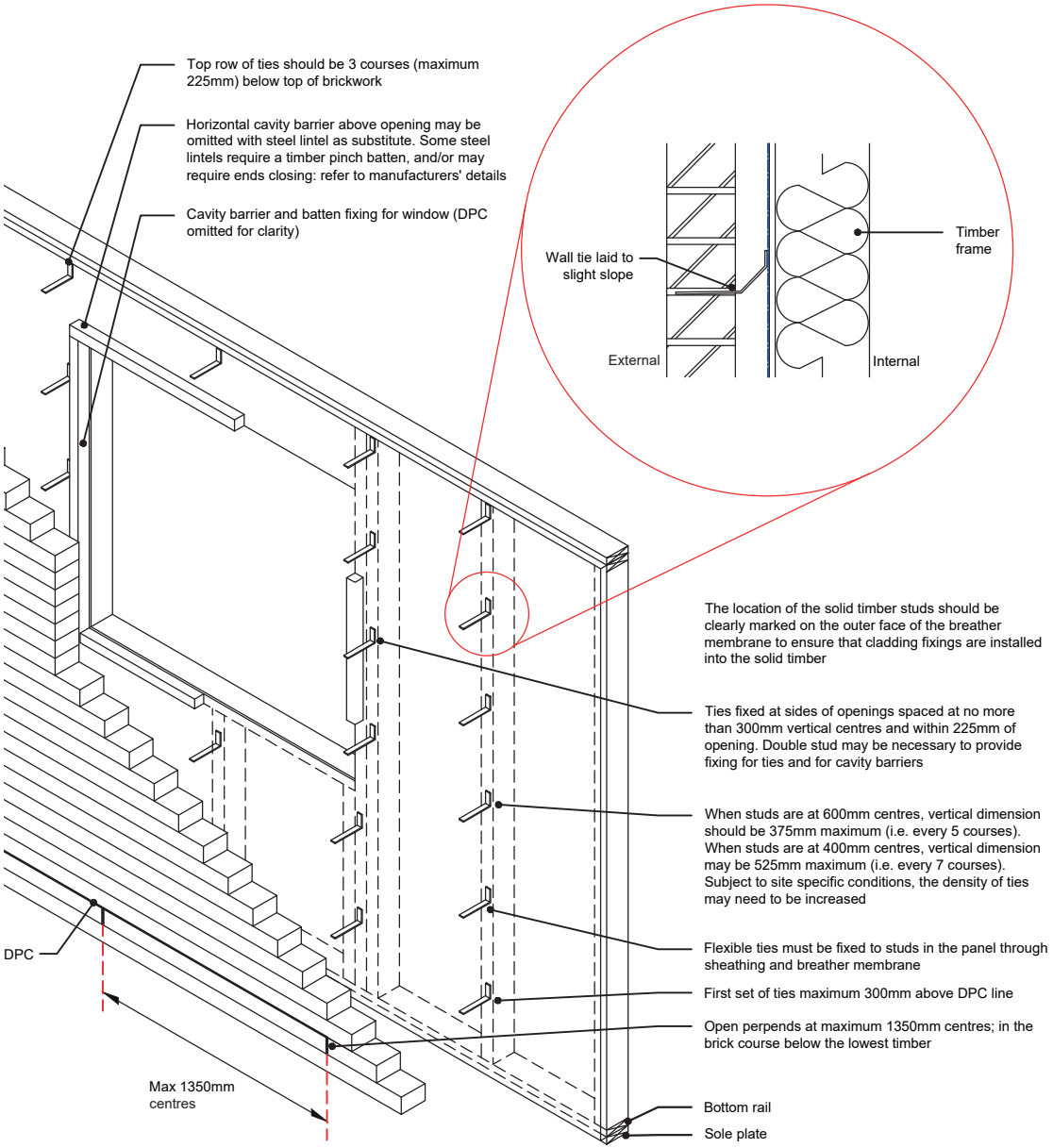
- Facing bricks must have a suitable level of durability and particular attention should be paid to the bricks resistance to frost and moisture.
- Bricks should be capable of supporting proposed loads.
- Bricks should comply with BS EN771 and PD 6697.
- Frost resistant bricks should be used in areas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

For further information on the suitability of masonry claddings and installation of stone heads within masonry cladding, reference should be made to the ‘External Walls - Traditional Masonry’ and ‘Appendix C - Materials, Products, and Building Systems’ sections of the Technical Manual.

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.

Location of wall ties



External masonry stone cladding

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.

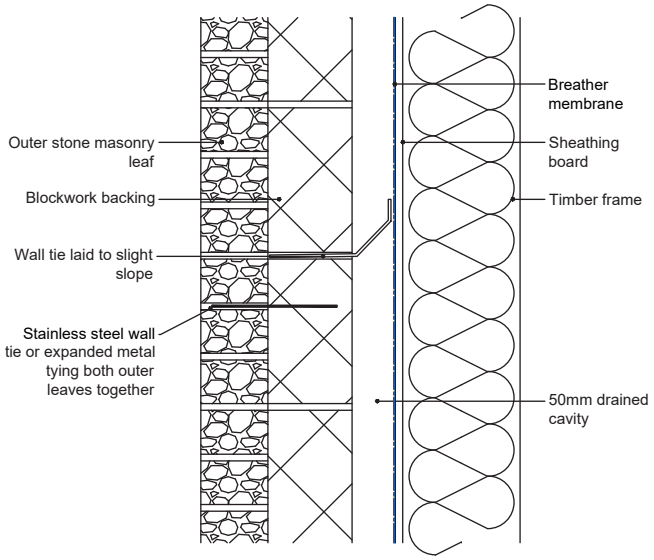
It is not recommended to use a soft, porous-type stone in a severe exposure zone. Consideration should be given to the compatibility of different stone to prevent staining and premature decay. Limestone and sandstone should not be mixed together.

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 90mm due to the irregularities of the stone, the stone should be backed with either 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.

Masonry cavity wall with stone outer leaf



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.

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 the previous guidance for cavity trays, 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.

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 Structural Engineer’s specification.

Cavity drainage and ventilation should provide an open area of not less than 500mm^2 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.

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

Window and door installations

Please refer to the 'Windows and Doors' guidance for installation requirements of frames including maximum gaps and fixings.

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.

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 is likely to have a minimum thermal performance.
- Seal gaps between the timber 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 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

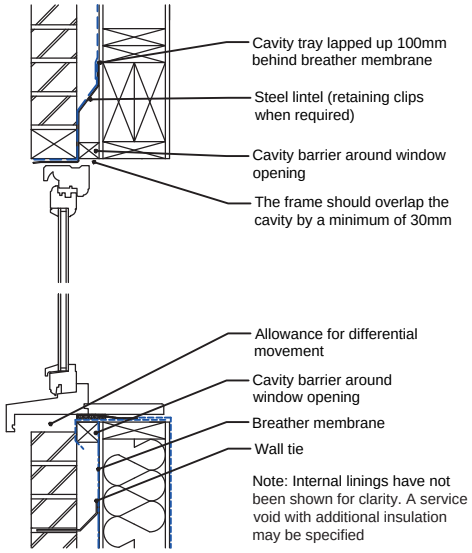
- The lintel should be the correct length and width for the opening and cavity width, the bearing length should be at least 150mm.
- Do not let masonry overhang lintels by more than 25mm.
- Continuity of the masonry bond should be maintained at supports for beams and lintels.

Do not:

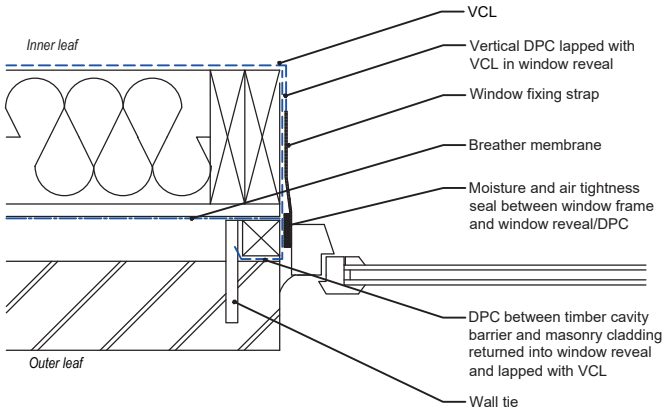
- Support lintels and beams on short lengths of cut blocks or make-up pieces.
- Apply load to lintels or beams before the masonry supporting has hardened.

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

Typical vertical section through window opening



Typical window reveal detail (normal exposure)

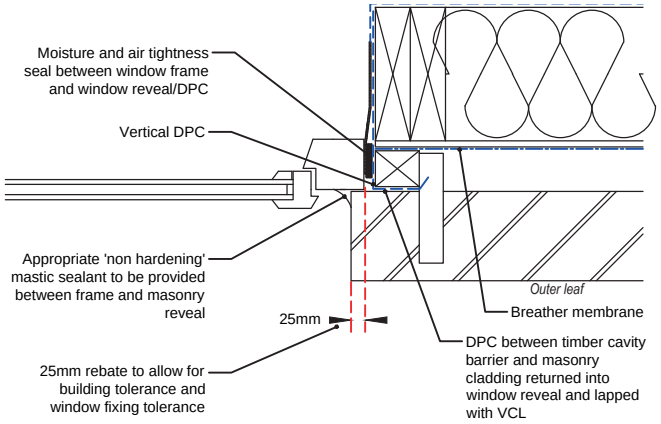


Windows and doors

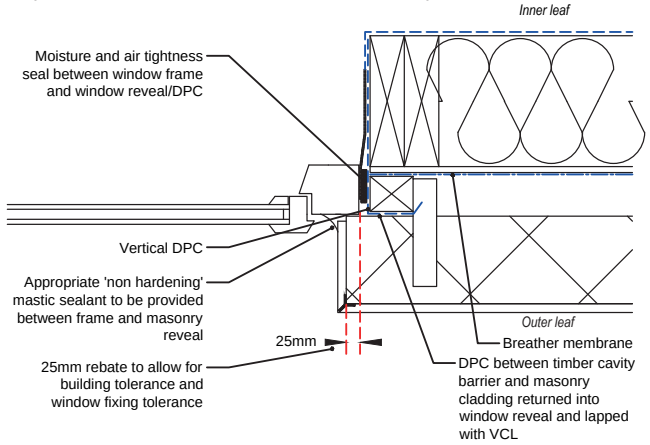
In areas of very severe exposure, checked rebates should be provided. The frame should be set back behind the outer leaf and should overlap.

