Chapter

6.1

NHBC

External masonry walls

This chapter gives guidance on meeting the Technical Requirements for external masonry walls.

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Introduction

This chapter provides guidance on external masonry which is used for the outer and inner leaves of a cavity wall construction, cladding to framed structures and to the limited solid wall construction used in housebuilding such as garages. General guidance on masonry cavity wall construction including the masonry inner leaf of a cavity wall are also provided within this chapter.

The guidance is consistent and complementary to that provided within Chapter 6.9 Curtain walling and cladding, which should be used for products and systems falling under that description.

There is a strong link to all chapters in Part 6 of this standards, particularly Chapters 6.2–6.5, 6.10 and 6.11.

The aim of this chapter is to provide clarity for external and cavity walls constructed of clay and concrete bricks and blocks, as well as natural stone.

Definitions for this chapter

Aggregate concrete masonry unit	Masonry unit manufactured from cementitious binder, aggregates and water, and which may contain admixtures and additions, colouring pigments and other materials incorporated or applied during or after unit manufacture.
Aircrete masonry unit	Masonry unit manufactured from hydraulic binders such as cement and/or lime, combined with siliceous based fine material, cell-generating material and water, and cured with high-pressure steam in autoclaves.
Blocks	Masonry units which, when used in its normal aspect, exceeds the length or width or height specified for a coursing unit (typical brick size). A common block size is 440mm long x 100mm wide x 215mm high.
Bricks	Bricks are designated in terms of their intended use. The co-ordinating sizes for bricks is generally 225mm long x 112.5mm wide x 75mm high. The work sizes are in effect co-ordinating sizes less a nominal thickness of 10mm for the mortar joint.
Clay masonry unit	Masonry unit made from clay or other argillaceous materials with or without sand, fuel or other additives fired at a sufficiently high temperature to achieve a ceramic bond.
Coastal locations	A site within a distance of 500m from the general coastline of the United Kingdom.
Compressive strengths	Where these are quoted in this chapter, they refer to the declared compressive strengths of masonry units.
Co-ordinating size	Size of a co-ordinating space allocated to a masonry unit, including allowances for joints.
Coursing unit	Masonry unit, commonly of brick sizes, used to assist in achieving the storey height of a wall in conjunction with full height blocks.
Fully filled cavity	The insulation thickness is such that it will be in full contact with both leaves of masonry when the building meets normal construction tolerances.
Manufactured stone masonry unit	Facing masonry unit having at least one exposed face with a close structure formed from either one or two homogeneous mixtures of aggregate, cementitious binder and other materials moulded under pressure and/or vibration, and with or without further processing, intended to resemble and be used as an alternative to natural stone.
Masonry	Assemblage of masonry units laid in a specified pattern and joined together with mortar.
Masonry unit	Preformed component intended for use in masonry construction.
Natural stone masonry unit	Masonry unit manufactured from natural stone.
Recessed joints	Where the mortar is raked out, about 5mm from the wall face. There are certain exposure conditions where these should not be used (Clause 6.1.6).
Work size	Size of masonry unit specified for its manufacture, to which the actual size conforms within permissible deviations.

6.1.1 Compliance

Also see: Chapter 2.1

External walls shall comply with the Technical Requirements.

External masonry walls that comply with the guidance in this chapter will generally be acceptable.

6.1.2 Provision of information

Designs and specifications shall be produced in a clearly understandable format, include all relevant information and be distributed to the appropriate personnel.

Designs and specifications should be issued to site supervisors, relevant specialist subcontractors and suppliers, and include the following information:

- construction materials
- wall layout with all dimensions shown
- position and size of openings
- wall layouts and elevations with dimensions shown
- coursing of bricks and blocks in relation to storey heights and opening positions
- all junctions, indicating position of DPCs and cavity trays (isometric sketches are recommended for complicated junctions)
- position and type of lintels
- position of restraint straps
- cavity closers
- reveals
- how support is given to other elements, eg padstones and wall plates
- movement joints
- acceptable methods of pointing or mortar joint finish
- type of insulant to be used
- type, spacing and location of wall ties
- position of fire breaks, cavity barriers and other passive fire-stopping; the required fire resistance period should be specified
- the setting out dimensions (should be masonry co-ordinating dimensions).

