6.

External Walls

Contents

Introduction

This section provides guidance on meeting the performance requirements for the following types of external masonry walls:

- Masonry cavity walls.
- Masonry cladding to timber frame structures and light gauge steel frame structures.
- Solid masonry walls to single storey non-habitable garages.

6.1.1 Compliance

The design, specification and construction of external masonry walls shall meet the performance requirements of this section.

6.1.2 Information to be provided

The Designer shall provide sufficient design details to demonstrate it meets the requirements of this section.

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

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

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

6.1.3 Structural design of walls

External masonry walls shall:

- Meet the requirements of relevant standards and Building Regulations.
- Be durable.
- Safely support and transmit intended loads to the foundations without undue movement.

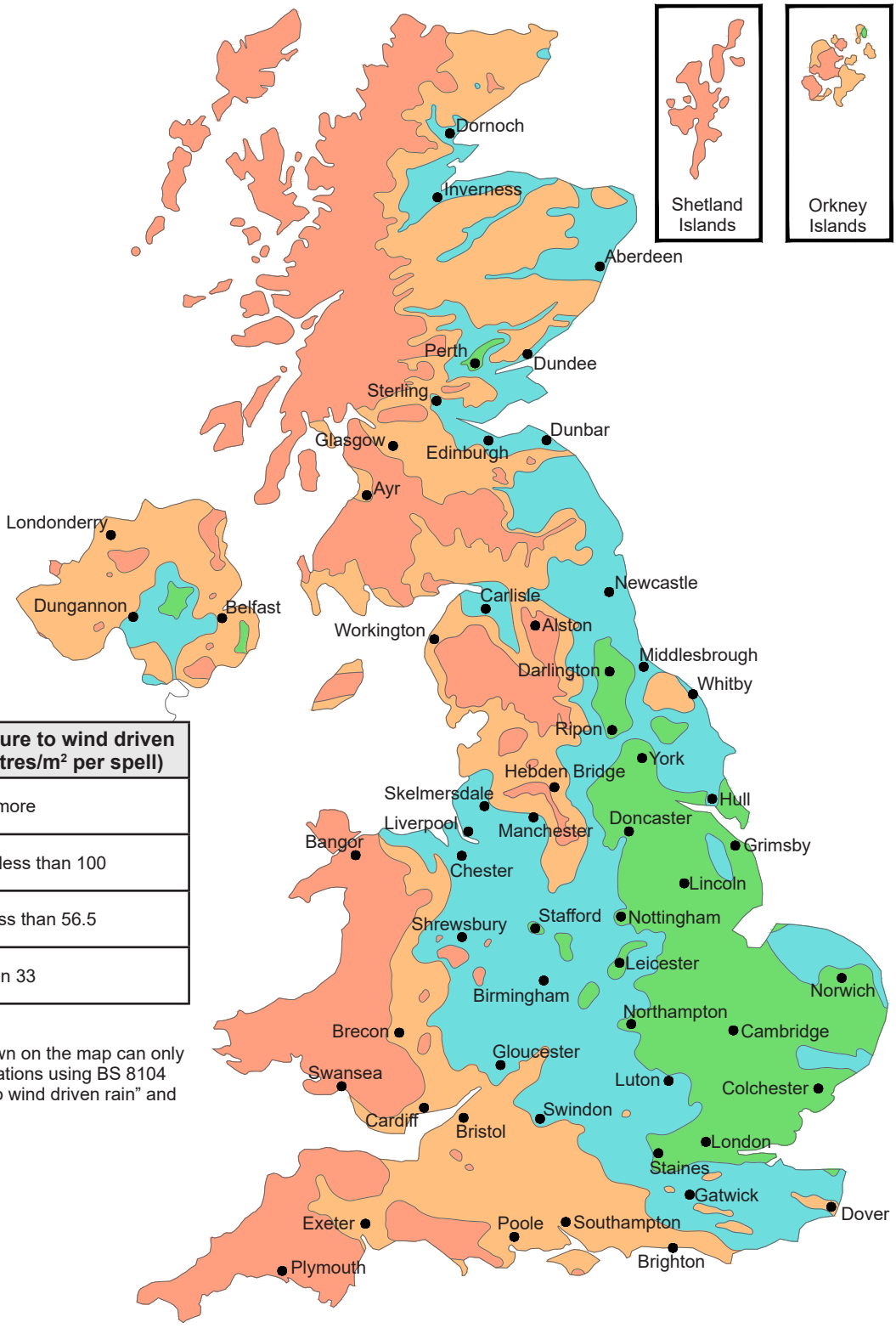
External masonry walls should satisfy the following standards:

- BS EN 1996-1-1
- BS EN 1996-2
- BS 8103 in relation to lateral restraint requirements
- BS EN 845-1
- BS EN 845-2
- BS EN 845-3

6.1.4 Exposure to the elements

The design and construction of external masonry walls shall be suitable for the site specific exposure location and shall be able to resist the passage of moisture to the inside of the home.

Materials, products, and building systems should be chosen to take into account wind driven rain exposure maps.



Exposure zones	Exposure to wind driven rain (litres/m² per spell)
Very severe	100 or more
Severe	56.5 to less than 100
Moderate	33 to less than 56.5
Sheltered	less than 33

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

For further information on determining the exposure for the site location please see BS 8104 and BR 262 for further guidance.

Specific requirements for cavity wall construction with full fill insulation

The following table outlines the minimum cavity widths for full fill insulation types for masonry cavity walls in varying exposure locations.

Suitable masonry cavity wall construction depending on exposure, for use with full fill cavity insulation				
		Minimum insulation thickness (mm)		
Exposure category	**Suitable wall construction (max 12m in height)**	**Built-in insulation**	**Retro-fill (other than UF foam) - blown in mineral wool, polystyrene beads etc.**	**Urea Formaldehyde Foam - UF foam**
Very Severe (Exposure zone 4)	Any wall with impervious cladding	50	50	50
	Fair-faced masonry with impervious cladding to all walls above ground storey	100	125	Not permitted
	Any wall fully rendered [2]	75	75	Not permitted
	Fair-faced masonry [1]	150	150	Not Permitted
Severe (Exposure zone 3)	Any wall with impervious cladding or render [2]	50	50	50
	Fair-faced masonry with impervious cladding or render [2] to all walls above ground storey	50	75	50
	Fair-faced masonry [1]	75	75	Not permitted
Moderate (Exposure zone 2)	Any wall with impervious cladding or render [2]	50	50	50
	Fair-faced masonry with impervious cladding or render [2] to all walls above ground storey	50	50	50
	Fair-faced masonry	50	75	75
Sheltered (Exposure zone 1)	Any wall with impervious cladding or render	50	50	50
	Fair-faced masonry with impervious cladding or render to all walls above ground storey	50	50	50
	Fair-faced masonry	50	50	50

Notes:
[1] In very severe exposure locations, fair-faced masonry with full fill cavity insulation must have a cavity width of at least 150mm and the insulation must have a third party product conformity certificate to confirm it can be used in this scenario.
[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 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.

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

6.1.5 Masonry suitability

Masonry units shall:

- Be capable of supporting intended loads.
- Be durable.
- Have appropriate compressive strength in accordance with Building Regulations.

The following shall be taken into account:

- Specification of masonry units.
- Freeze/thaw resistance.
- Sulfate attack.
- Frogs and perforations.
- Reclaimed masonry units.
- Corbelling and architectural brick detailing.
- Specification of natural stone masonry.

Specification of masonry units

Masonry units should:

- Comply with BS EN 771 and PD 6697.
- Be used in accordance with BS EN 1996-1 and BS EN 1996-2.
- Be specified and installed in accordance with the manufacturers recommendations.

Freeze/thaw resistance

Frost attack can occur through the repeated action of rain water freezing and thawing. When water turns into ice, there is increase in volume which can eventually cause stresses to masonry units and lead to spalling.

This can be avoided by specifying freeze/thaw resistant masonry units in areas that are prone to prolonged periods of saturation as per the below table:

Freeze/thaw resistance category	Possible use case*
F2 – Severe exposure to freeze/thaw	Can be used in normal building situations and all exposures to wind driven rain. F2 rated masonry units should be used: • Below DPC • Brickwork plinths • Chimneys • Capping, coping and sills
F1- Moderate exposure to freeze/thaw	Provides a moderate freeze/thaw resistance and in general F1 rated masonry units can be used between DPC and eaves. However they should not be used in areas of severe or very severe exposure to wind driven rain or elevated sites.
F0 – Passive exposure to freeze/thaw	Not freeze/thaw resistant – should not be used externally unless completely protected by impermeable cladding.

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

Common influences which can lead to frost attack include:

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

Details to reduce persistent wetting and lessen the risk of frost attack:

- Parapet walls should have a coping or capping (for further guidance on parapet walls, see ‘External Walls - Parapets’).
- Sills and coping should have a weathered upper surface.
- Paths around the building should drain away from walls to avoid saturating brickwork.

Additional considerations

- External painted finishes on brickwork has the potential to trap moisture and as such the manufacturer should be consulted to ensure the decorative finish will not have a detrimental impact on brickwork durability.
- Masonry units with low soluble salts should be specified where there is a risk of brickwork being persistently wet.
- Most concrete bricks have a strength of 22N/mm^2 and are durable in most situations and are equivalent to frost resistance class F2 for clay bricks. For copings and sills, bricks with a compressive strength of 36N/mm^2 should be used.
- Concrete blocks used in the outer leaf without protective cladding or render must have a compressive strength greater than 7.3N/mm^2 or have a density of at least 1,500kg/m^3.

- In Scotland, all clay bricks used externally should be frost-resistant, F2, S2 or F2, S1 to BS EN 771-1 and all concrete bricks used as facings should be 22 N/mm^2 to BS EN 771-3.
- In areas of severe and very severe exposure to wind driven rain, the following should be specified:
  - Clay facing bricks which are frost-resistant F2, S2 or F2, S1 to BS EN 771-1.
  - Concrete bricks with a minimum strength of 22N/mm^2 to BS EN 771-3.
  - Concrete blocks with a minimum density of 1,500kg/m^3 or compressive strength greater than 7.3N/mm^2.
  - Calcium silicate masonry units must be confirmed to be F2 rated to BS EN 771-2 by the manufacturer.

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.

Sulfate attack

To reduce the chance of sulfate attack, sulfate resisting masonry units should be chosen.

Frogs and perforations

Frogged bricks have a depression in the face of the brick. They should be laid with the major depression, or frog, facing up so that it is fully filled with mortar during laying. 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.

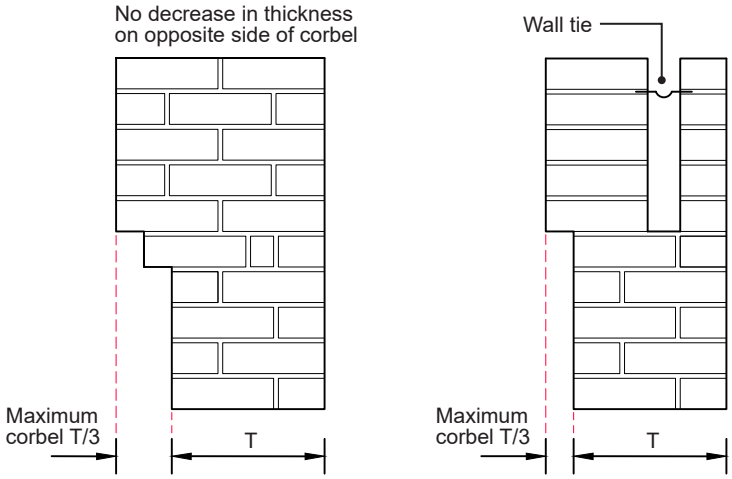
Reclaimed masonry units

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

Corbelling and architectural brick detailing

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

Where architectural brick detailing is specified, the brick manufacturer should confirm the expected durability of the product in the proposed use will meet our Warranty service life requirement of 60 years.