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

Typical rebated window frame detail for areas of very severe exposure - external masonry brick reveal



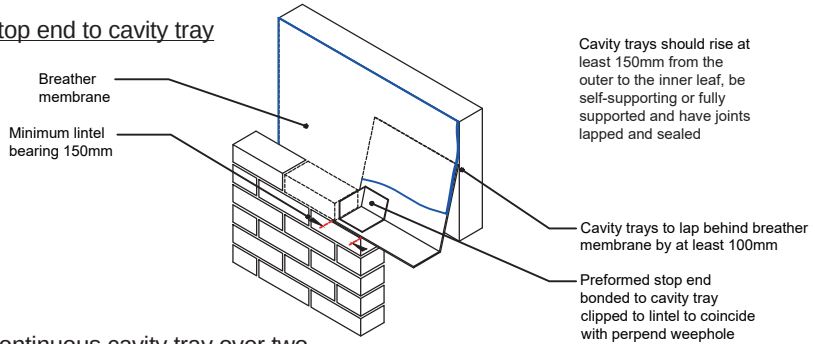
Typical rebated window frame detail for areas of very severe exposure - rendered masonry reveal



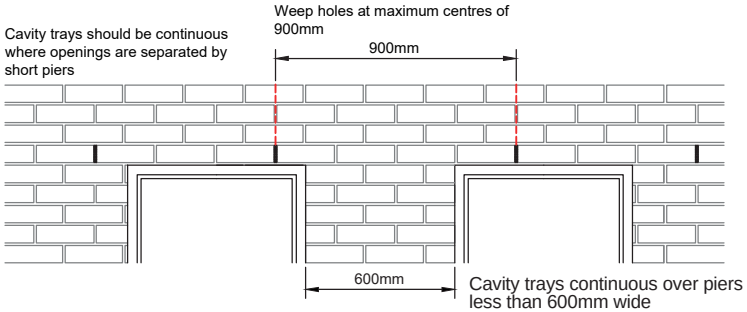
When installing window/door frames in a checked rebate, allow for the frame to be deeper:

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

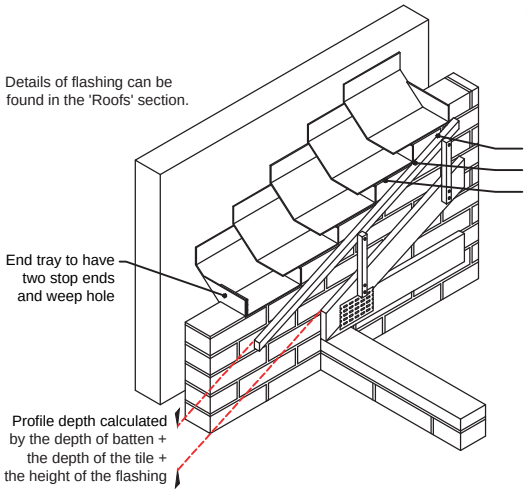
Stop end to cavity tray



Continuous cavity tray over two openings and a small pier



Installation of stepped cavity tray



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.

Profile line

Heel of tray should be installed against profile

Mortar should be raked out under the cavity tray to a depth of 25mm

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 flashings should be linked into the cavity tray (lapped in below).

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 are to be provided:

- Cavity trays are to be provided to comply with relevant regional Building Regulations.
- At all interruptions likely to direct rain water across the cavity, such as rectangular ducts, lintels and recessed meter boxes.
- Above cavity insulation that is not taken to the top of the wall, unless that area of wall is protected by impervious cladding.
- 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.
- Continuously above lintels where openings are separated by short piers.
- Above openings where the lintel supports a brick soldier course.

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 perpend to the end of the cavity tray. Stop-ends can be formed by sufficiently turning up the end of a DPC tray into the perpend joint. Surplus mortar should be removed from cavities and wall ties cleared of mortar droppings and debris as the work proceeds.

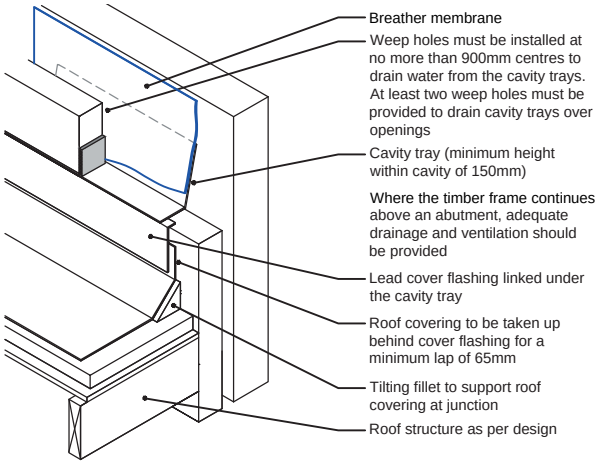
Other perforations of the building envelope

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.

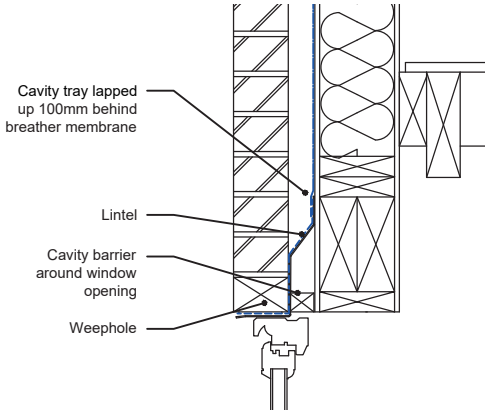
Proprietary cavity tray systems

At stepped and lower storey abutments, and around corners in low rise external walls, a proprietary cavity tray system should be used.

Flat roof abutment cavity tray construction



Cavity tray and lintel



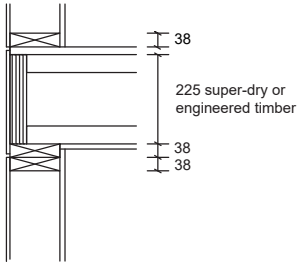
Differential movement at floor zones

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 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

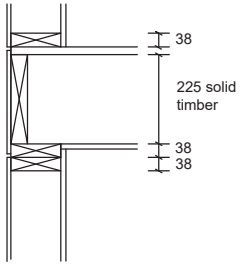


225 mm engineered timber = 2 - 3 mm differential movement depending on tightness of build.

Expect 6 mm movement per storey, or 7 mm 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 - 4 mm (depending on tightness of build) to the differential movement allowances quoted.

Solid Timber



225 mm solid timber = 6 mm differential movement.

Expect 9 mm movement per storey, or 10 mm 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.

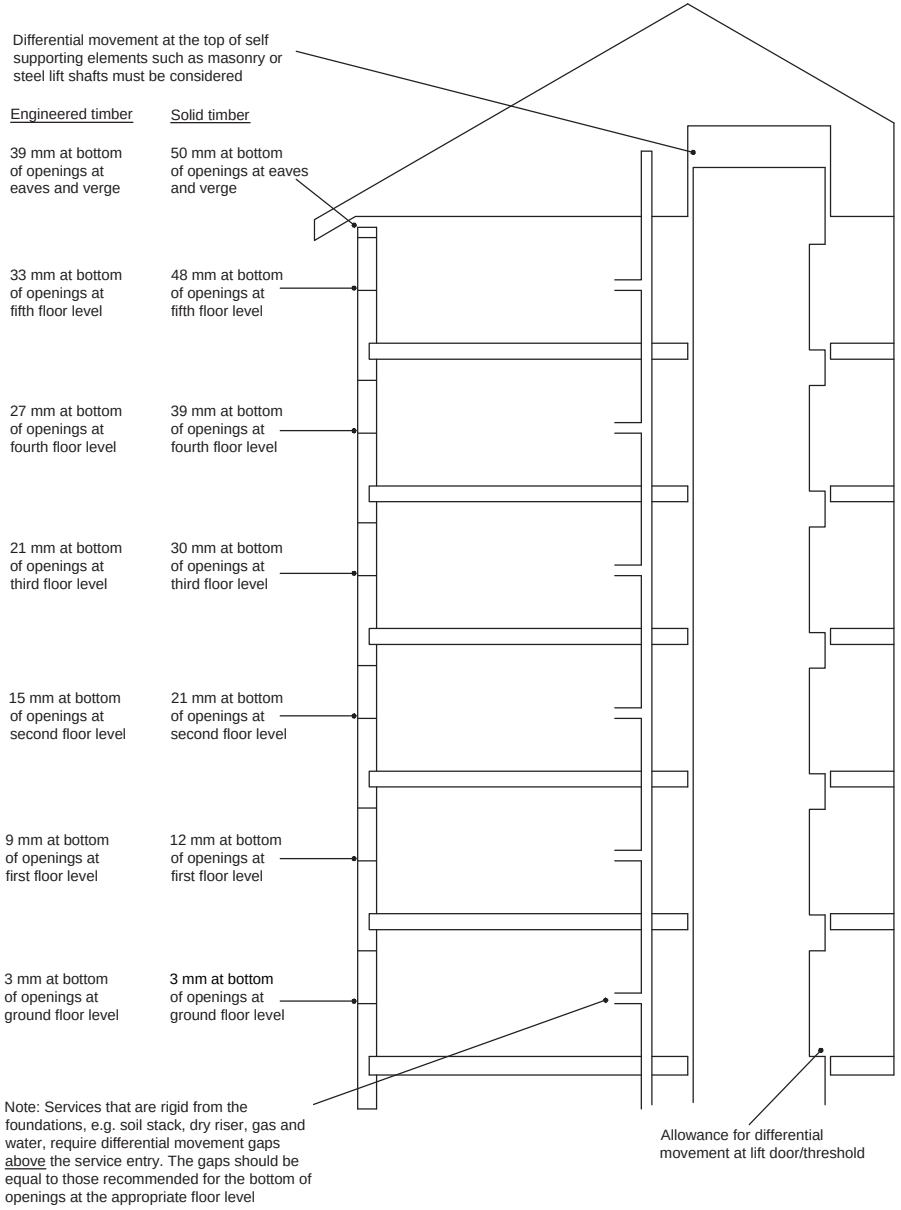
Self supporting claddings (masonry)

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.