Where proprietary products are to be used, manufacturers generally have specific requirements for fixing and/or assembly. This information should also be made available for reference on site so that work can be carried out satisfactorily in accordance with the design and specification.

6.1.3 Structural design

External masonry shall be designed to support and transfer loads to foundations safely and without undue movement. Issues to be taken into account include:

1) **compliance with relevant standards**
2) **lateral restraint**
3) **concentrated loads**
4) **bonding**
5) **movement joints**
6) **damp proof courses.**

6.1.3.1 Compliance with relevant standards

Design of masonry walls should comply with relevant standards:

Structural design	BS EN 1996-1-1 Eurocode 6: Design of masonry structures — General rules for reinforced and unreinforced masonry structures PD 6697 Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2
Intermediate floors, roofs and walls designed to provide lateral restraint to external walls	BS 8103 (all parts) Structural design of low-rise buildings
Ancillary components	BS EN 845-1 Specification for ancillary components for masonry — Wall ties, tension straps, hangers and brackets BS EN 845-2 Specification for ancillary components for masonry — Lintels BS EN 845-3 Specification for ancillary components for masonry — Bed joint reinforcement of steel meshwork
Walls of homes, or buildings containing homes, over three storeys high	Designed by an engineer in accordance with Technical Requirement R5

6.1.3.2 Lateral restraint

Lateral restraint provided by concrete floors

Concrete floors, with a minimum bearing of 90mm onto the wall, can provide adequate restraint. Concrete floors running parallel to, and not built into, walls require restraint straps to provide restraint to the wall.

Lateral restraint provided by timber floors

Timber joisted floors can provide adequate restraint when joists are carried by ordinary hangers to BS EN 845-1, and connected to the wall with restraint straps. In buildings up to two storeys, timber joisted floors can provide adequate restraint without strapping when:

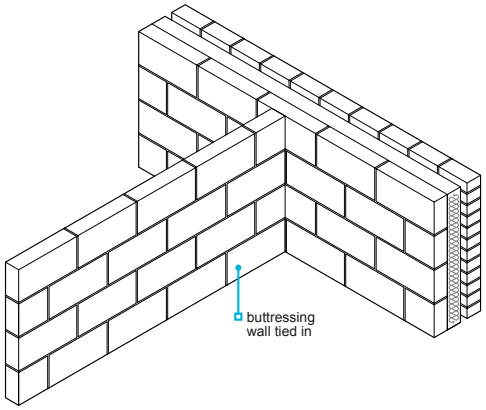
- the minimum bearing onto masonry is 90mm (or 75mm onto a timber wall plate), or
- joists are carried by BS EN 845-1 restraint-type hangers with performance equivalent to a restraint strap spaced at a maximum of 2m centres.

Lateral restraint provided by buttressing walls

The ends of every wall should be bonded or otherwise securely tied throughout their full height to a buttressing wall, pier or frame. Long walls may be provided with intermediate buttressing walls, piers or support dividing the wall into distinct lengths within each storey, with each distinct length being a supported wall for the purposes of this section.

The intermediate buttressing walls, piers or supports should provide lateral restraint to the full height of the supported wall, and they may be staggered at each storey.

Figure 1: Lateral restraint by buttressing wall



Lateral restraint and acoustics

The ends of separating walls are only tied into the inner leafs and do not have multiple ties across the separating wall cavity at the end of the wall.

6.1.3.3 Concentrated loads

Concentrated loads should be designed by a suitably qualified engineer, for example at the bearing of trimmers, lintels, multi-ply trusses or steel beams.