Specification of stone masonry

Natural stone masonry

Natural stone masonry must be selected by the designer, to be based on its suitability for the specific design requirements and site exposure and orientation of the building/plot.

The following should be satisfied:

- Natural stone masonry should also comply with BS EN 12370 or have evidence it is not susceptible to salt crystallisation when used below DPC level.
- The natural stone must be suitably durable for the proposed exposure to protect against freeze/thaw.
- The natural stone units must satisfy BS EN 771-6 and the units must be selected based on the performance of the actual sourced product and not a generic one.
- The selected stone performance information may be found in a Declaration of Performance document issued by the quarry supplier.
- A statement from the supplier, confirming the natural stone units are freeze/thaw resistant must also be provided.

The following should also be taken into account for natural stone:

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

It is 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.

Sawn bed stonework and random rubble stonework (natural stone)

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

In the case of random rubble stonework used as a facing in a cavity wall, the rubble should have a minimum thickness of 150 mm, which may be increased depending on the type of stone supplied by the quarry. The rubble facing may be built in two ways:

- As a facing to a standard two-leaf cavity wall that will be typically post-fixed to the outer leaf, **or**
- Forming the outer leaf itself – in this case the rubble stonework will normally be built up at the same time as the inner leaf, steps to the rear of this rain-screen must be avoided to prevent water running down the inner face and 'splashing' the insulation and inner leaf.

Mortar specification for natural stone masonry

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.

Wall tie specification for natural stone masonry

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 for natural stone masonry (applicable to masonry cavity walls only)

Full fill cavity insulation should only be considered where the outer leaf is backed by brick/blockwork, although this is still dependent on exposure, i.e. either partial fill, leaving a residual cavity of 50mm, or a clear cavity should always be the preferred options. A full third party product conformity certificate, BS8104 analysis, site specific designs, information on porosity of stone and strict acceptance from the manufacturer for any wall build-up will be required.

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

Movement joints for natural stone masonry

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 for natural stone masonry

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

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

Jambs and mullions

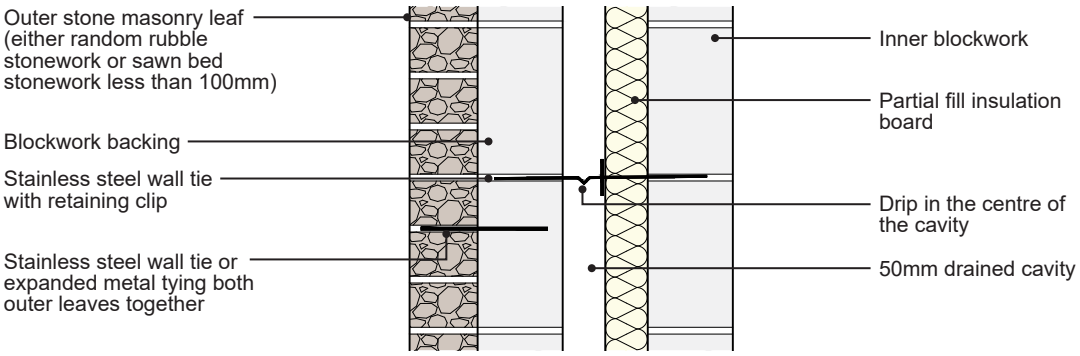
Stone jambs and mullions should be fixed at the top and bottom with stainless steel pins. Stainless steel frame-type cramps can also be used to give extra stability at jambs.

Cast stone masonry

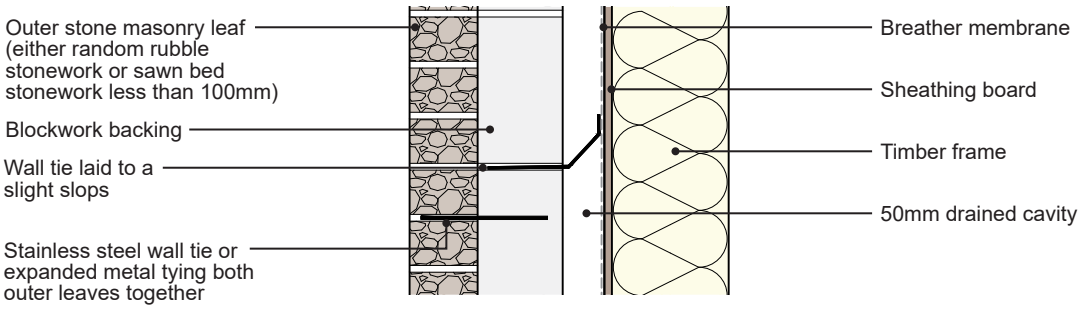
Cast stone masonry units shall satisfy the following:

- Meet the requirements BS EN 771-5 and proof of CE marking should be made available on request.
- Cub test data and capillary absorption test details should be provided.
- To comply with BS 1217:2008 the manufacturer should clearly state the weathering class i.e. either CAT and/or ISAT and the number and date of the British Standard applicable (i.e. BS 1217: 2008).
- The Manufacturer of the cast stone should provide evidence of UKCSA membership.

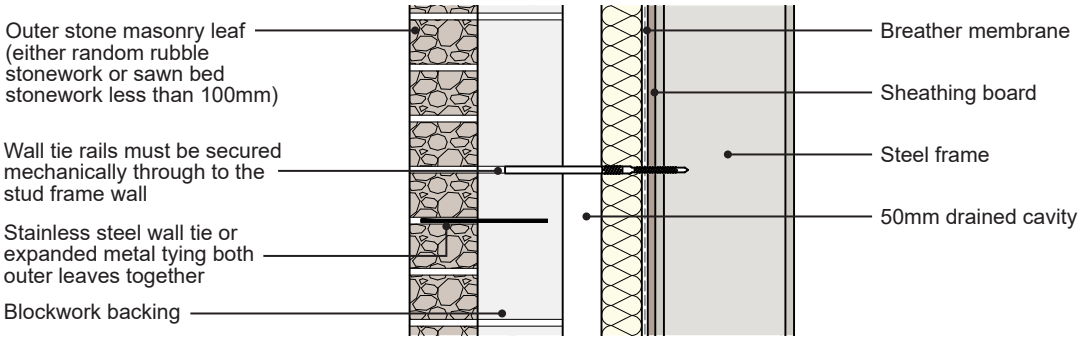
Masonry cavity wall with stone outer leaf



Timber frame with blockwork backing wall and stone outer leaf



Light gauge steel frame with blockwork backing wall and stone outer leaf



6.1.6 Mortar

Mortar shall be selected to achieve adequate strength and durability and be suitable for the type of masonry units and exposure.

Mortar specification

Mortar shall:

- Comply with BS EN 1996-1-1
- Be used in accordance with PD6697

Mortar mixes shall be selected from BS EN 998-2.

Mortars below DPC are exposed to higher levels of saturation and therefore require higher durability classification (see BS EN 998-2).

Mixing

Mortar should be mixed by machine, or ready mixed retarded mortars should be used. Mortar should be carefully and consistently proportioned and then thoroughly mixed using a mechanical mixer, except for very small quantities.

Batching and mixing equipment should be kept clean to avoid contamination with materials used previously.

Recessed mortar joints

Recessed mortar joints should be avoided where:

- Bricks are not frost resistant unless the brick manufacturer has confirmed their use for that particular location.
- The development is on steep sloping ground, facing open countryside or within 8km of a coast or large estuary.
- Bricks are perforated closer than 15mm to the face.
- There is no reasonable shelter from driving rain, e.g. from buildings or groups of trees within 50m and of similar height to the home.
- The cavity is to be fully filled with cavity insulation.

Sulfate attack

Mortar is susceptible to deterioration by sulfate attack, especially when masonry is at a high saturation risk and/or where S1 designated clay bricks are specified. High saturation risks include:

- Below DPC
- Areas of severe or very severe exposure to driving rain
- Parapets
- Chimney stacks
- Retaining walls

Where the mortar is at risk of sulfate attack, sulfate resisting mortar should be specified.

6.1.7 Horizontal damp proof courses (DPC)

Horizontal DPCs shall be suitable for their intended purpose and be provided to prevent moisture rising or entering the home.

- DPCs should be of a flexible material such as:
  - Bitumen based materials (BS 6398, BS EN 14967).
  - Polyethylene (BS 6515, BS EN 14909). Polyethylene DPCs should not be used as cavity trays in walls, below copings or in parapets.
  - Other Proprietary materials with an appropriate third party product conformity certificate.
- DPCs 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.
- DPCs must be located at least 150mm above the external ground level.
- Damp proof membranes should be lapped with the DPC with a minimum overlap of 100mm.
- 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).

Please note, for further guidance on correct selection of DPC and cavity tray materials see ‘Appendix C.’

Rendering below DPC

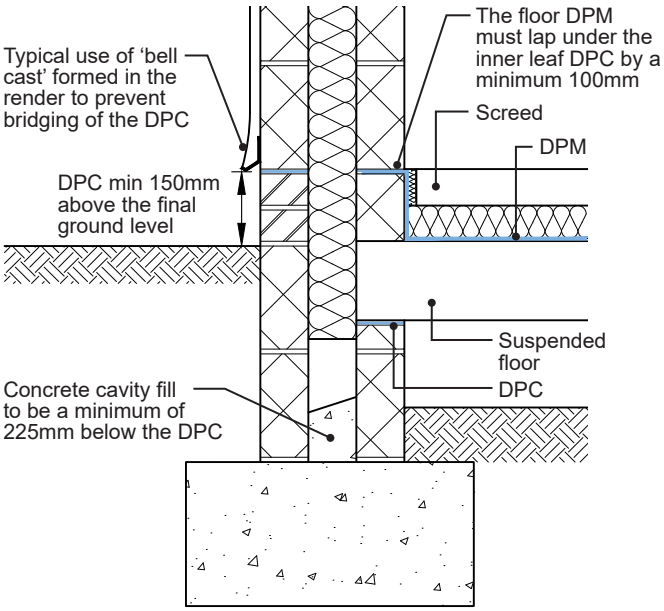
- Rendering below DPC should only be carried out using a specialist render manufacturer’s specification.
- A proprietary uPVC bead or stainless steel bead should be used above and below where the renders meet at the DPC.
- DPC should extend through the rendering system in between the bellcast beads or render stop system.
- 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.