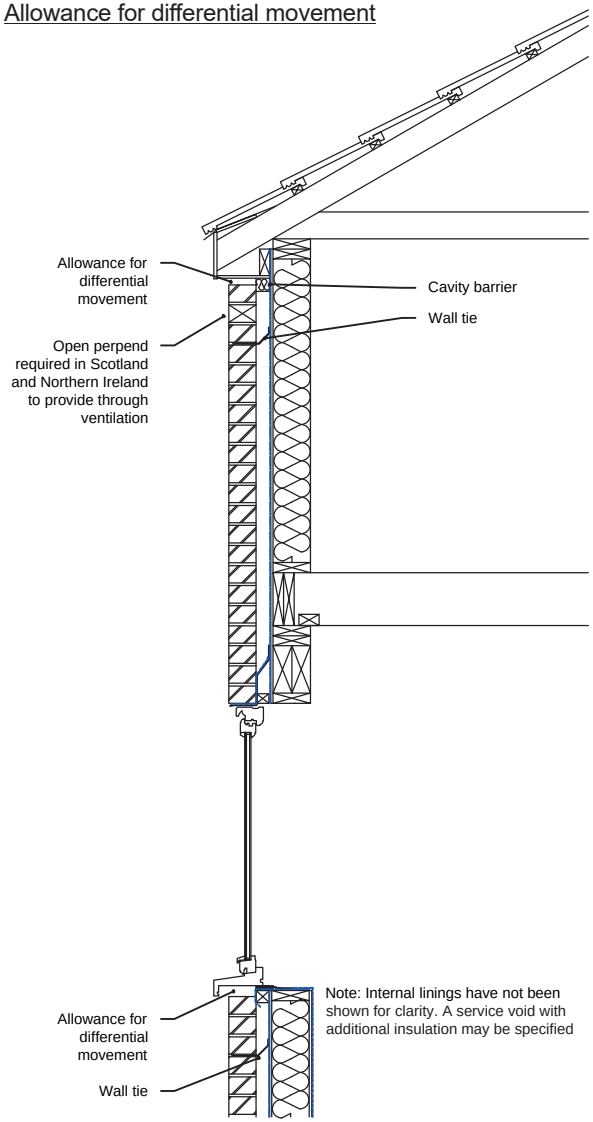
Masonry cladding should not be supported on the timber frame structure.

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

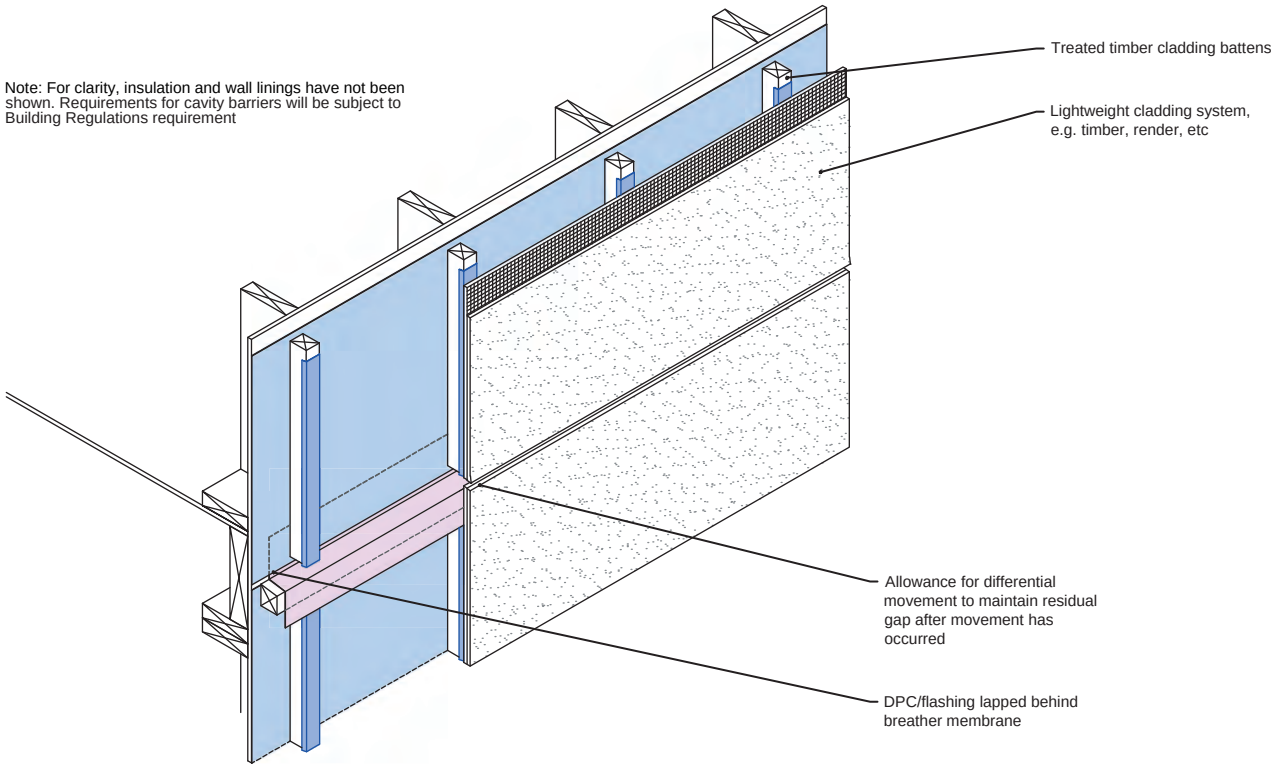


Allowance for differential movement



Differential movement at floor zone with cladding supported on timber frame

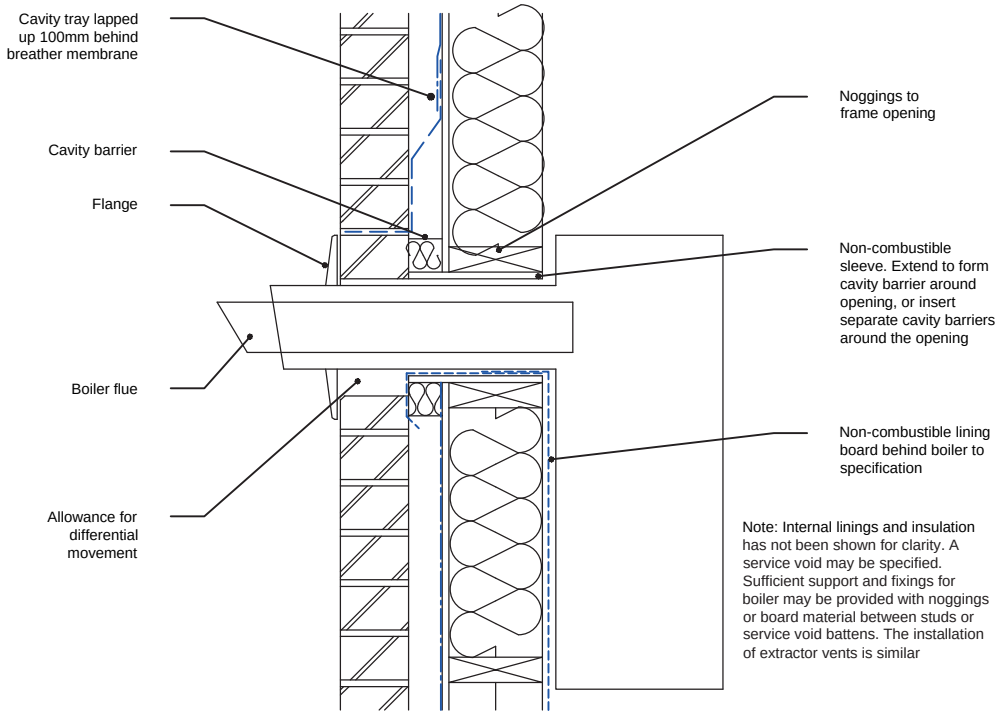
Horizontal cross grain timber and construction gaps are concentrated at floor zones and this is where the majority of movement occurs. Vertical timber battens or other rigid cladding support systems should not span over the floor zones of timber frame buildings. Gaps should be provided to accommodate 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 above of 1mm for every 38mm of horizontal cross grain timber.



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.

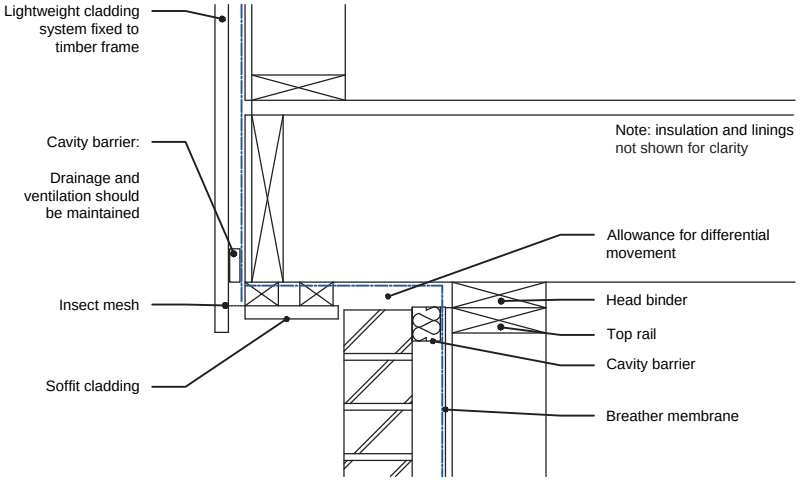
Differential movement at services



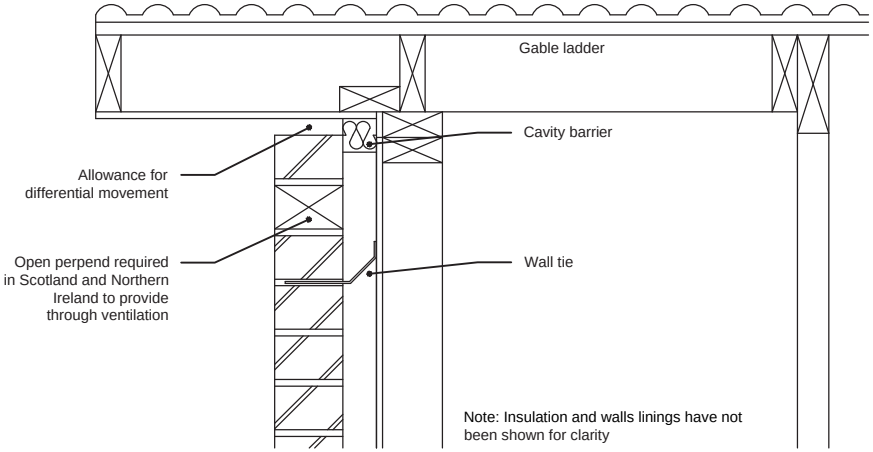
Services

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, 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.