Where bearing stresses under concentrated loads are greater than the strength of the supporting masonry wall, padstones and spreaders should be provided.

Padstones and spreaders may be required to support concentrated loads.

6.1.3.4 Bonding

Where partition walls abut an external wall constructed of similar materials, fully bonded or tied joints are acceptable. Partition walls may act as buttressing walls mentioned above. To reduce the risk of cracking, a tied joint is preferable where:

- materials have dissimilar shrinkage or expansion characteristics, eg dense concrete and aircrete concrete
- there is a connection between a load-bearing wall on foundations and a non load-bearing wall supported on a ground-bearing slab.

Tied joints should be formed using expanded metal, wire wall ties or a proprietary equivalent, spaced at maximum 300mm intervals. Dissimilar materials should not be used in the same wall (eg clay bricks as ‘make up’ courses in concrete blockwork walls).

6.1.3.5 Movement joints

Movement joints should be included in long lengths of walling to control expansion or contraction of masonry panels and reduce unsightly cracking, and detailed so that stability is maintained. Where possible, joints should be hidden in corners, or behind rainwater pipes, and:

- run the full height of the superstructure masonry wall
- should not coincide with window and door openings
- continue from those provided in the substructure to the superstructure (movement joints may be needed in the superstructure and not in the substructure, providing suitable allowance is made for relative movement).

Vertical movement joints should be provided in the outer leaf, in accordance with Table 1.

Table 1: Suitable dimensions and spacings for movement joints[1]

Material	Joint width (mm)	Normal spacing (m)
Clay brick	16[2]	10–12
Dense concrete bricks	10	7.5–9
Lightweight concrete block and brick (aircrete or using lightweight aggregates)[3]	10	6[4]
Dense concrete block and reconstructed walling (using dense aggregate)[3]	10	7.5–9[3]
Any masonry in a parapet wall	10	Half the above spacings and 1.5 from corners (double frequency)
Natural stone masonry	10[5]	15–20[6]

Notes

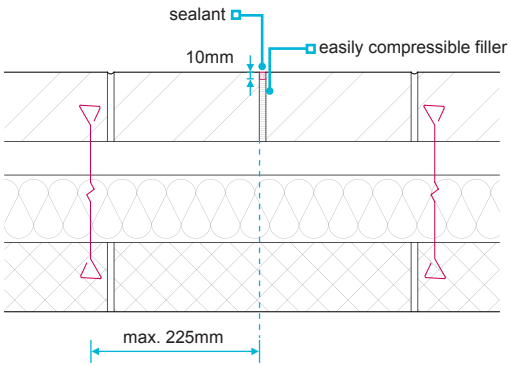
1. Manufacturer's guidance for the provision of movement joints and bed joint reinforcement should be considered.
2. For clay bricks, the joint width in mm should be spacing in metres + 30%, ie, at 8m movement joint spacing, the joint width should be 10mm.
3. Lightweight concrete masonry units are generally made of aggregates that have a gross density not exceeding 1,500kg/m³. Dense concrete masonry units are generally made of aggregates that have a gross density exceeding 1,500kg/m³.
4. The ratio of length to height of the panels should generally not exceed 3:1.
5. As defined within PD 6697.
6. Located no more than 7.5m from an external corner.

The spacing of the first movement joint from a return should not be more than half of the dimension in Table 1.

Movement joints are not generally necessary in the inner leaf of cavity walls, but consideration should be given to providing:

- movement joints in rooms with straight unbroken lengths of wall over 6m
- bed joint reinforcement as an alternative to movement joints in areas of risk, eg under window openings.

Figure 2: Movement joint sealant



Wall ties should be provided on either side of movement joints, in accordance with Clause 6.1.18.

Where masonry walls form panels in a framed structure, movement joints should be provided in accordance with BS EN 1996-2 and PD 6697.

Movement joints should be formed using the correct materials, and account taken of:

- joint width and depth
- anticipated movement and capability of the material
- surface preparation and backing materials
- likely design life of the joint.