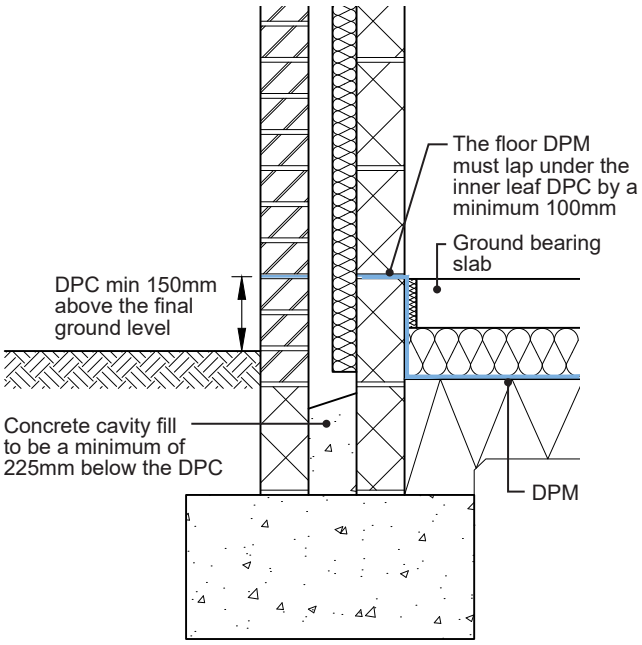
DPC and DPM arrangement

Suspended floor

Example shown with a rendered wall and beam and block floor



Ground bearing slab



Please refer to the ‘Drainage’ section for further guidance on drainage passing through external walls.

6.1.8 Gas protection system

Where a gas protection system (e.g. gas membranes) is required it shall be specified in accordance with relevant standards. Gas protection systems shall be installed to manufacturers recommendations.

Where a gas protection system is required it should be specified and installed by suitably qualified persons.

Where gas membranes horizontally bridges the cavity, a cavity tray should be provided above. Cavity trays should be sealed to the gas membrane in accordance with gas membrane manufacturers instructions to prevent capillary damp ingress at the joint.

Please refer to the 'Ground Conditions – Managing Ground Contaminants' section for further guidance.

6.1.9 Cavities

External masonry walls shall be constructed using an inner and outer leaf with a cavity which resists the passage of moisture to the inside of the home.

- Cavities should not be bridged and should be kept clear of mortar snots and other debris.
- Cavities below ground should be filled with concrete ensuring there is a minimum gap of 225mm between DPC and the top of concrete. Concrete for cavities should be GEN 1 grade and a consistence class S3.
- The cavity should have a minimum width of 50mm.
- The two leaves should be appropriately tied.
- For traditional masonry cavity walls, the cavity may be fully or partially insulated depending on the exposure to wind driven rain. For partial fill insulation, a minimum clear residual cavity of 50mm should always be provided.
- For timber frame and light gauge steel framed buildings, partial fill insulation may be used however a minimum clear residual cavity of 50mm should be maintained. For further information please refer to the 'External Walls – Timber Frame' and 'External Walls – Light Gauge Steel Frame' sections.

Cavity drainage and ventilation for timber framed buildings

Cavity drainage and ventilation in timber framed buildings with masonry cladding should:

- Be provided with full height open perpends at a maximum of 1350mm centres or equivalent open area. Weep-holes alone are unsuitable for timber frame construction.
- 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.
    - Where the soleplate overhangs and a masonry outer leaf is specified, the setting out of the masonry should take the sole plate overhang into account and maintain a 50mm cavity from the face of the sheathing board to the back of the masonry.

Cavity trays at DPC level

Cavity trays must not be specified at DPC level between the external masonry cladding and the timber frame as it can impede on the drainage and ventilation requirements for the timber frame.

Where a cavity tray is proposed at DPC level, proprietary open perpends must be used above and below the cavity tray to provide:

- Drainage and ventilation to the timber frame above the cavity tray, and,
- Ventilation to the sole plate below the cavity tray.

Where flexible DPC materials are to be used as a cavity tray, they should have supporting evidence in the form of a Declaration of Performance to BS EN 14909:2012. They should also have a third party product conformity certificate their suitability for use as a cavity tray.

Cavity drainage requirements for light gauge steel framed buildings

Where masonry cladding is specified in front of the light gauge steel framed buildings, the cavity needs to have adequate drainage. Suitable drainage weeps and cavity tray systems should be provided.

6.1.10 Cavity barriers

Cavity barriers shall be durable and must not adversely affect the structure of the external wall or the performance weatherproof envelope.

Where required by statutory regulations, cavity barriers shall:

- Be of a suitable material.
- Specified and installed within the scope of the test certification and/or the third party product conformity certificate.
- Be installed in accordance with the manufacturer's recommendations.
- Be suitable for the location they are installed.

Where cavity barriers are required by statutory regulations, their specification, positioning and installation should satisfy the requirements of the Building Regulations.

Where vertical cavity barriers are required, they should be continuous for the full height of the wall and extend below DPC level.

Where horizontal cavity barriers are provided they must be tested for the scenario and have a third party product conformity certificate. A cavity tray must also be specified above with appropriate drainage.

6.1.11 Wall ties

Wall ties shall be of the correct type and suitable for the intended purpose and location.

Wall ties should be:

- In accordance with BS EN 845-1 or have an appropriate third party product conformity certificate for their intended use and location.
- Specified to accommodate movement where the design requires.
- Specified and installed as per the manufacturer's instructions.
- Spaced in line with the guidance in the 'External Walls' section or as per an Engineers design and specification. Wall ties should be specified at a minimum density in accordance with BS EN 1996 -1-1. This should not be less than 2.5 ties per m^2 and may increase with cavity width.

Wall ties should be installed so that they:

- Are long enough to be embedded a minimum of 50mm into each leaf.
- Have a slight fall towards the outer leaf and have the ability to hold insulation against an internal leaf for partial fill scenarios.
- Have the drip positioned in the centre of the cavity.
- Are clear of mortar droppings.
- Have a staggered or a diamond pattern.

Wall ties for traditional masonry cavity walls

Wall ties for traditional masonry cavity walls should be stainless steel or a non-ferrous metal and should also satisfy the below requirements.

Spacing of wall ties

This table may be used for dwellings up to three storeys high in areas of sheltered and moderate exposure locations, with a cavity width between 100mm-150mm.

	Max horizontal spacing (mm)	Max vertical spacing (mm)
General wall area	900	450
Openings and movement joints	Within 225	Not more than 300[1]
Top of gable walls	225 (parallel to top of the wall)	Not more than 300[2]
Top and bottom of openings	450	N/A

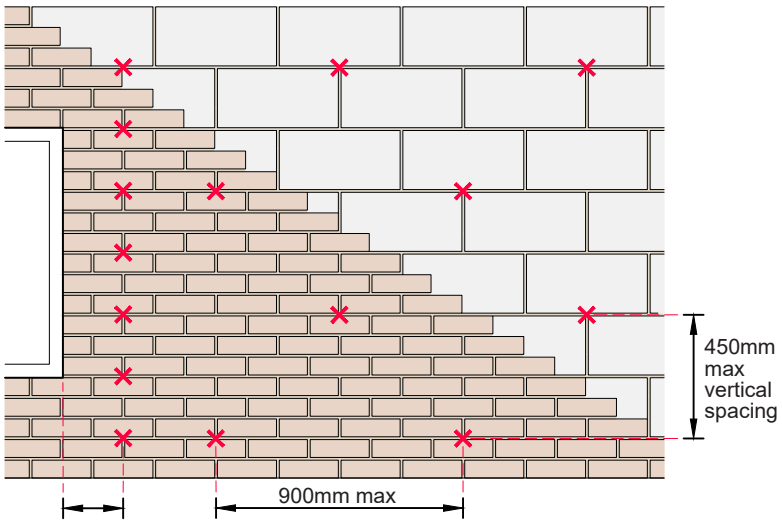
[1] The vertical spacing of number of ties may need adjusting to produce equivalent number of ties when using insulation boards.
[2] The vertical spacing of number of ties may need adjusting to produce equivalent number of ties when using spandrel panels.

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

Cavity widths between 100mm-150mm in severe and very severe exposure locations, or elevated locations of over 150m above sea level

A site specific assessment should be carried out by an Engineer. The 'Spacing of wall ties' table may be acceptable if used with stiffer wall tie types (e.g. types 1 or 2 in accordance with PD6697).

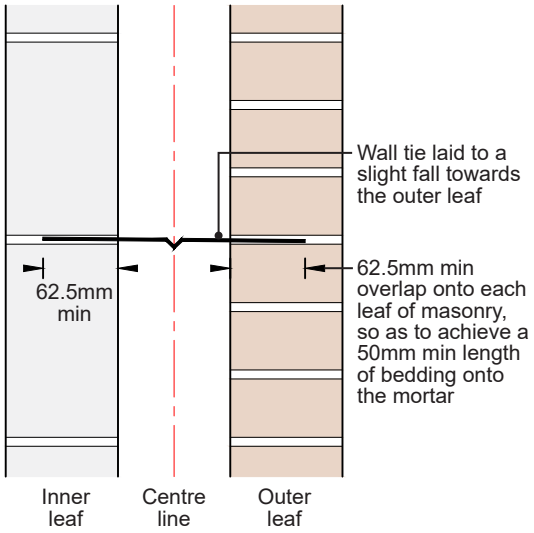
Wall tie locations



Provide additional ties at movement joints and openings at 225mm max horizontal spacings

The horizontal spacing may need to be decreased depending on the cavity size

Wall tie provision



Wall ties for timber framed buildings

In addition, wall ties should also:

- Be constructed from austenitic stainless steel.
- 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 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 (where the basic wind speed exceeds 25m/sec) and any areas where the site is at an altitude of 150m or more above sea level.
  - An increased wall tie density may be required in exposed locations or for buildings higher than three storeys in height, the actual performance required for each site location or building should be determined by an Engineer.
- For timber framed structures, maintaining a 225mm horizontal wall tie spacing can be difficult as the timber studs may be more than 225mm away from the movement joint or opening. Introducing additional timber studs may be impractical and therefore an alternative solution of using slip ties at 300mm vertical centres with 50mm embedment into the masonry either side of the movement joint, could be considered subject to an Engineers design.

Wall ties for light gauge steel framed buildings

Wall ties should also meet the following provisions:

- Wall tie density depends on a number of site specific factors and should be considered by an Engineer.
- External skin of brick should be attached to the metal frame with either epoxy coated galvanized ties or austenitic stainless steel ties (to DD140, BS 12, BS 5268, BS 8200).
- Ties are normally fixed in vertical channels, these channels are then fixed through the sheathing board or insulation board to the light gauge steel frame with stand-off screws (screws should be isolated from the channels with neoprene or similar washers).
- The wall tie rails, ties, and fixings, should come as a ‘kit’ supplied by the manufacturer. Wall tie systems made up from off the shelf products will not be acceptable for Warranty.
- The wall tie system ‘channels’ should be fixed to ensure the fixings go into the centre line of the steel frame studs.
- Cavity wall insulation should be of the rigid type and should be compatible with the manufactures requirements of the wall tie rail system.
- 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.
- Top row of ties should be 225mm below top of brickwork (at eaves and verge levels).
- When studs are at 600mm centres, the vertical dimensions of wall ties should be 375mm centres maximum. When studs are at 400mm centres, the vertical dimension should be a maximum 450mm vertical centres.

6.1.12 Thermal insulation

Thermal insulation shall be specified correctly and installed to avoid damp and interstitial condensation issues occurring within the wall makeup. The overall insulation value of the wall shall meet the requirements of relevant Building Regulations.