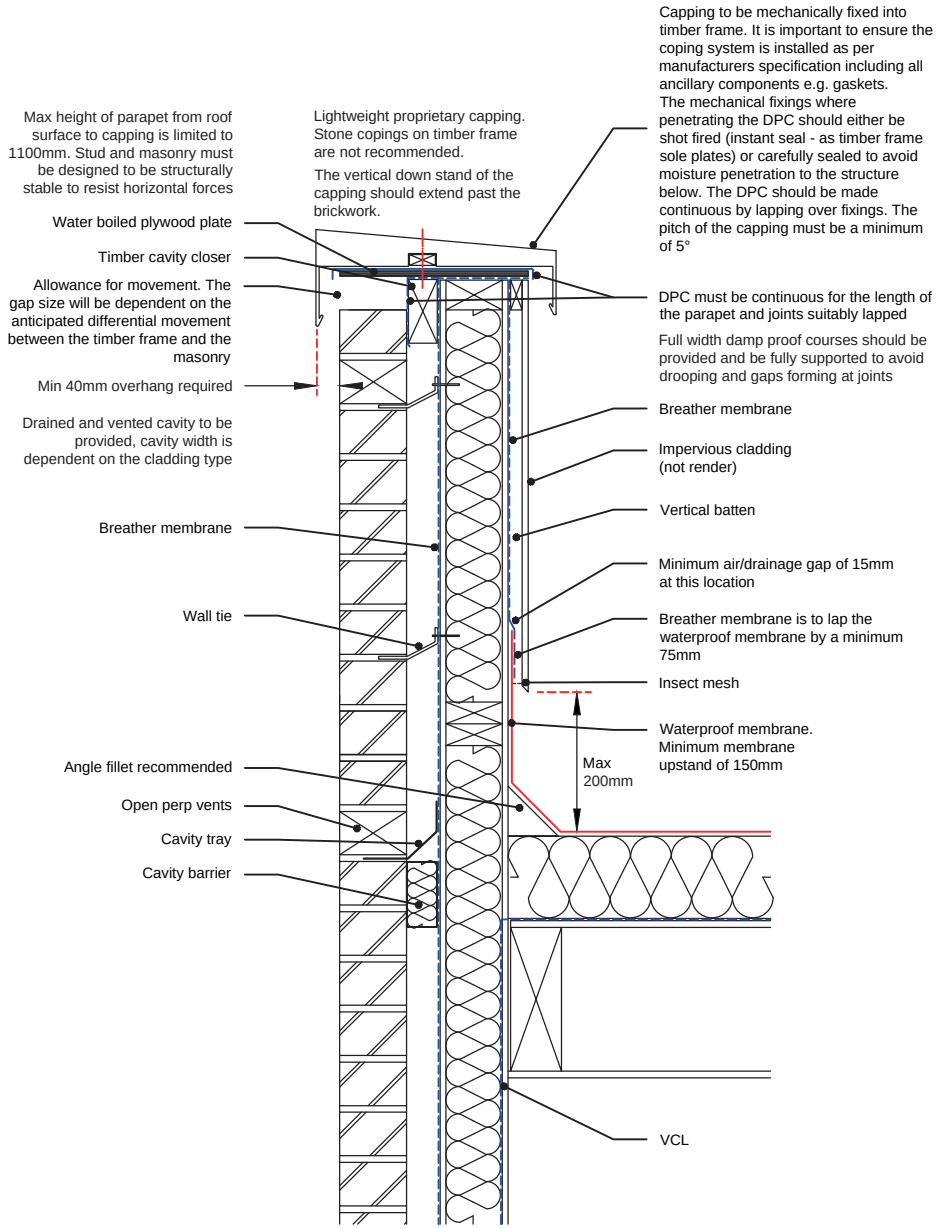
Differential movement at cantilevered overhang



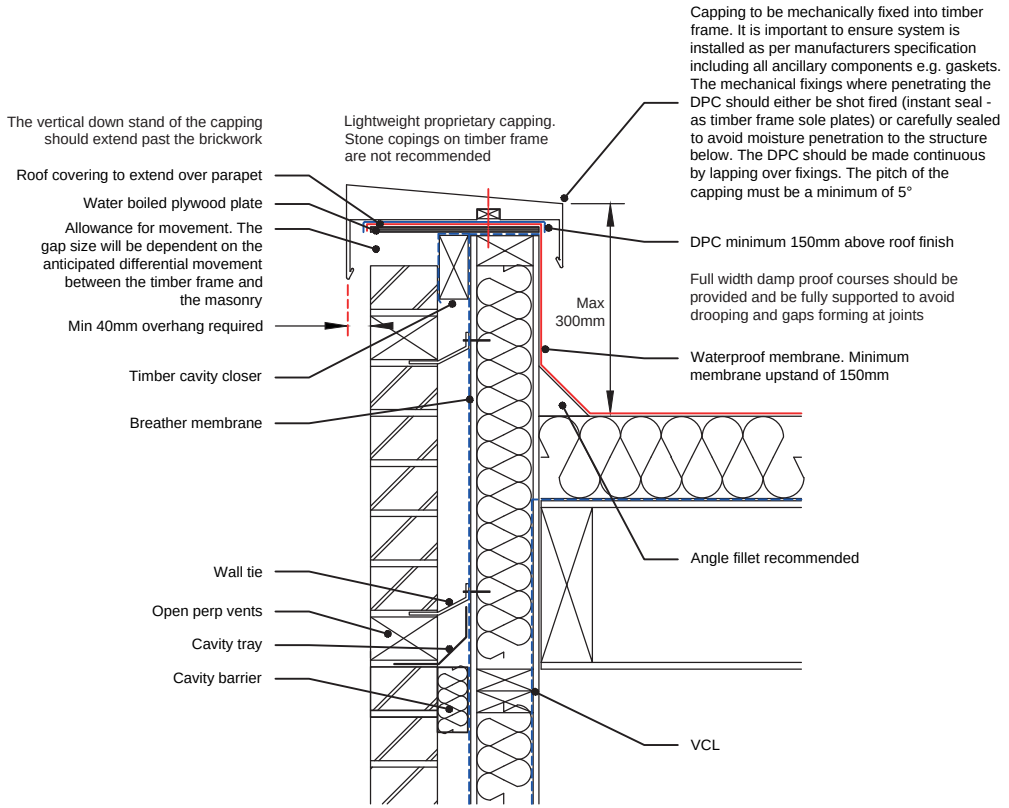
Differential movement at verge



Coping detail for up to 1100mm from roof



Parapet coping detail for up to 300mm

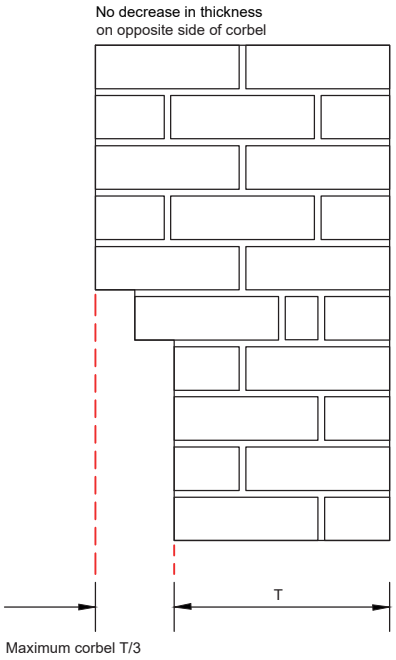


Parapets

- 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.

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 a Charted Structural 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 resistant to the gable spandrel panel, including details of the restraint used and the fixings should be provided.

General references used in this section

- BS EN 1995-1-1: 2004+A1: 2008 Eurocode 5 Design of timber structures. General: Common rules and rules for buildings.
- BS 5268-2: 2002 Structural use of timber. Code of Practice for permissible stress design, materials and workmanship.
- BS 5268-3: 2006 Structural use of timber. Code of Practice for trussed rafter roofs.
- BS 5268-4 Section 4.1: 1978 Structural use of timber. Part 4 Fire resistance of timber structures. Section 4.1 Recommendations for calculating fire resistance of timber members.
- BS 5268-4 Section 4.2: 1990 Structural use of timber. Part 4 Fire resistance of timber structures. Section 4.2 Recommendations for calculating fire resistance of timber stud walls and joisted floor constructions.
- BS 5268-6.1: 1996 Structural use of timber. Code of Practice for timber frame walls. Dwellings not exceeding seven storeys.
- BS 5268-6.2: 2001 Structural use of timber. Code of Practice for timber frame walls. Buildings other than dwellings not exceeding four storeys.
- BS EN 14081-1: 2005 Timber structures. Strength graded structural timber with rectangular cross section. General requirements.
- BS 8417: 2003 Preservation of timber. Recommendations.
- BS EN 13986: 2006 Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking.
- BS EN 300: 2006 Orientated strand boards (OSB). Definitions, classification and specifications.
- BS EN 636: 2003 Plywood. Specifications.
- BS EN 622-4: 2009 Fibreboards - Specifications. Requirements for softboards.
- BS EN 622-3: 2004 Fibreboards - Specifications. Requirements for medium boards.
- BS EN 622-2: 2004 Fibreboards - Specifications. Requirements for hardboards.
- BS 4016: 1997 Specification for flexible building membranes (breather type).
- BS EN 845-1: 2003+A1: 2008 Specification for ancillary components for masonry. Ties, tension straps, hangers and brackets.
- EN 14732: 2011 Timber structures. Prefabricated wall, floor and roof elements. Requirements Draft for comment.

6.

External Walls

6.3
Light Gauge Steel Frame

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) will be acceptable as meeting 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 panellised 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 warrantied projects must provide:

- A comprehensive full structural design specification and supporting calculations for each house type on the proposed project and,
- Evidence of a third party system approval (UKAS or equivalent) for the system, or has been assessed by our Warranty Innovations team and,
- Evidence of a valid ISO 9001 Quality Assurance Certification (or equivalent) held by the Manufacturer, covering the manufacture of their product/system and,
- Full details of all claddings and specifications of DPC's, breather membranes, 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 four 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 a Chartered Structural Engineer will be required, for all buildings registered for Warranty.