Clay bricks expand and require movement joints formed from easily compressible materials, such as:

- flexible cellular polyethylene
- cellular polyurethane
- foam rubber.

Concrete bricks and blocks contract, and the following materials, are acceptable for use in contraction joints:

- hemp
- fibreboard
- cork.

The joints should be formed using semi-rigid, closed cell polyethylene or other suitable materials.

To perform effectively, a sealant in a movement joint should be applied against a suitable debonding joint filler board/backing rod so that the sealant only adheres to the two opposing masonry faces.

6.1.3.6 Damp proof courses

DPC materials should conform to BS 8215 and PD 6697 Table 1.

Designers should pay adequate attention to the characteristics of the materials chosen for DPCs. Materials that squeeze out or are impaired on highly stressed walls are undesirable and should not be used as DPCs. DPCs' adhesion to mortar, and their ability to resist sliding and/or shear stresses, should be considered, especially in relation to lateral loading.

Where DPCs are required to provide resistance to shear, eg in frame or crosswalled structures, the design of wall panels should reflect this, and the deemed to satisfy rule of Approved Document A, or equivalent regulation, may not be appropriate.

In general, advice on the resistance to compression, tension, sliding and shear should be sought from the manufacturers of the DPC.

6.1.4 Fire resistance

External cavity walls shall adequately resist the passage of fire.

The cavity in the masonry cavity wall of a building can provide a route for the spread of smoke and flames.

Cavities should be closed with cavity barriers, in accordance with Building Regulations.

Cavity barriers should be provided:

- at the edges of cavities, including around openings, eg windows and doors,
- where the cavity abuts compartment walls and floors
- to break up extensive cavities which could act as a route for fire spread.

Vertical cavity barriers, where required, should extend below the DPC, and care should be taken to ensure continuity of cavity barriers where cavity trays are installed at DPC level.

Where cavity barriers are used, they should be sized appropriately for the dimensions of the cavity. Normally, they are installed under compression; as such, maintaining the design cavity width is critical.

Significant reduction in cavity width will mean that the barrier cannot be fitted without creating problems for the following leaf of masonry. Significant widening in the cavity width will mean that the barrier may not be fitted with the appropriate level of compression and its performance may be impaired.

Concealed spaces

Where cladding is fitted to a masonry substrate wall, cavity barriers should be provided. Cavity barriers to concealed spaces behind external cladding should be positioned:

- at the edges of cavities, including eaves and verges, around openings such as windows and doors, and entry/exit points for services
- at the junction between an external cavity wall and every compartment floor and compartment wall.

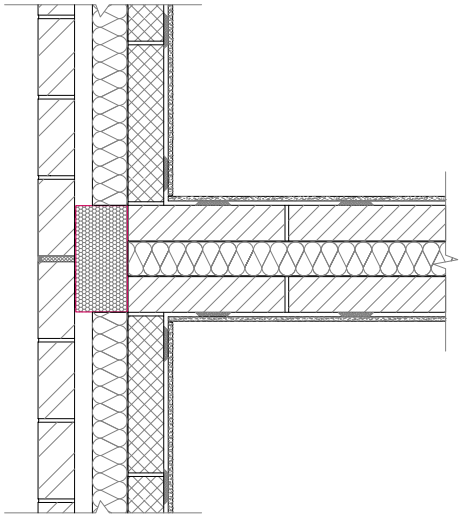
6.1.5 Acoustic resistance

External walls adjacent to separating walls shall be designed to resist flanking sound transmission.

Acceptable levels of sound reduction between homes may be achieved by:

- the inner leaf of an external cavity wall having sufficient density
- sealing air paths, particularly at junctions between the masonry cavity and separating elements
- allowing appropriate spacing between the openings in external walls
- structural members not transferring across or breaching separating walls.