Thermal insulation should:

- Have an appropriate third party product conformity certificate for use in it's intended location.
- Be installed in accordance with the manufacturer's instructions.
- In all situations where partial fill insulation is specified, a 50mm residual cavity must be maintained.
- 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 insulated cavities, mortar joints to facing brickwork should not be recessed.

Traditional masonry cavity walls

For traditional masonry cavity walls, cavity wall insulation may be either full fill or partial fill depending on the exposure location of the site.

Injected and blown fill insulation

Where injected and blown fill insulation is proposed, the insulant material should have a third party product conformity certificate and be suitable for the wind driven rain exposure.

Injected and blown fill insulation should be installed by a manufacturer approved contractor and in line with the third party product conformity certificate.

Framed walls

Cavity wall insulation to framed walls shall also satisfy the following:

- 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 framed structure.
- Joints between the 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 insulation manufacturer requires the joints to be taped, the tape must be of a type as recommended by the insulation manufacturer, breathable to allow water vapour to move freely and resist water penetration.
- Where the insulation board has an integral foil facing on one side only, the insulation should be fixed so the foil is facing towards the cavity side.
- The insulation board should be covered with a breather membrane adjacent to the cavity where required by the insulation manufacturer or third party product conformity certificate for the insulation.

Timber framed walls

For timber framed walls, the following should also be satisfied where cavity wall insulation is specified between the timber frame and masonry cavity:

- Allowance should be made for differential movement to occur at floor zones.
- 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.
- Foil faced insulation boards should not be taped.

For further information on thermal insulation for timber framed buildings, please refer to the 'External Walls – Timber Frame' section.

Light gauge steel framed walls

For light gauge steel framed walls, The following should also be satisfied where cavity wall insulation is specified between the light gauge steel frame and masonry cavity.

The insulation should be fixed to the outside face of the steel studs to create a 'warm frame' construction.

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.

6.1.13 Chases in masonry walls

Chases in masonry walls shall not impair on the structural integrity of the wall.

Chases should:

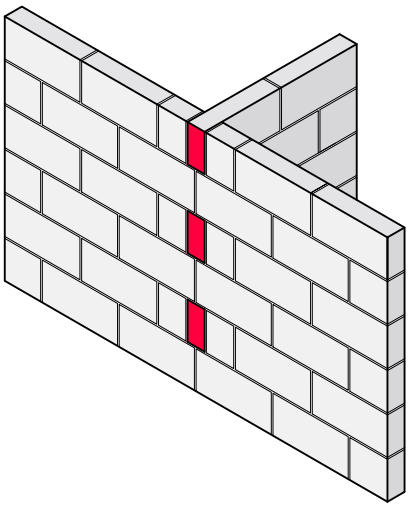
- Only be made in solid masonry (not hollow blocks).
- A horizontal chase must not exceed 1/6 the thickness of the single leaf.
- A vertical chase must not exceed 1/3 the thickness of the wall.

6.1.14 Bonding internal walls to external cavity walls

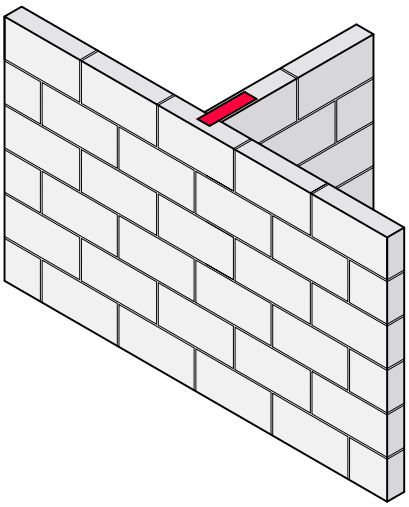
External walls shall be appropriately bonded to internal walls as specified by the designer.

Where an internal wall abuts an external wall, they may be tied or bonded together. Tied joints should be formed using expanded metal strip, wall ties or equivalent fixings, at maximum 300mm vertical centres.

Block bonding internal walls to inner leaf



Block bonding internal walls to inner leaf using ties



To reduce the risk of cracking, tied joints should be used where:

- Materials have dissimilar shrinkage or expansion characteristics.
- There is a connection between a load-bearing wall on foundations and a non-load-bearing wall supported on a ground-bearing slab.

Dissimilar materials in the same wall should be avoided (clay bricks used to make up courses in blockwork walls).

6.1.15 Movement joints in masonry

Movement joints shall be introduced to control expansion and contraction of masonry walls, reduce cracking and maintain structural stability of the wall. The width of the joint shall be sufficient to accommodate both reversible and irreversible movements whilst maintaining the weatherproof envelope.

Vertical movement joints should be provided to the outer leaf of cavity walls as indicated in the ‘Spacing of movement joints’ table. Movement should also satisfy the following:

- Movement joints should run the full height of the wall and not coincide with window and door openings.
- Generally the ratio of length to height of the panels should not exceed 3:1.
- 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.
- For any given wall elevation where there is a mix of masonry e.g. brickwork external leaf lower level with a rendered block upper level, the requirement of a full height movement joint should be based on the shorter spacing requirement e.g. for the blockwork at 6m not brickwork at 12m.
- Wall ties should be provided at 300mm maximum vertical spacing either side of the movement joint, and within 225mm horizontal spacing of the movement joint.
- 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.

Where traditional cavity masonry walls or masonry cladding is specified for concrete/ (hot rolled) steel framed buildings, horizontal movement joints should be provided with the use of shelf angles at vertical centres in accordance with current design standards. They should be capable of accommodating at least 1mm movement per continuous meter of vertical clay masonry. Shelf angles should not be fixed back to a timber framed or LGSF structures. Please refer to the 'External Walls – Timber Frame' or 'External Walls – Light Gauge Steel Frame' sections for further guidance on accommodating differential movement.

Materials for filling movement joints

The material for filling movement joints to accommodate expansion should be easily compressible to approximately 50% of its original thickness.

Flexible cellular polyurethane, cellular polyethylene or foam rubbers are satisfactory materials.

Hemp, fibreboard, cork and similar materials should not be used for expansion joints in clay brick masonry, but may be used for contraction joints in calcium silicate and concrete masonry.

Sealants

Movement joints should be sealed with an appropriate sealant which can provide sufficient flexibility whilst resisting water penetration.

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.

Allowances for compression thickness of the sealant must allow for the specified movement joint width plus the non-compressible thickness of the seal.

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.

Spacing of movement joints

Material	Normal spacing	Joint thickness
Clay brickwork [2, 3]	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
Natural stone masonry	15-20m [4]	10mm

Notes:
For clay, calcium silicate and concrete masonry, manufacturer's guidance for the spacing and sizing of movement joints should be considered. Where the designer seeks to deviate from the above table, the manufacturer should provide a site specific design and specification taking site and plot specific factors into account (examples include, orientation, mortar and wall build-up).

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 and be 1.5m from corners.
[3] For clay brickwork, a variation can be accepted if the Engineer designs to PD6697.
[4] Located no more than 7.5m from an external corner.

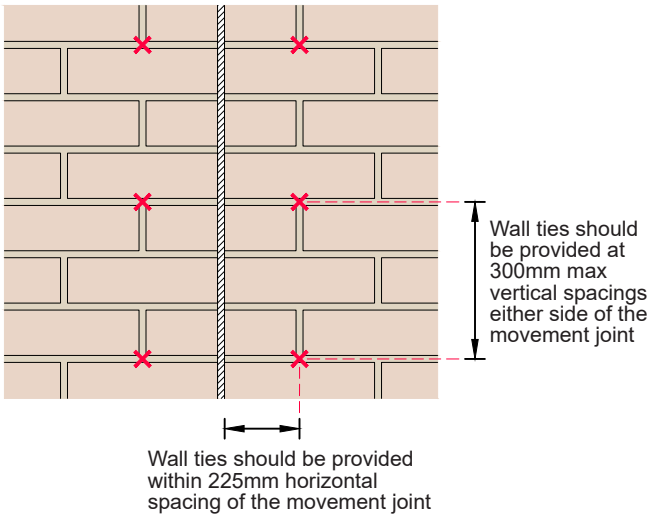
Additional requirements on movement joints for concrete bricks

The rate and extent of movement in concrete bricks can be considerably different to that of clay bricks.

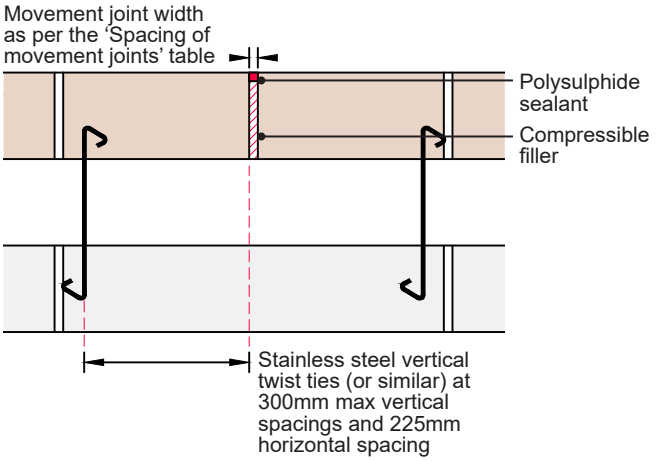
With the high differential of movement between the various available raw materials used in concrete brick manufacture, it is imperative that the design for movement in a wall panel is specific to the shrinkage capacity of the concrete brick used and the requirements of the manufacture should be followed.

In all cases site specific advice should be obtained from the manufacture before work begins.

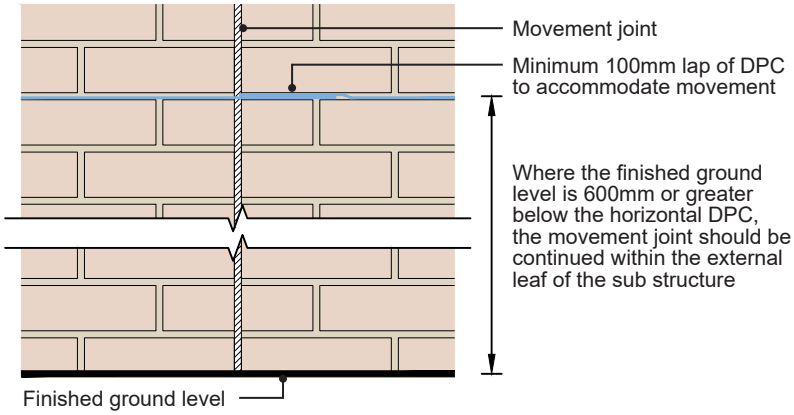
Wall ties in proximity to movement joints



Typical movement joint detail



Movement joints below DPC



6.1.16 Bed joint reinforcement

Where bed joint reinforcement is specified, an Engineer's design must be provided. Bed joint reinforcement shall be of the correct type and suitable for their intended purpose and location.

Bed joint reinforcement may be required to critical areas to accommodate stresses such as above and below window openings. The Engineer may require this to be provided as part of the overall design specification.

Where provided, they will be in addition to movement joints, not instead of. Bed joint reinforcement potentially can increase spacing of movement joints subject to the Engineer's specification.