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 either grade S280GD or 350GD 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/m^2 zinc coating (Z)
- Ground floor joists and ring beams in such floors should be pre-galvanised to 460g/m^2 zinc coating (Z).
- Positioned below the waterproofing layer of a flat roof, balcony or terrace should be pre-galvanised to a minimum 600g/m^2 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/m^2 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 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).

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, but where essential should be carried out with specialist tools. The maximum size of rectangular holes should not exceed 40% of the overall section, and length should not exceed 60% of the overall section or be the depth of the section apart. No holes should be closer than 1.5 times the depth of the section to the end of the member, notches are not acceptable.

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 courses (DPC)

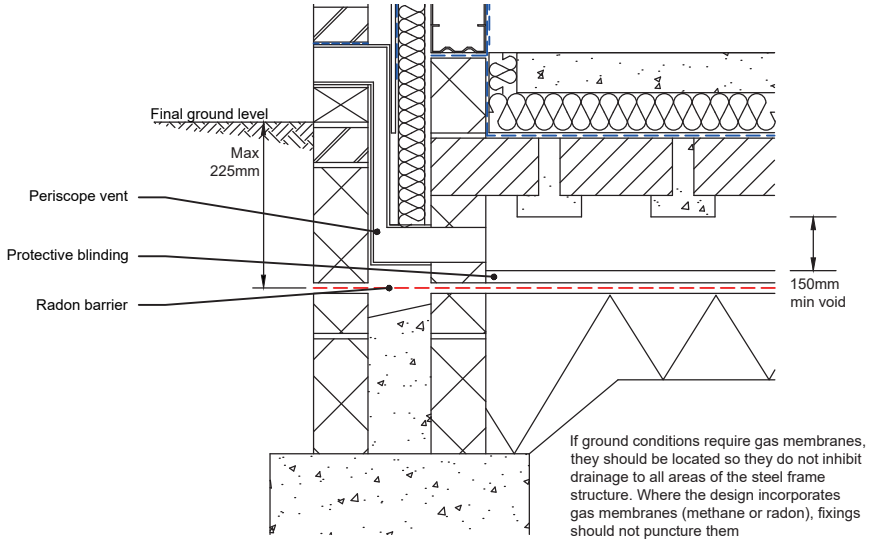
1. DPC's should be of a flexible material, be suitable for the intended use, and should have appropriate 3rd party certification. The installation specification of DPC's should follow good design practice in accordance with BS 8215.
2. Blue bricks or slate will not be accepted as a DPC.
3. DPC's should 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

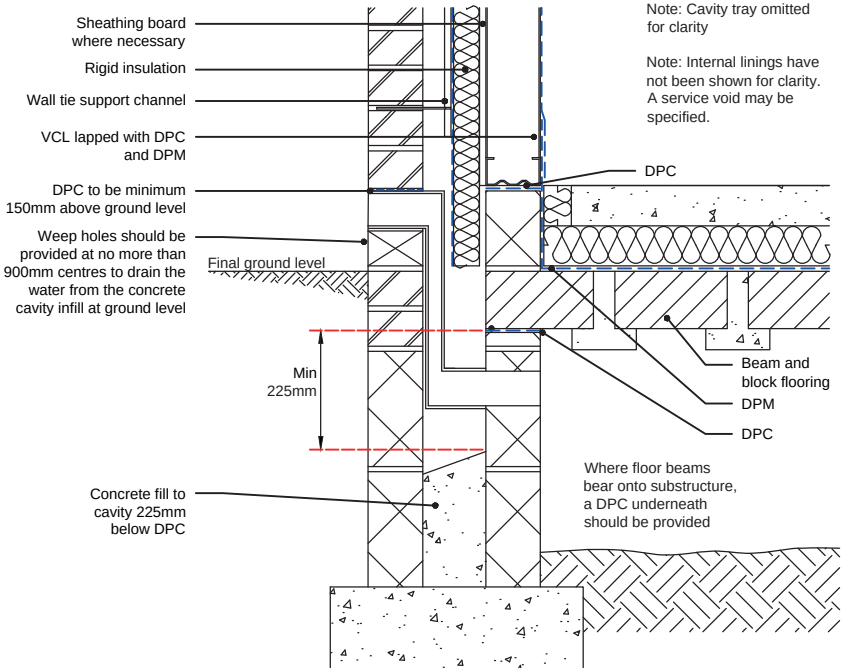
1. Rendering below DPC should only be carried out using a specialist render manufacturer's specification. No render system should bridge the DPC and a proprietary uPVC bead or stainless steel bead should be used above and below where the renders meet at the DPC.
2. DPC should extend through the rendering 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 'Render Applications' section.

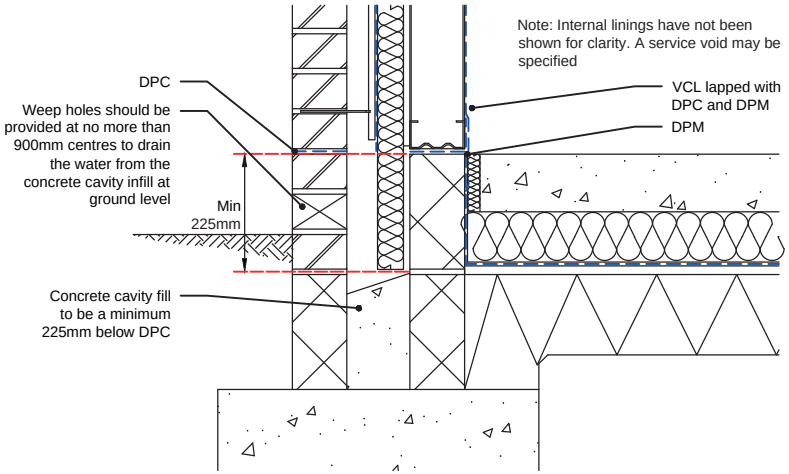
Possible gas membrane detail



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.

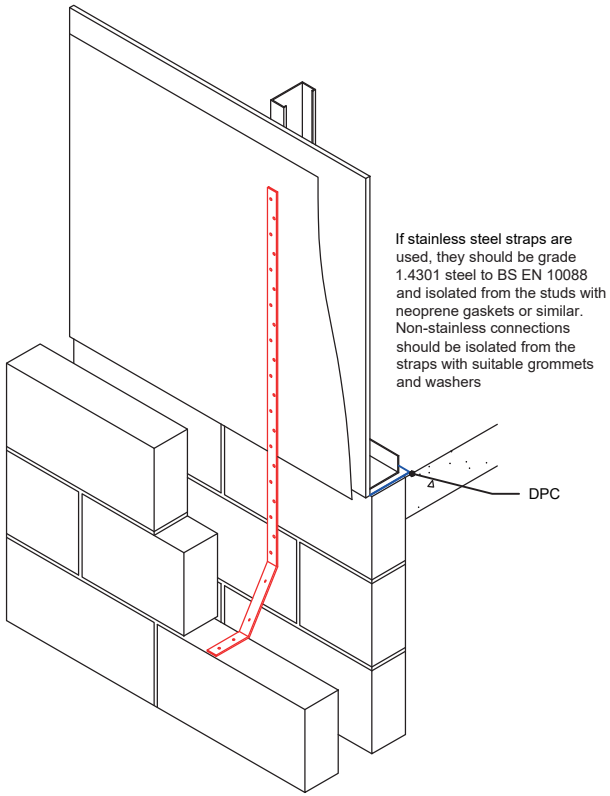
Some packing may be needed to achieve the required tolerances.

Fixing of frames to substructures

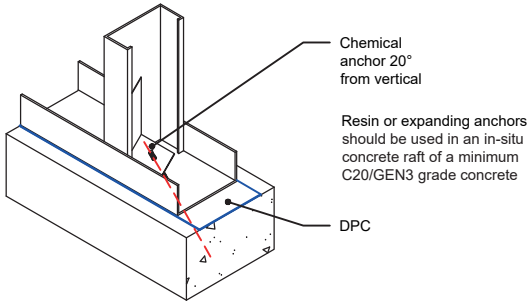
The oversite DPM should be attached to the side of the slab and returned under the DPC on which the frame is placed. The DPC/DPM detail requires careful attention to prevent the cavity being bridged and providing a ledge for mortar droppings.

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.

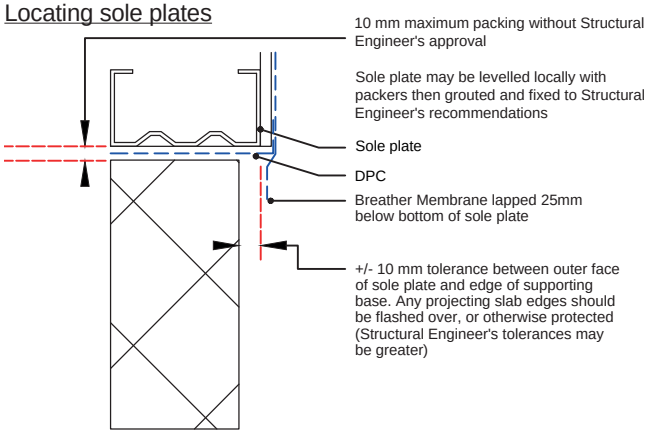
Example of holding down strap



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.

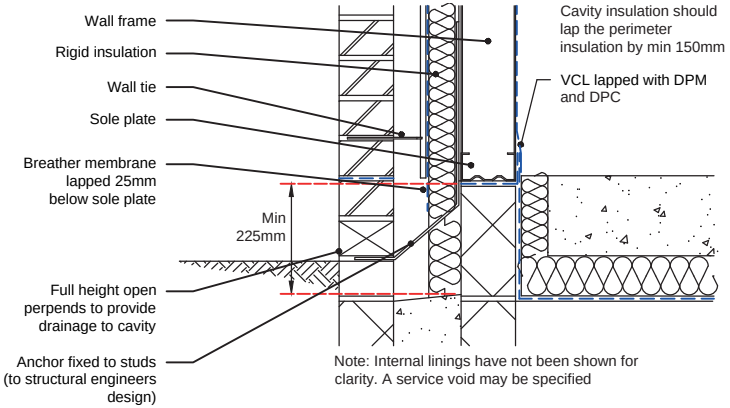
Where level access ramps are required these should only be limited to the entrance door area only (not the entire perimeter). Provision for a slotted drainage channel should be constructed with a gradient away from the door (see the 'Windows and Doors' section for level threshold guidance).