Figure 3: Lateral restraint and acoustics



The density of external walls and the position of openings adjacent to separating walls should be in accordance with Building Regulations and, where relevant, an assessment which complies with Technical Requirement R3. Refer to the Robust Details Handbook for the specification of separating wall and floor constructions and their associated flanking walls.

Where different block materials are used, eg aggregate separating wall with aircrete inner leaf, differential drying and cracking can occur, so it is important that the separating wall goes through (and not up to) the inner leaf.

6.1.6 Exposure

Also see: Chapter 6.7

External walls shall be suitable for their exposure and resist the passage of moisture to the inside of the home. Issues to be taken into account include:

1) durability
2) rain penetration
3) freeze/thaw cycles.

6.1.6.1 Durability

Masonry can become saturated, and may remain so for long periods. Therefore, precautions should be taken to resist frost damage and sulfate attack affecting:

- parapet walls and copings
- sills and projections
- masonry below the DPC at ground level
- freestanding walls.

Masonry units and mortar should comply with BS EN 1996-1-1 and be used in accordance with Table 15 of PD 6697 and the manufacturer's recommendations. In addition, mortar mixes should be selected from BS EN 998-2 Table NA.1, and only cement types listed in BS EN 998-2 NA.1.2 should be used.

Cement with sulfate-resisting properties should be used where S1 clay bricks are used in the following situations:

- below the DPC where there are sulfates present in the ground
- below the DPC where there is a high risk of saturation
- retaining walls
- parapets
- freestanding walls
- rendered walls
- areas of severe, or very severe, exposure to driving rain.

Reclaimed bricks should only be used where in accordance with Technical Requirement R3.

6.1.6.2 Rain penetration

In prolonged periods of driving rain, water will penetrate the outer leaf of a masonry wall. The following should be taken into account:

- site-specific exposure to wind-driven rain
- suitability of the wall construction and insulation method
- design detailing for the local exposure, and the likely quality of workmanship on site
- single skin garage walls (additional care needs to be taken to ensure this type of structure does not allow for water penetration prematurely)
- wall tie drips should be located in the centre of the clear cavity
- cavity trays, DPCs and weep vents should be installed in accordance with this guidance.

Exposed parts of the building should be given particular attention when selecting a suitable construction method, as this may affect the choice for the whole building.

Complete resistance can only be achieved with an impervious cladding. However, the following approaches can reduce the risk of rain penetration:

- providing cladding to the wall
- increasing the clear cavity width (minimum 50mm) for partial fill insulation or the width of fully filled cavity insulation (increasing the cavity width for fully filled cavity insulation greatly reduces the risk of rain passing through the cavity)
- rendering the wall and specifying crack-resistant backing material
- designing protective features to keep the wall dry, eg projecting sills and deep overhanging eaves and verges
- ensuring mortar joints are fully filled (where fully filled cavity insulation is proposed, recessed joints should not be used)
- following the recommendations of any assessment of the insulation and the manufacturer's recommendations
- ensuring that cavities are not bridged.

Cavities should be continuous around enclosed porches and habitable areas.

Insulation should be in accordance with Clause 6.1.7 and Table 2.

In Scotland, Northern Ireland, the Isle of Man and other places where the exposure to driving rain is very severe (severe or very severe when building using timber frame), masonry should form a rebate at the reveals of openings to avoid a straight through joint where the frame abuts the masonry, or a proprietary cavity closer assessed in accordance with Technical Requirement R3 should be used.

Sills, copings and similar features should meet the requirements of BS 5642 Parts 1 and 2, and be weathered and throated unless adequate alternative provision is made to protect the brickwork from saturation, frost damage and staining.

Variations to the exposure shown on the map can only be made by site-specific calculations using BS 8104 Code of practice for assessing exposure of walls to wind-driven rain.

Adapted from BRE Report 211 Thermal Insulation: avoiding risks.