6.1.17 Differential movement between masonry cladding and timber frame

Where masonry cladding is specified for a timber framed building, the building shall be designed to ensure that differential movement occurs evenly to external elevations and the internal structure. Site specific calculations shall be used to determine movement gap sizes, however in absence of site specific calculations, the guidance within this section and the 'External Walls – Timber Frame' section can be followed.

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.

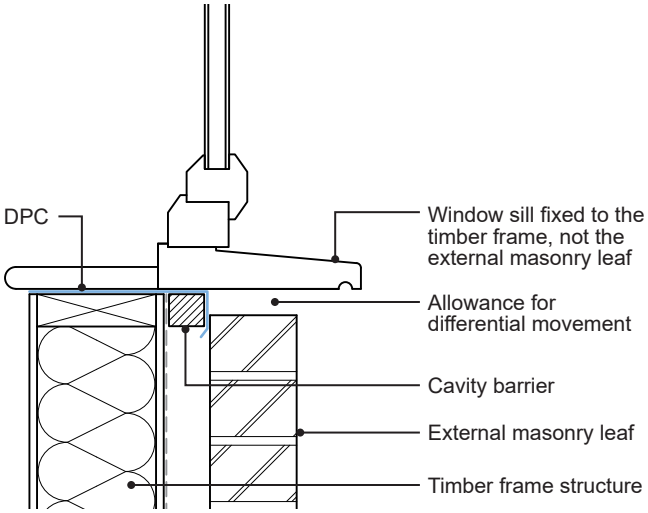
For the purposes of Warranty, a storey is defined as a space between two consecutive floors or between a floor and a roof. The number of storeys should be counted from the lowest external ground level and it should include the ground storey.

Gap location	Differential movement gap size[1]	
	Engineered floor joists	**Solid timber floor joists**
4th Storey	45mm	Engineer design required
3rd Storey	35mm	45mm
2nd Storey	25mm	35mm
1st Storey	15mm	20mm
Ground storey or lowest level of timber frame	5mm	5mm
[1] The compressed thickness of the material used to fill the gap must be added to the dimensions given.		

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

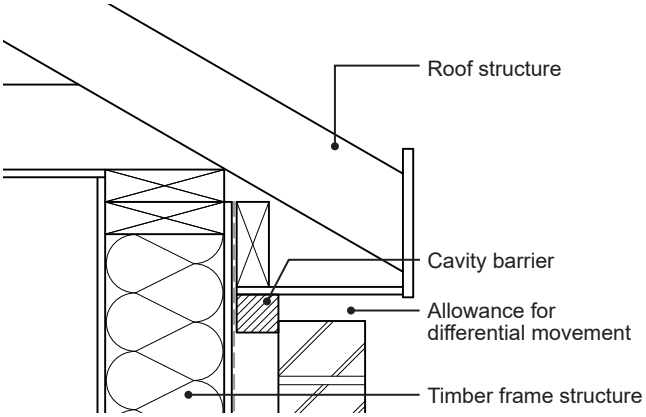
Allowance for differential movement at sill

As the window frame will be fixed to the timber frame, as movement occurs a gap at the top of the window / door may open up and will need to be allowed for to prevent water ingress.

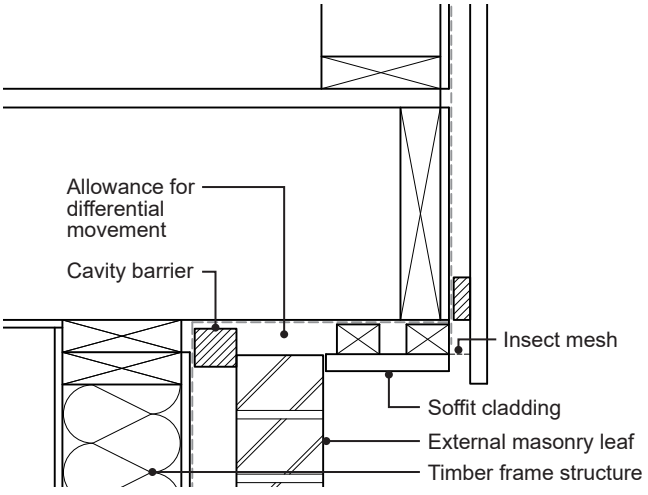


Differential movement at eaves

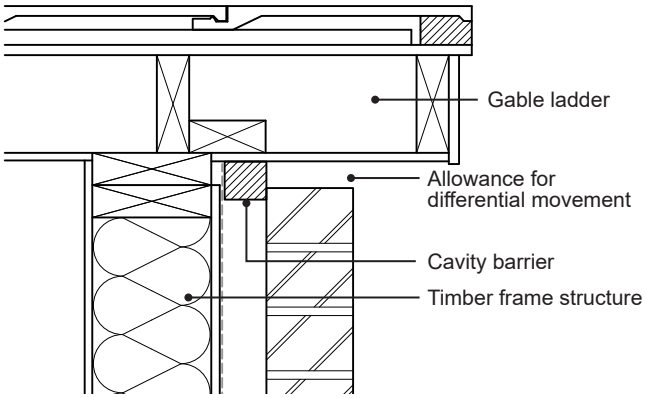
Where there is no overhang protecting the junction between the external masonry cladding and eaves or verge soffit and the movement gap exceeds 10mm, the gap should be protected with a compressible filler material or mesh to prevent the entry of birds. The compressible filler material or mesh should not impede on the differential movement between the external masonry cladding and timber frame.



Differential movement at cantilevered overhang

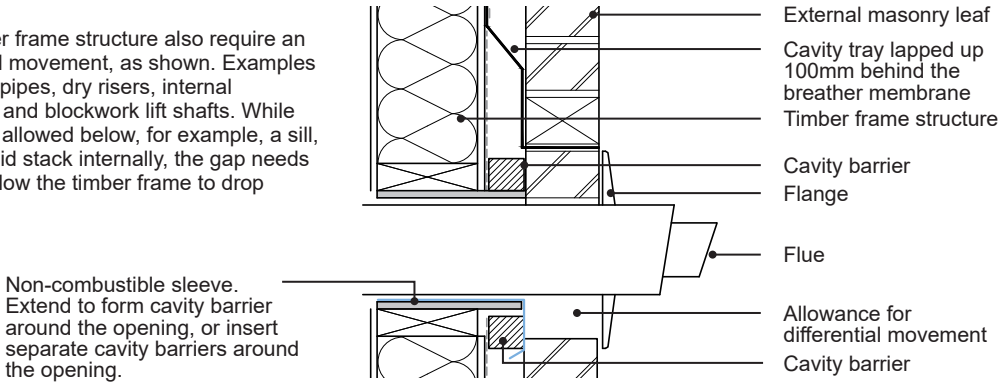


Differential movement at verge



Differential movement at 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, SVPs, cable trays and blockwork lift shafts. While gap allowances externally are allowed below, for example, a sill, when a branch comes off a rigid stack internally, the gap needs to be left above a service to allow the timber frame to drop around it.



6.1.18 Lintels

Lintels shall safely support the applied loads, be of the correct type and size, and be suitable for the location and exposure.

Lintels should be the correct length and width for the opening and cavity width. Simple lintels should have a minimum bearing of 100mm for spans up to 1.2m. The lintel bearing may be increased to 150mm for spans over 1.2m. Lintels combined with a cavity tray should have a minimum bearing of 150mm. In all circumstances minimum bearing lengths should be in accordance with the manufacturer's recommendations. Lintels should also:

- Comply with BS EN 845-2 where steel or concrete lintels are used.
- Have padstones or spreaders present under the bearings where required.
- Be wide enough to provide adequate support for the loads above.
- Be provided where openings frames are not designed to support superimposed loads.
- Be provided over recessed meter boxes.
- Comply with relevant thermal requirements.

Lintels should not:

- Have masonry overhang the lintels by more than 25mm.
- Be supported on short lengths of cut blocks or make-up pieces.
- Have concrete loads applied before the brickwork is full bedded as per the lintel manufacturer's requirements.

Note:
1. Support for masonry walls should not be provided by timber lintels or beams (Oak or any species).
2. For guidance on Lintels in external walls in a coastal locations, please refer to 'Appendix B'.

Separate lintels

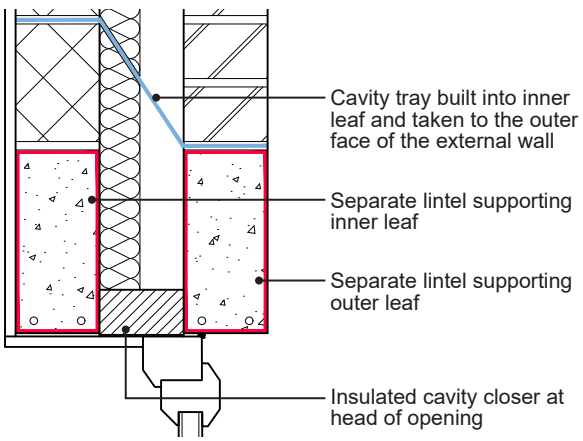
Separate lintels supporting inner and outer masonry leaves should:

- Have an insulated cavity closer installed at the head of the opening.
- Have a cavity tray which is built into the inner leaf and taken to the outer face of the external wall directly over the external lintel.
- Be able to carry loads without causing differential movement between both leaves of masonry.

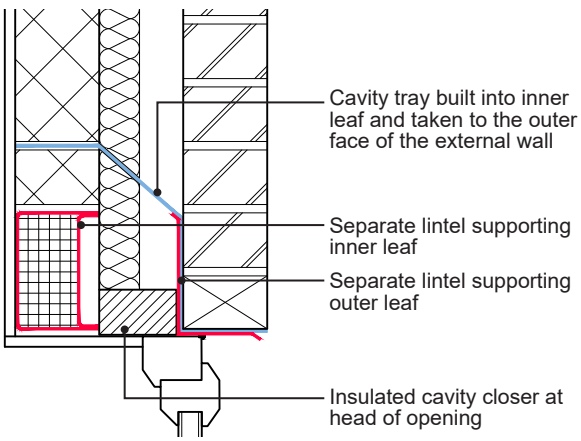
The outer lintel must be suitable for the exposure and be either:

- Continuous reinforced reconstituted cast stone without joints.
- Reinforced concrete without joints.
- Steel.