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/m^2 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/m^2. 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/m^2.

Sole plate/foundation junctions

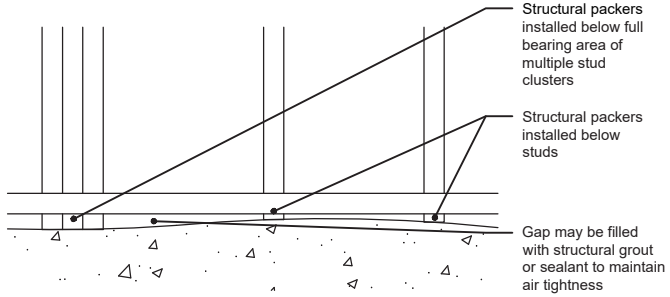


Packing under the steel frame

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 Frame Designer.

Packing of sole plates



Thermal insulation

Rigid 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 0.6MNs/g when calculated from the results of tests carried out in accordance with BS 3177 at 25ºC, 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 should be provided to the 'cold side' of the insulation.

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.

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*. The vapour resistance (not resistivity) of the vapour control material should not be less than 250 MNs/g.

*Vapour control plasterboard should only be used subject to a condensation risk analysis demonstrating the suitability of the wall build up.

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.

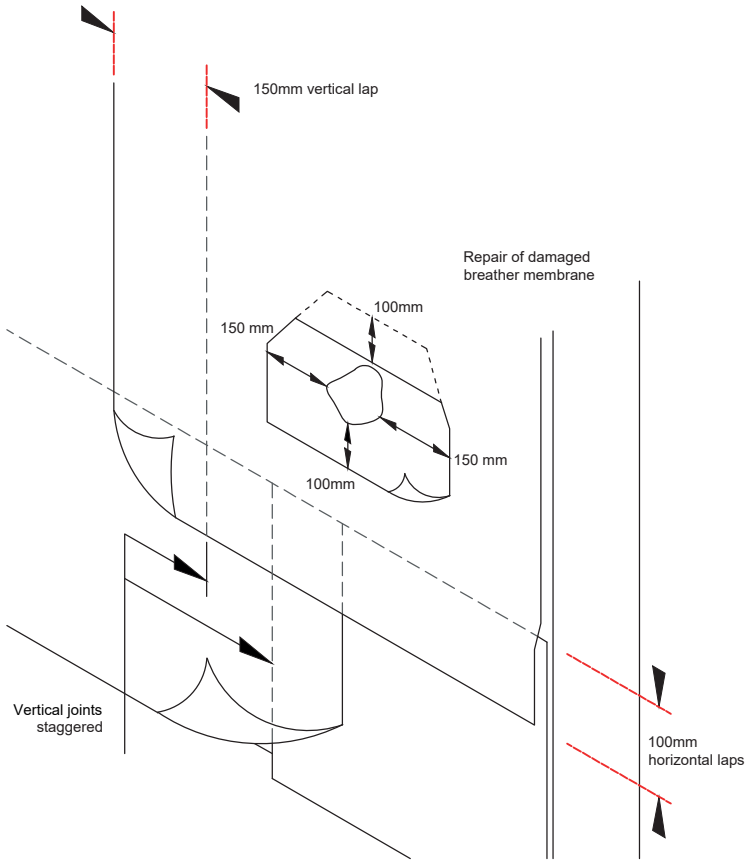
Plasterboard

Plasterboard should be to BS 1230 and not less than:

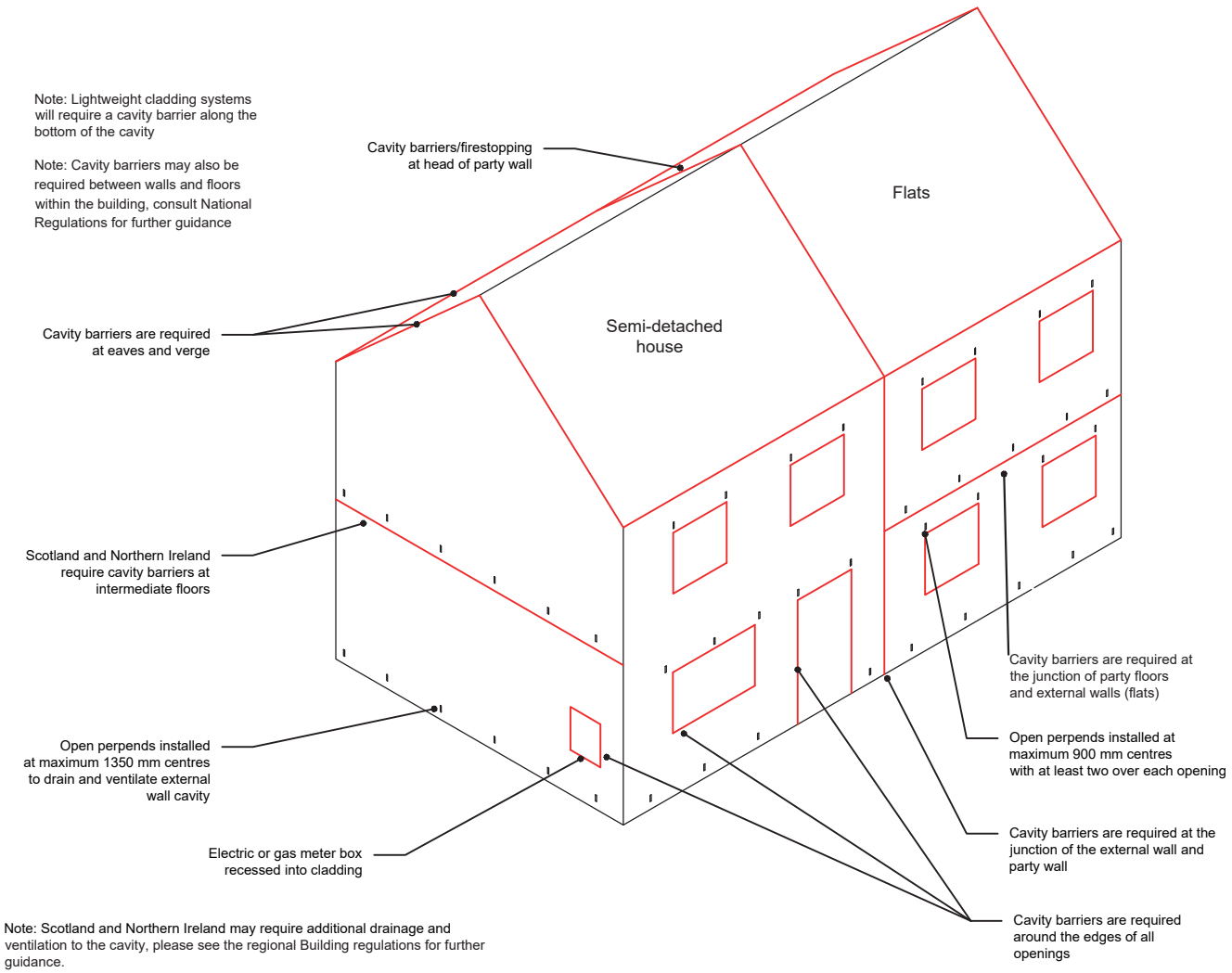
- 9.5mm for stud spacing up to 450mm, or
- 12.5mm for stud spacing up to 600mm.

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 perpends



Note: Scotland and Northern Ireland may require additional drainage and ventilation to the cavity, please see the regional 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.
- 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 manufacturers instructions) to form a continuous barrier.
- Backed by studs, rails or floor joist.
- In accordance with manufacturer or independent certifier's guidance.

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

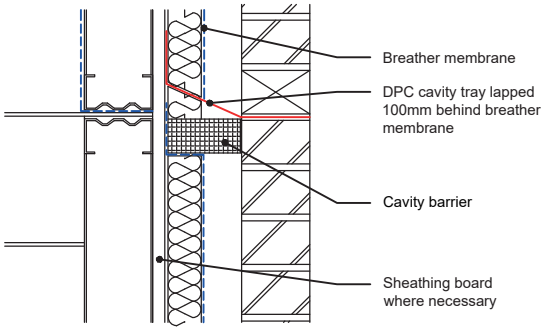
Cavity barriers are required to prevent the spread of smoke and flame within concealed spaces.

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 approval mineral wool product.
- Calcium silicate, cement-based or gypsum-based at least 12mm thick.
- An independently assessed and certified proprietary product.

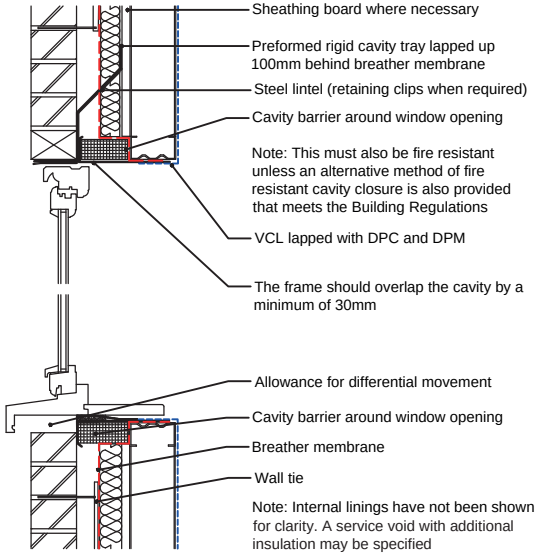
Cavity tray above horizontal cavity barrier - Steel frame



Window and door installations

Please refer to the 'Windows and Doors' guidance for installation requirements of frames including maximum gaps and fixings.

Typical vertical section through window opening



In this instance the steel frame has been shown with an external sheathing board

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.