Figure 4: Checked rebate

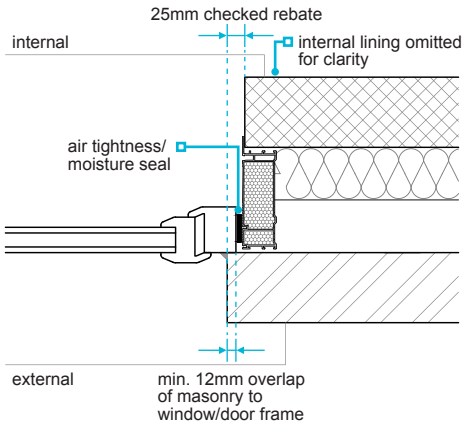


Figure 5: Exposure zones

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

6.1.6.3 Freeze/thaw cycles

Common factors which affect the level of freeze/thaw cycles include:

- degree of exposure (incidence of frost)
- saturation of the masonry
- frost resistance of the masonry
- localised protection of the masonry by roof overhangs, trees and other buildings.

Good detailing can limit persistent wetting and reduce the risk of frost attack:

- paths should drain away from walls to avoid saturating bricks near the ground
- sills, copings and similar features should have a weathered upper surface
- a coping or capping should be provided for all parapet walls, chimneys and freestanding walls, unless clay bricks of F2 and S2 classification to BS EN 771-1 are used
- masonry units and mortar should be used in accordance with Table 15 of PD 6697.

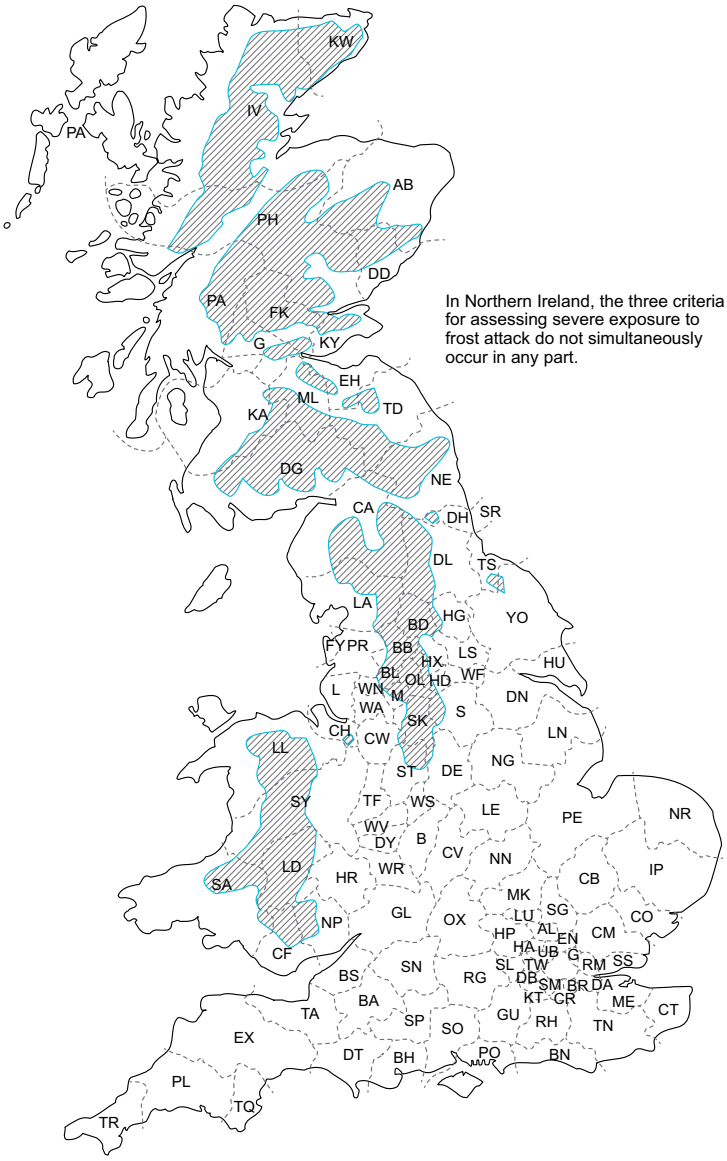
Copings should have:

- an overhang
- throatings a minimum of 30mm clear of the wall
- a continuous supported DPC which projects beyond the line of the wall.