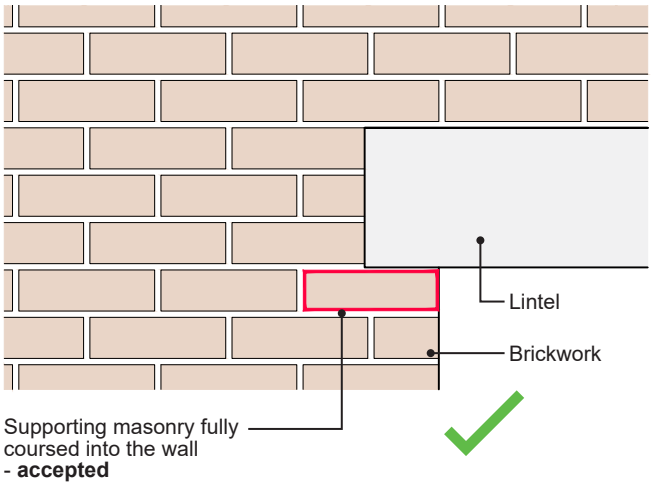
Reconstituted stone or reinforced concrete lintels



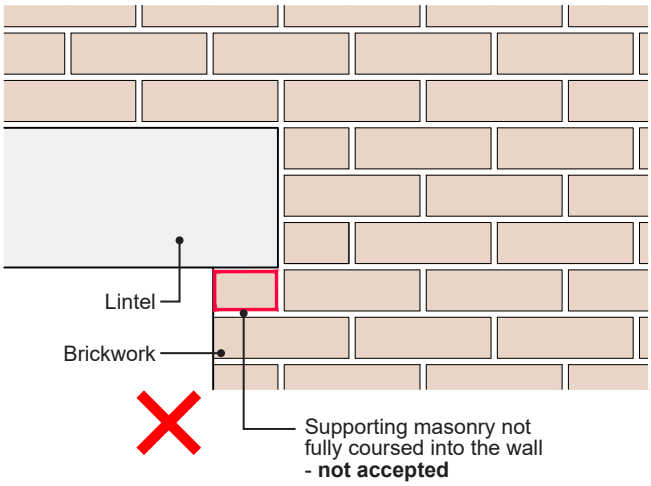
Steel lintels



Correct method of brick bond around lintels



Incorrect method of brick bond around lintels



6.1.19 Forming a weather resistant opening

Openings within the external masonry wall shall be designed and constructed to resist the passage of moisture to the inside of the home and be appropriate for the exposure.

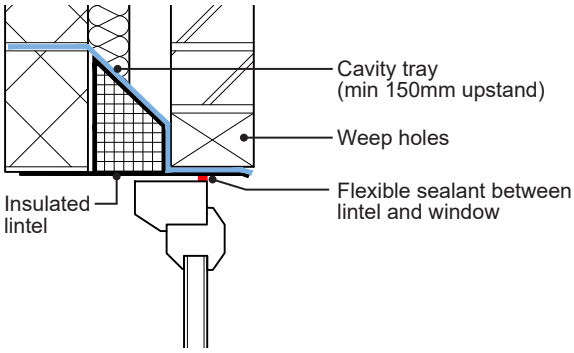
For guidance on gaps around window and doors, please refer to the 'External Window and Doors' section.

Cavity closers

Proprietary cavity closers should be used to close the cavity between the inner and outer leaf. The cavity closer should be:

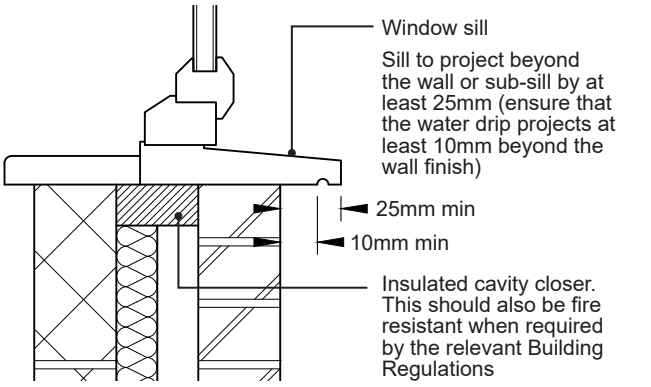
- Suitable for the site exposure.
- Insulated to prevent interstitial condensation.
- Specified and installed to prevent the passage of moisture to the inside.
- Installed as per the manufacturer's instructions.
- Fitted in one continuous piece unless the manufacturer provides detailed installation instructions for jointing.
- Fire resistant where required by the Building Regulations.

Cavity tray detail in relation to window head

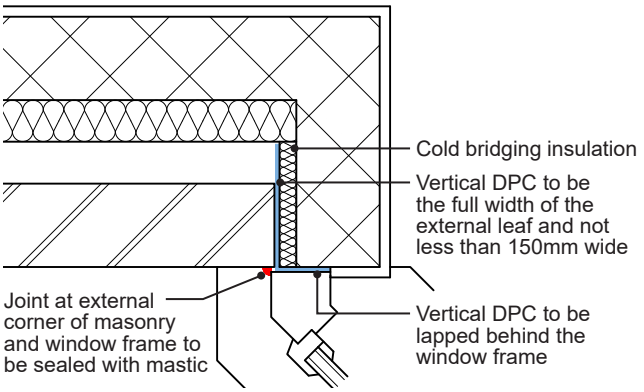


Lintel must comply with relevant thermal requirements.

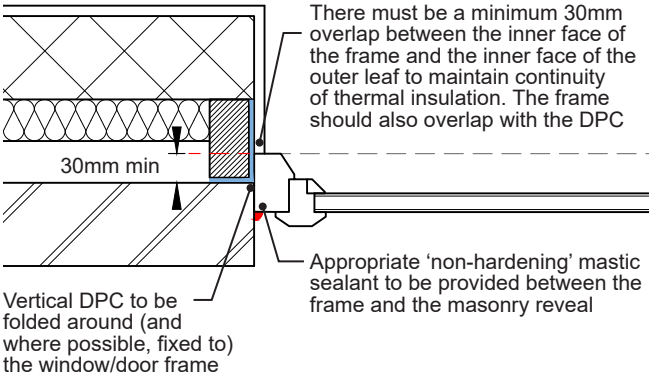
Typical vertical section through window sill



Bay window detail



Typical window reveal detail (normal exposure)



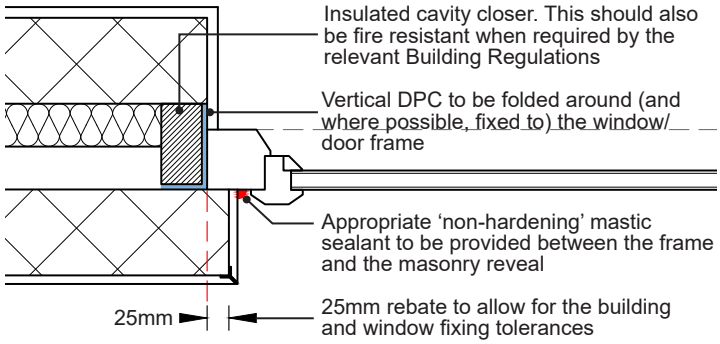
Checked rebates

Checked (rebated) reveals are required in Scotland and in any areas of very severe exposure in England and Wales. 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 cavity closer with an appropriate third party product conformity certificate may be used.

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

Typical rebated window frame detail



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.

6.1.20 Cavity trays and their ancillary components

Cavity trays and their ancillary components shall be suitable and durable for their intended purpose and be provided to prevent moisture entering the home. Particular attention shall be paid to:

- Specification
- Cavity tray locations
- Weep holes
- Stop-ends
- Stepped cavity trays
- Flat roof abutments

Specification

Cavity trays should:

- Meet the requirements of BS EN 14909.
- Have an appropriate third party product conformity certificate confirming suitability for use as a cavity tray.
- Rise at least 150mm from the outer to the inner leaf, be self-supporting or fully supported and have joints lapped and sealed.
- Comply with the relevant Building Regulations.

Cavity trays should be proprietary preformed cavity tray systems at stepped and lower storey abutments, complicated junctions and around corners in low rise masonry walls.

For framed structures, Cavity trays should lap behind the breather membrane by at least 100mm.

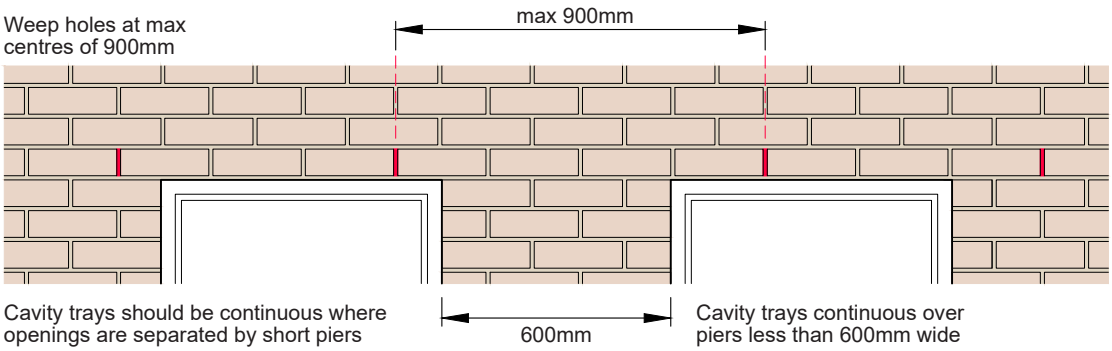
Please note: Polyethylene DPCs should not be used as a cavity tray. Please refer to 'Appendix C' for further guidance.

Locations

Cavity trays should be provided in the following locations:

- Above all openings and interruptions likely to direct rain water across the cavity such as window and door openings, rectangular ducts, lintels and recessed meter boxes.
- Above horizontal cavity barriers.
- Above cavity insulation that is not taken to the top of the wall, unless that area of wall is protected by impervious cladding e.g. where a spandrel is provided cold pitched roof.
- Continuously above lintels where openings are separated by short piers.
- Above openings where the lintel supports a brick soldier course.
- Directly above openings that are under a compartment floor with a cavity barrier and cavity tray already present.
- 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.
- Above lintels in walls in exposure zones 3 and 4. In zones 1 and 2 where the lintel is not corrosion-resistant and not intended to function as its own cavity tray.

Continuous cavity tray over two openings and a small pier



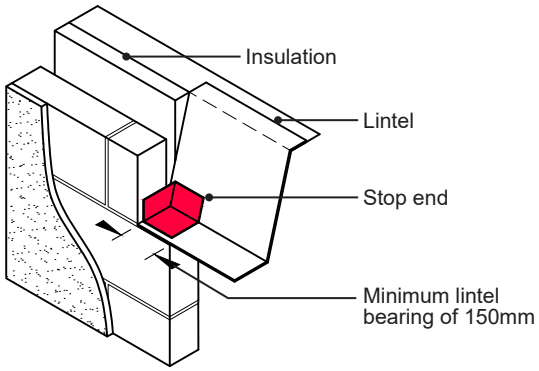
Weep-holes

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

Stop ends

Stop ends should be provided to the cavity tray and they may 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 may also 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.

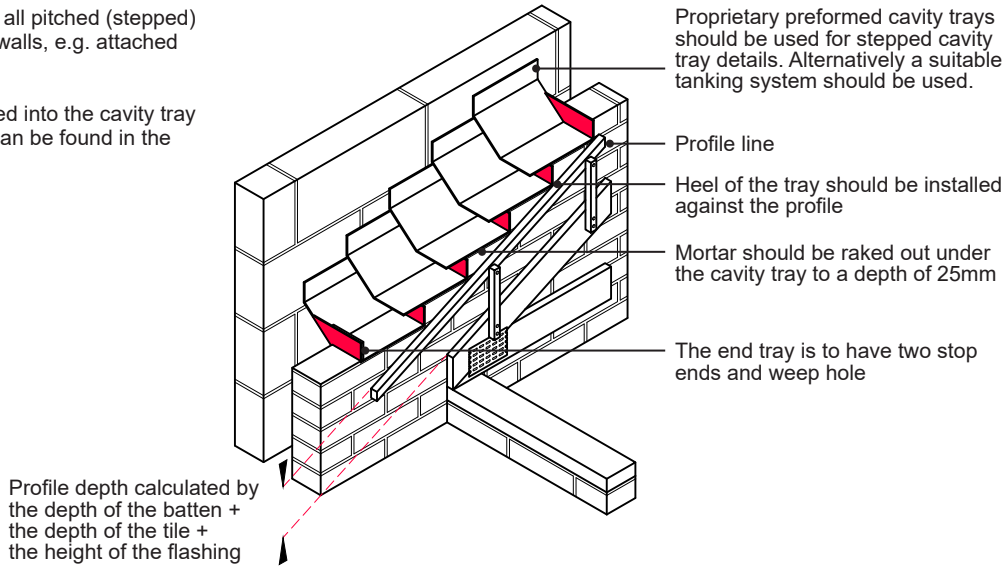


Note: Lintel must comply with relevant thermal requirements.