Acoustic performance:

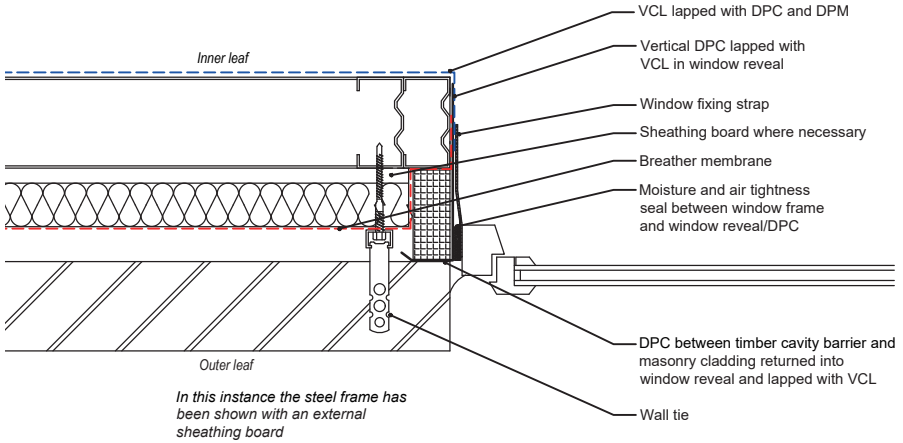
- Seal gaps between steel frame wall and the element being installed into the opening.
- The element being installed into the opening may have a minimum acoustic requirement.

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.
- 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.

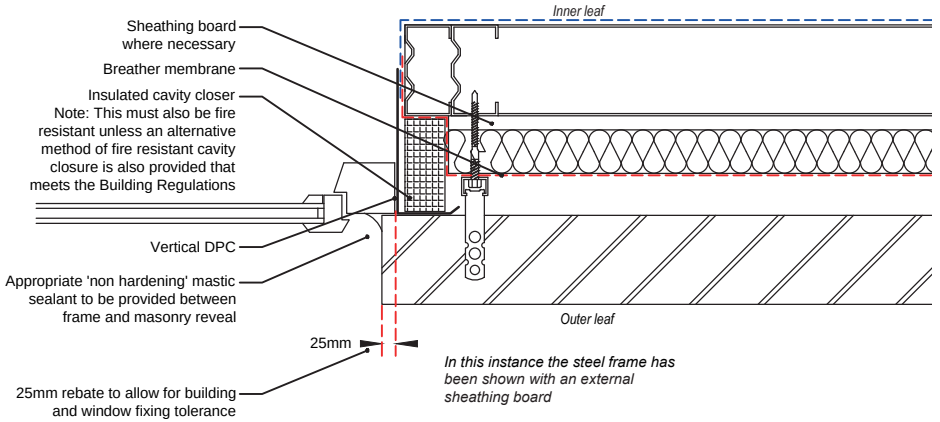
Further information on the installation of lintels can be found in the 'External Walls - Traditional Masonry' section of the Technical Manual.

Typical window reveal detail (normal exposure)



In this instance the steel frame has been shown with an external sheathing board

Typical rebated window frame detail for areas of very severe exposure



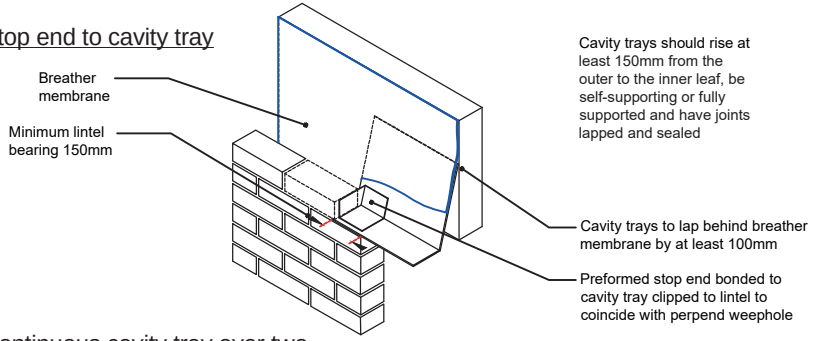
In this instance the steel frame has been shown with an external sheathing board

Windows and doors

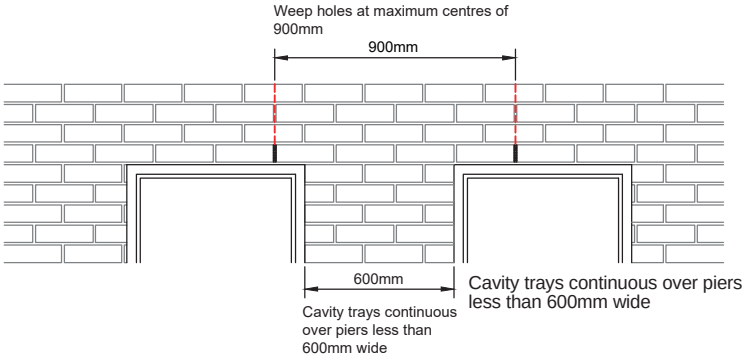
In areas of very severe exposure, checked rebates should be provided. The frame should be set back behind the outer leaf and should overlap.

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

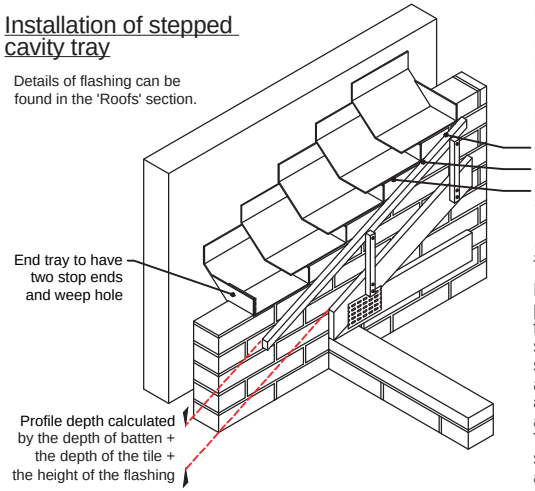
Stop end to cavity tray



Continuous cavity tray over two openings and a small pier



Installation of stepped cavity tray



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.

Profile line
Heel of tray should be installed against profile
Mortar should be raked out under the cavity tray to a depth of 25mm

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)

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 are to be provided:

- Cavity trays are to be provided to comply with relevant regional Building Regulations.
- At all interruptions likely to direct rain water across the cavity, such as rectangular ducts, lintels and recessed meter boxes.
- Above cavity insulation that is not taken to the top of the wall, unless that area of wall is protected by impervious cladding.
- 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.
- Continuously above lintels where openings are separated by short piers.
- Above openings where the lintel supports a brick soldier course.

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 perpend to the end of the cavity tray. Stop-ends can be formed by sufficiently turning up the end of a DPC tray into the perpend joint. Surplus mortar should be removed from cavities and wall ties cleared of mortar droppings and debris as the work proceeds.

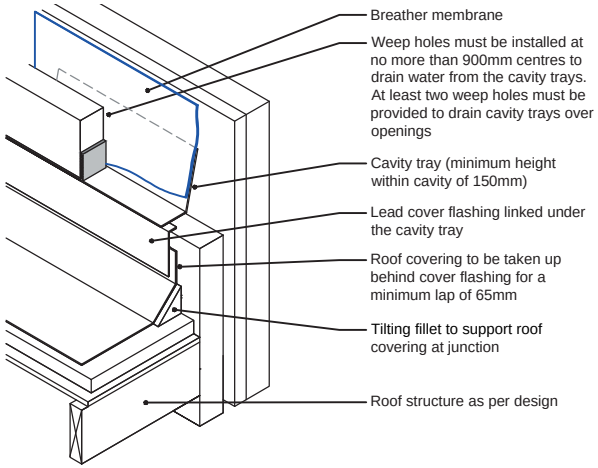
Other perforations of the building envelope

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.

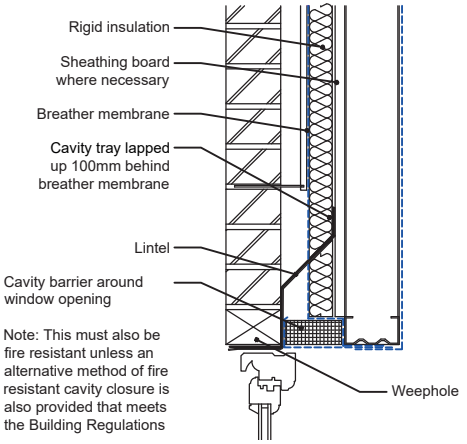
Proprietary cavity tray systems

At stepped and lower storey abutments, and around corners in low rise external walls, a proprietary cavity tray system should be used.

Flat roof abutment cavity tray construction



Cavity tray and lintel



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.
- 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

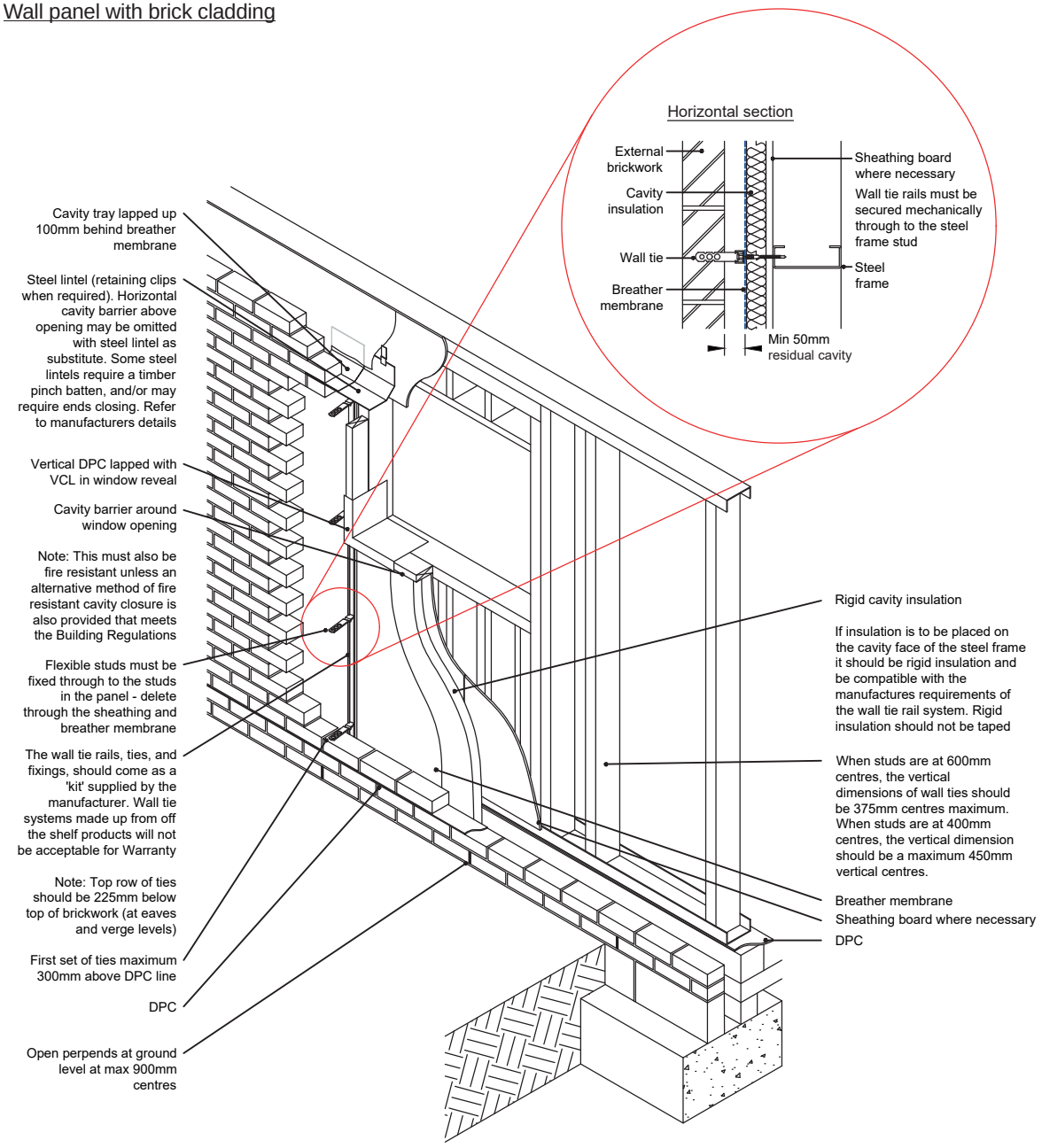
- Cavity trays must be provided above all cavity barriers, windows and door openings, etc.
- Cavity trays should extend 150mm either side of the door or window openings and have stopped-ends.
- A continuous cavity tray should be provided where intermediate floors meet the external wall.
- Soft joints 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' section of the Technical Manual.

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

Wall panel with brick cladding



External masonry stone cladding

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.

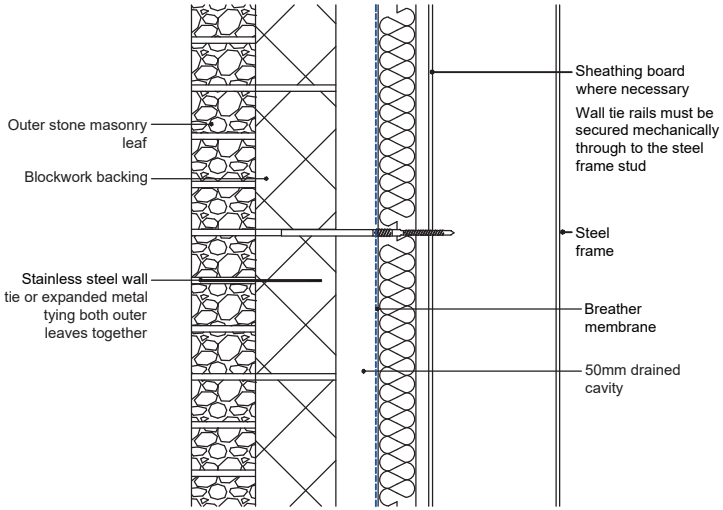
It is not recommended to use a soft, porous-type stone in a severe exposure zone. Consideration should be given to the compatibility of different stone to prevent staining and premature decay. Limestone and sandstone should not be mixed together.

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 90mm due to the irregularities of the stone, the stone should be backed with either a brick or 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.

Steel frame with stone outer leaf



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.

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 the previous guidance for cavity trays, 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.

Claddings supported on the steel frame

Claddings supported on the steel frame should be connected to it on vertical treated timber battens, or a carrier system, to form a drained cavity to all areas of the external Steel frame wall. These should be fixed to the structural steel frame and not just through the sheathing and to the Structural engineers specification. For further details on Claddings please see the External walls claddings section.

Minimum cavity width to steel frame

Steel 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

Render

For further guidance on render requirements, please see the ‘External Walls - Render’ section of the Technical Manual.

6.

External Walls

6.4 Render

Introduction

This Section provides guidance on meeting the functional requirements of Section 6 of the Technical manual. This guidance document provides guidance on site- made renders and factory made renders.

This rendering section should be read in conjunction with Section 6.1 Traditional Cavity masonry walls, Section 6.2 Timber frame and 6.3 Light gauge steel frame. 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 (and vented for framed structures) provided to separate and protect a 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 maybe 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 leafs to timber frame or light steel frame structures:

- A drained (and vented, if timber/ SIP framed) cavity will be required between the frame and out 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 in the external wall with weeps and stop ends provided.

Please note: For Warranty purposes weep-holes 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 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, cills 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. 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.

- 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.
- For high absorption e.g. lightweight blockwork, common bricks etc. and smooth dense substrates (such as engineering bricks); direct rendering is not acceptable for Warranty purposes.

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.

For high absorption e.g. lightweight blockwork, common bricks etc. and smooth dense substrates (such as engineering bricks); direct rendering is not acceptable, as the moisture can be extracted by the substrate from the wet render which affects its curing and bonding capability.

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 bed joint reinforcement within the mortar joints. This should be provided in accordance with the structural 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.

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 marked in accordance with EN 998-1 or EN 15824 for specification of the render. Evidence of the CE 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, or
- Insulated concrete formwork (ICF)

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. (See Appendix B 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 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.

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 C2 of the Technical manual and the ICF concrete core should be suitably reinforced to avoid cracking (In accordance with the Structural 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 (BBA or BDA not ETA)

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.

General conditions

These are systems applied to the exterior walls of existing or new buildings, comprising of an insulant and a protective render finish..

A third party product approval such as BBA, BDA is required for the 'combined render and insulation 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.

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.

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 insulated render 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 insulation type for the structure and application should be suitable for the intended purpose and, when required, should be keyed to receive the desired base coat and reinforcement. The insulated render system should be designed to minimise the risk of interstitial condensation and the effects of thermal bridging. 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.

In accordance with the render system manufacturer's recommendations appropriate beads should be provided 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.

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

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

Proprietary preparation works

- Ensure all fixings, cables, fence posts, light fitting, satellite dishes and other ancillary fittings and fixtures are temporarily removed to enable the easy application of the insulated render system.
- Remove existing and provide temporary downpipes, avoid allowing the temporary downpipes to spill water over the render system.
- If required reset all drainage gulley'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.

Where an insulated render system is used as a cladding to a timber or light gauged steel 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.

General rendering requirements 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

- 15mm 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 location UPVC beads are recommended.
- Only clean water should be used for mixing.

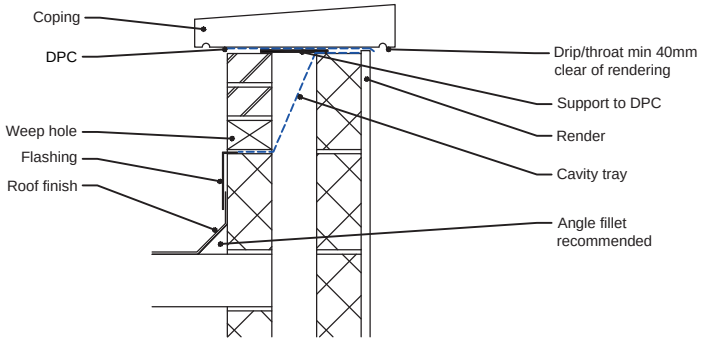
Vertical and horizontal flatness

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.

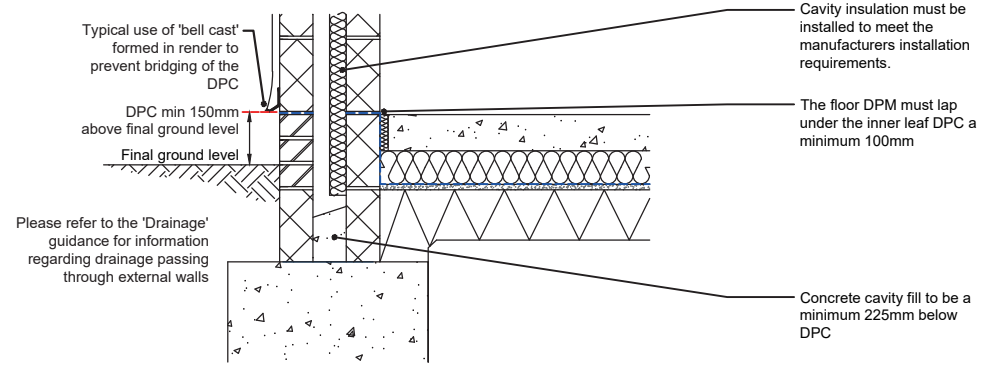
Render below DPC, backs of parapets or chimneys - ALL Cases (i.e. within 150mm of the adjacent ground level)

- 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

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 of Section 6.

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 and take account of the product manufacturer's recommendations.

CE 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.

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 flanking transmission at:

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

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

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 avoided through 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 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 testing of water penetrations to critical joints in accordance with CWCT test methods is required to check to site workmanship of the building envelope as constructed. Areas and method of testing is to be agreed prior construction. See CWCT Technical Note 41 for guidance.

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 should be calculated in accordance with BS EN 1991 and movement should be accommodated without any reduction in performance. Fixings and supports should be designed to accommodate specified loads and take account of the product manufacturer's recommendations.

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.

Rainscreen systems and their materials must comply with the Building Regulations Approved Document B.

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 8417:2003, 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 should be correctly fitted without gaps, fill the cavity and be fixed with stainless steel staples or equally durable fixings.

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 least 10% of the board width.

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 twice the board thickness or plain shank nails at least 2.5 times the board thickness.

Butt joints at board ends should occur at battens. Nails should be either hot dipped galvanised, stainless steel or equally durable. Aluminium nails should not be used with timber treated with a preservative containing copper. Galvanised nails should not be used with Western Red Cedar.

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 Association 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.

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

T 0800 183 1755 E enquiries@labcwarranty.co.uk

www.labcwarranty.co.uk