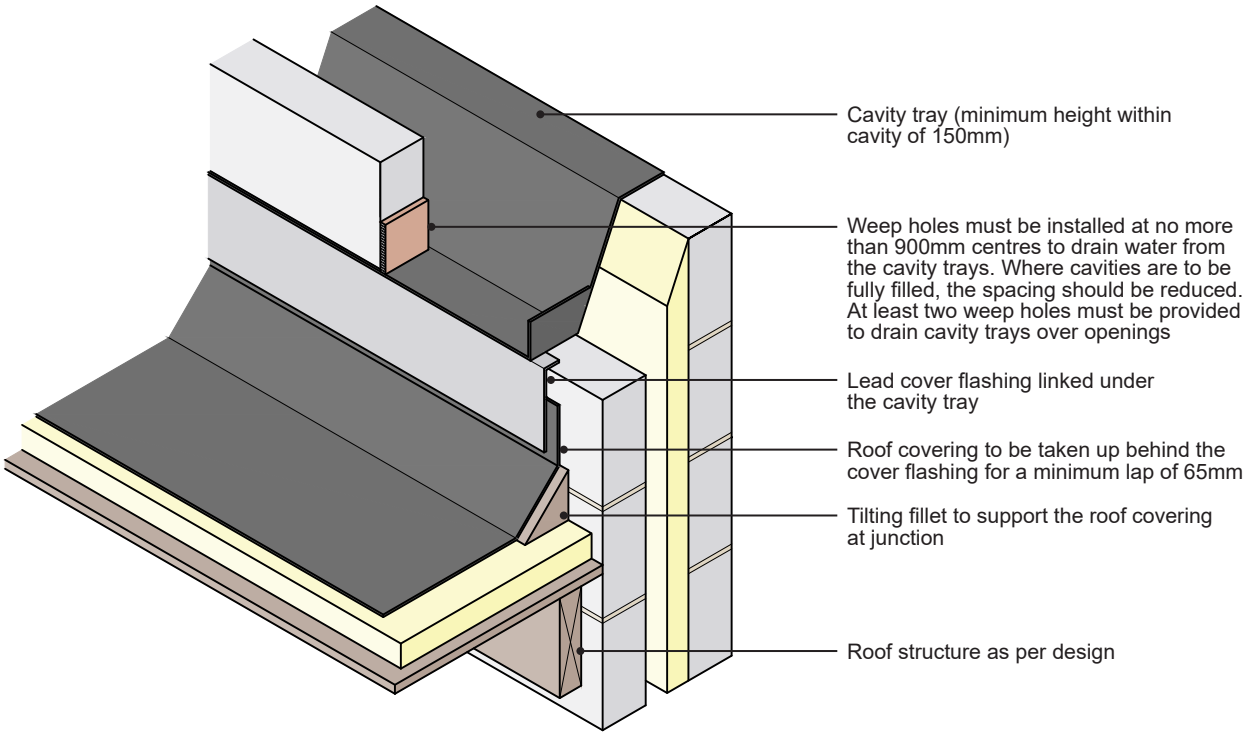
Installation of stepped cavity tray

Stepped cavity trays are required at all pitched (stepped) roof abutments with external cavity walls, e.g. attached garages or staggered terraces.

A lead cover flashing should be linked into the cavity tray (lapped in below). Flashing details can be found in the 'Roofs' section.



Flat roof abutment cavity tray construction



6.1.21 Penetrations through the external leaf

Penetrations through the external leaf shall be appropriately sealed to prevent moisture or vermin entering the cavity or the inside of the building.

Proprietary elements, such as ventilators, soil pipes, etc. which penetrate the building envelope should be installed and sealed to prevent ingress of moisture or vermin in accordance with the manufacturer's instructions.

6.1.22 Feature stone surrounds to openings

Feature stone surrounds shall be specified and installed to resist the passage of moisture or interstitial condensation to the inside of the home and shall be compatible with the surrounding structure. Particular attention should be paid to:

- Material specification
- Fixings
- Cold bridging
- Differential movement
- Sills
- Stone heads and cavity trays
- Mortar

Material specification

Where cast stone surrounds for openings are specified, the units must satisfy BS EN 771-5 and be durable for the proposed exposure to protect against freeze/thaw.

Where natural stone surrounds for openings are specified:

- The natural stone must be suitably durable for the proposed exposure to protect against freeze/thaw.
- The natural stone units must satisfy BS EN 771-6 and the units must be selected based on the performance of the actual sourced product and not a generic one.
- The selected stone performance information may be found in a Declaration of Performance document issued by the quarry supplier.
- A statement from the supplier, confirming the natural stone units are freeze/thaw resistant must also be provided.

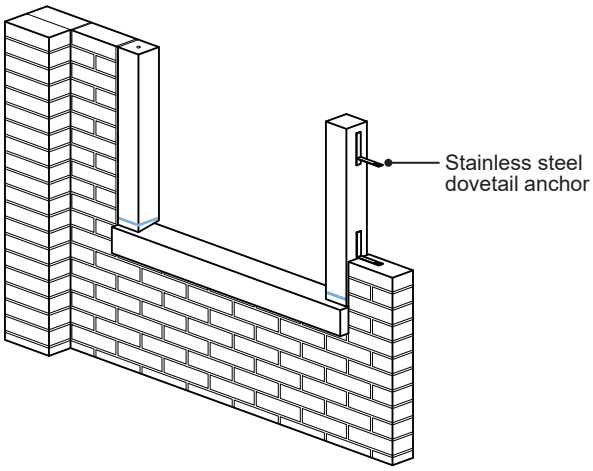
Fixings

Stone jambs and mullions should be fixed at the top and bottom with stainless steel pins as per the cast stone manufacturer's or Engineers specification. Stainless steel frame-type cramps can also be used to give extra stability at jambs. Where required, stone mullions should also be fixed to the surrounding structure.

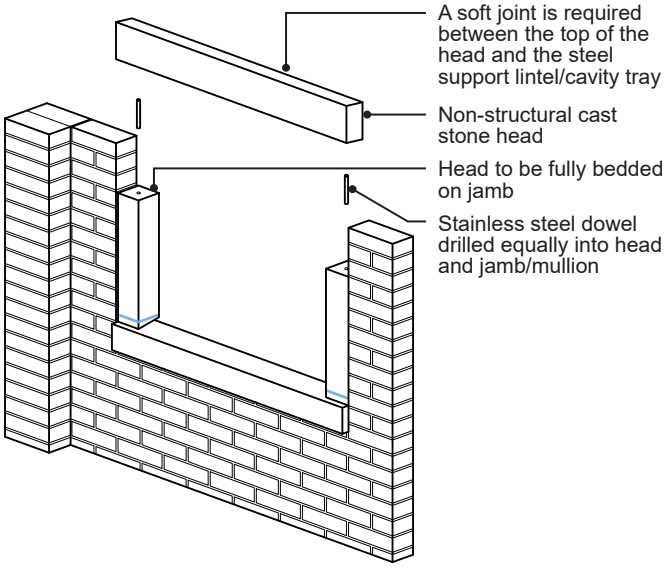
To control water penetration through joints in window surrounds, e.g. at junctions between jambs and mullions and sills, rectangular and T-shaped water bars should be provided.

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

Stone jamb mullion fixing to walls



Stone jamb mullion fixing to walls



Preventing cold bridging

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

Differential movement and slip planes

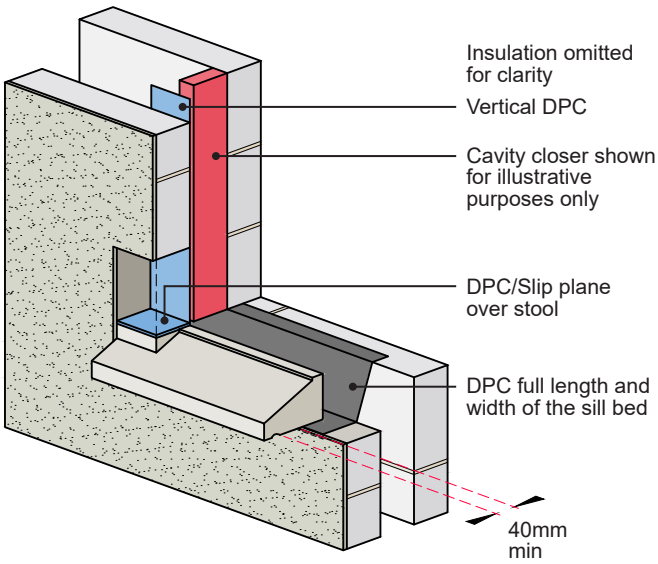
Where cast stone butts up to other materials, allowance must be made to accommodate differential movement e.g. where cast stone abuts clay brickwork, a slip surface between the stone and clay brickwork.

Sills

Where sills are specified, they should be laid on a DPC (slip plane) which should be turned up at the back and ends for the full depth of the sill.

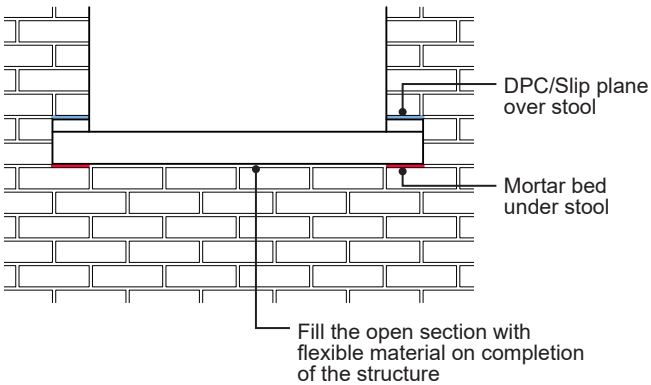
The mortar bed below sills should be trowelled smooth, allowed to set, cleaned off, and then a DPC laid over. The open section below the sill should be sealed with a flexible material only on completion of the structure.

Stone sills with insulated cavity closer



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

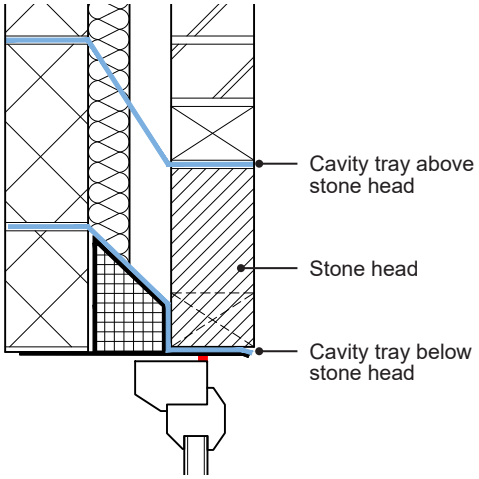
Stone sill



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.



Cavity trays and weeps

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

Mortar

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

6.1.23 Lateral restraint

Masonry cavity walls shall be adequately restrained at floors and roofs. Particular attention should be paid to location, type and method of restraint.

Lateral restraint of walls can be provided by lateral restraint straps, restraint type joist hangers or other forms of restraint proven by an Engineer.

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.

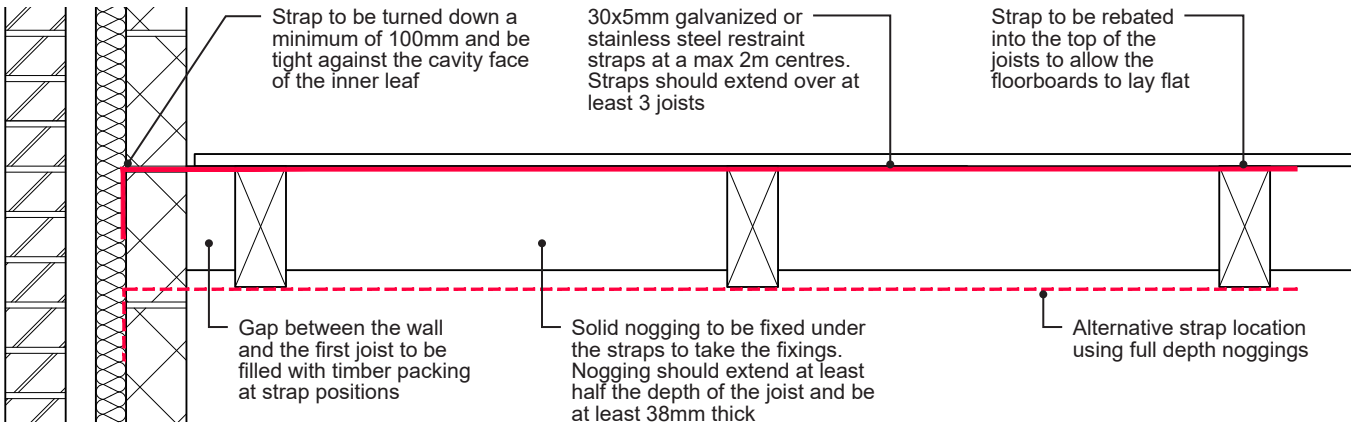
No straps are necessary in buildings, up to and including two storeys where:

- 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.
- Concrete floors that have a minimum 90mm bearing on supported wall.
- Restraint type joist hangers are used as described in BS 5268: 7.1.

Timber joists

Where joists run parallel to a wall, restraint straps should:

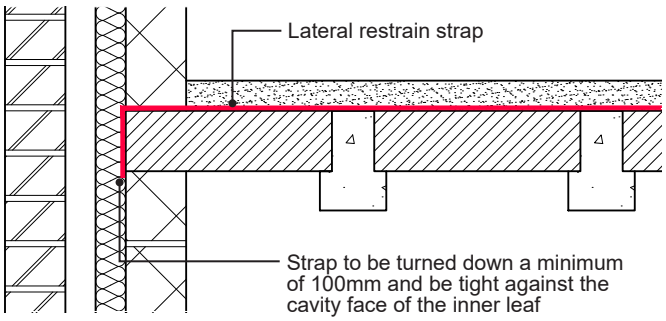
- Be fixed at 2m centres and should pass at least 3 joists.
- Be supported on noggins.
- Be fixed to timber members with steel 50mm long × 5mm diameter wood screws or by 100mm×4mm (8SWG) round nails at not less than 110mm centres with a minimum of four fixings of which at least one fixing should be in the third joist, or in a nogging beyond the third joist.
- For metal web joists, lateral restraint straps should be fixed to strongbacks as per the strap manufacturer's details.



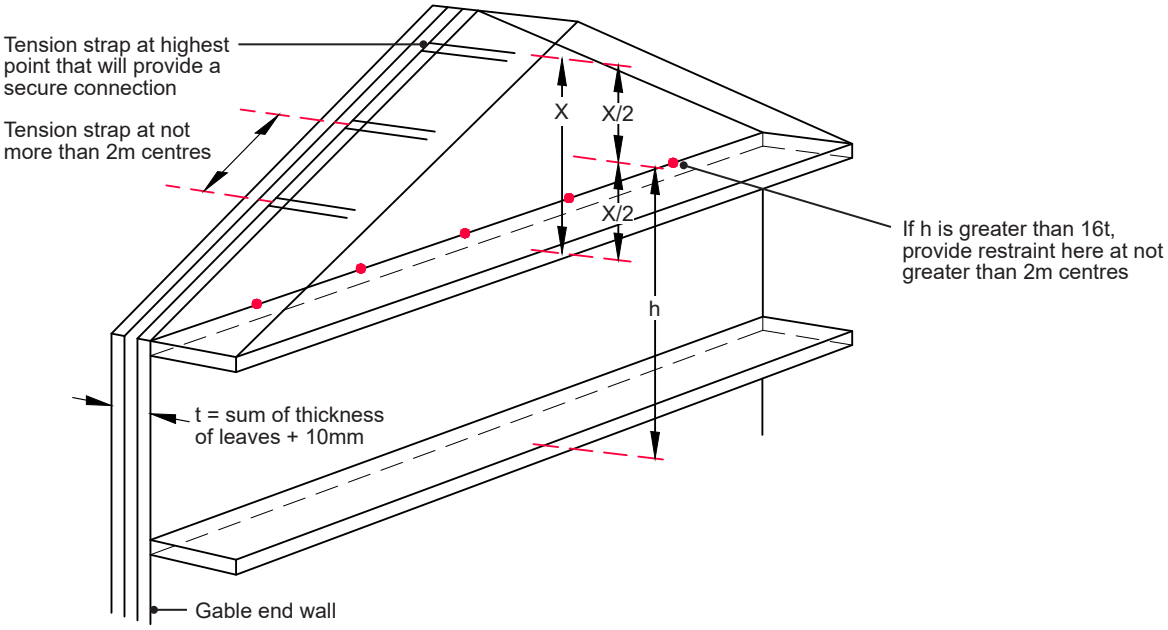
Concrete beams or planks

Where concrete beams or planks run parallel to the wall, the restraint straps should:

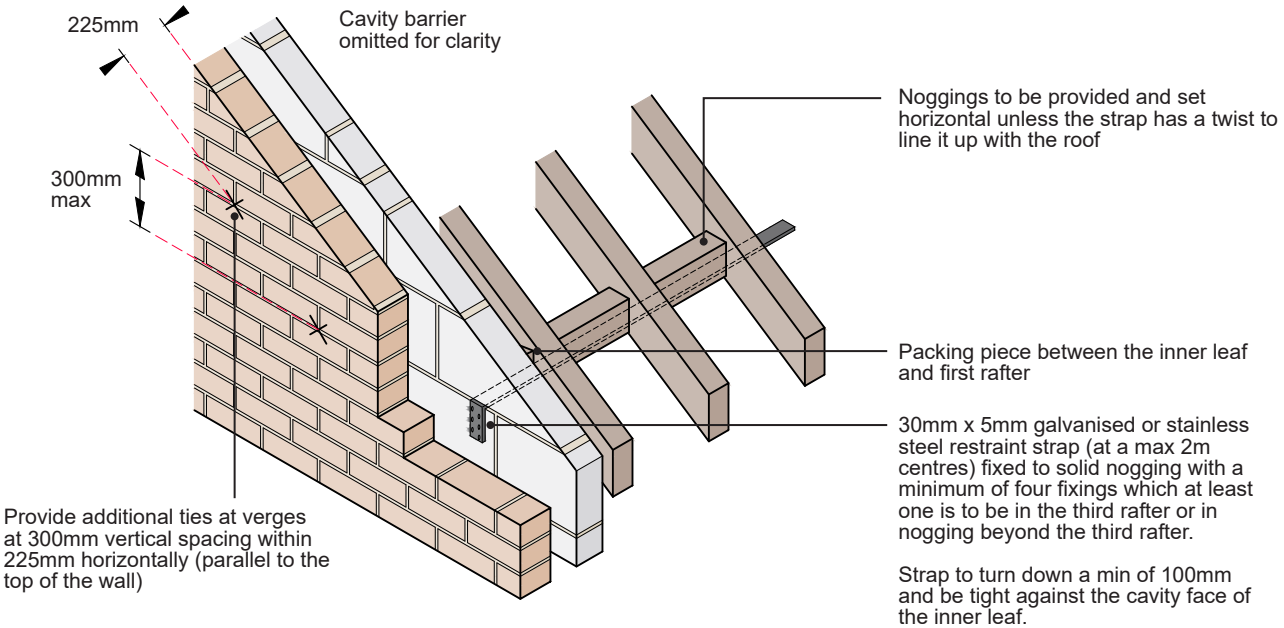
- Be spaced at 2m centres.
- Extend at least 800mm or up two beams, whichever is greater.
- Be tight against the face of the inner leaf wall and be turned down a minimum 100mm.
- Have their fixing specification designed by an Engineer.



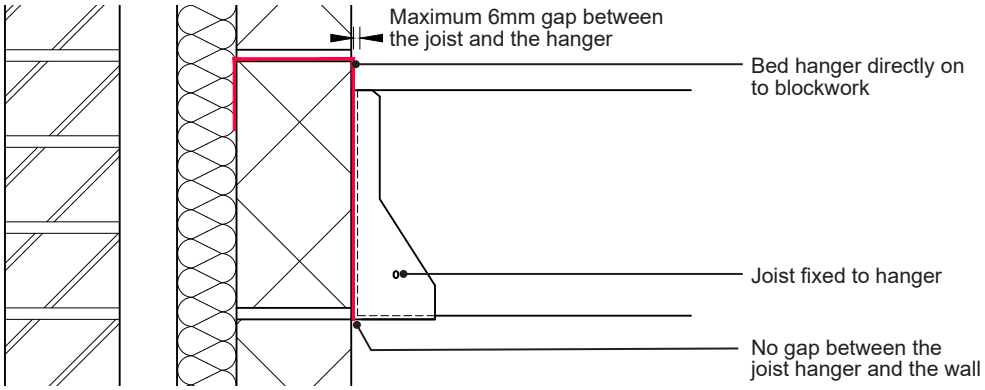
Restraint strap at ceiling joist and rafter level



Rafter/gable wall detail



Restraint type joist hanger



It is necessary to ensure that:

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

Do not:

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

6.1.24 Masonry chimneys

Please refer to the ‘Chimneys and Flues’ section.

6.1.25 Solid walls for single storey non-habitable garages

Solid walls for single storey non-habitable garages shall meet the relevant requirements of this section and the requirements of the ‘Garages’ section.

6.1.26 Additional requirements for new walls connecting to existing walls

Where new walls are connecting to existing walls, the designer shall ensure structural stability is maintained, whilst maintaining the integrity of the weatherproof envelope and accounting for any differential movement.

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.

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.

Differential movement

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.