The following should be taken into account when selecting bricks:

- manufacturers' recommendations, including the choice and use of mortar and the type of joint finish
- bricks that are not frost-resistant (F0,S2 or F0,S1 to BS EN 771) may not be acceptable for use externally, unless completely protected by a cladding which can adequately resist the passage of water
- where there is a risk that brickwork may be persistently wet, bricks should be specified that are low in soluble salts
- painted or decorated finishes can trap moisture in external brickwork and increase the risk of frost damage, sulfate attack or other detrimental effects.
  The manufacturer should be consulted to ensure that the proposed decorative finish will not have a detrimental impact on the brickwork durability
- in Scotland, all clay bricks used as facings should be frost-resistant, F2,S2 or F2,S1 to BS EN 771-11, and all concrete bricks used as facings should be 22N/mm² to BS EN 771-3.

Figure 6: Frost exposure zones



In Northern Ireland, the three criteria for assessing severe exposure to frost attack do not simultaneously occur in any part.

Severe exposure to frost attack

The hatched areas on the map opposite have a frost more than 60 days in a year and annual rainfall over 1m, and are 90m above sea level. They are therefore all considered to be at severe exposure to frost.

In areas of severe exposure to frost, the following types of brick are acceptable:

- clay facing bricks which are frost-resistant F2,S2 or F2,S1 to BS EN 771-1
- clay bricks which are classified in the manufacturer's published recommendations as satisfactory for the exposure
- concrete bricks with a minimum strength of 20N/mm² to BS EN 771-3
- concrete blocks with a minimum density of 1,500kg/m³ or compressive strength greater than 7.3N/mm²
- most types of aircrete blocks with render.

Exceptionally severe frost exposure
These are locations which face long stretches of open countryside and are within an area of severe frost exposure, where only frost-resistant bricks F2,S2 or F2,S1 to BS EN 771 are acceptable for the superstructure.

Where there is doubt about the suitability of a facing brick for sites in areas of exceptionally severe frost exposure, written confirmation should be obtained from the brick manufacturer that the brick is suitable for the geographical location, and location in the structure.

6.1.7 Thermal insulation

Thermal insulation shall be adequate and installed correctly. Issues to be taken into account include:

1) **thermal insulation materials**
2) **installation**
3) **injected and blown fill insulation**
4) **construction type.**

The insulation value of the wall must meet the requirements of the Building Regulations. Cold bridging should be avoided. Particular care is needed:

- at openings
- between external walls and roofs, internal walls and floors
- behind or around components installed in the cavity such as sub-floor vents, inset meter boxes, cavity trays or windposts.

6.1.7.1 Thermal insulation materials

Relevant standards include:

BS EN 13162	Thermal insulation products for buildings — Factory made mineral wool (MW) products — Specification
BS EN 13163	Thermal insulation products for buildings — Factory made expanded polystyrene (EPS) products — Specification
BS EN 13164	Thermal insulation products for buildings — Factory made extruded polystyrene foam (XPS) products — Specification
BS EN 13165	Thermal insulation products for buildings — Factory made phenolic foam (PF) products — Specification
BS EN 13166	Thermal insulation products for buildings — Factory made extruded polystyrene foam (XPS) products — Specification
BS EN 13167	Thermal insulation products for buildings — Factory made cellular glass (CG) products — Specification
BS EN 14064-1	Thermal insulation products for buildings — In-situ formed loose-fill mineral wool (MW) products — Specification for the loose-fill products before installation
BS EN 16809-2	Thermal insulation products for buildings — In-situ formed products from loose-fill expanded polystyrene (EPS) beads and bonded expanded polystyrene beads — Specification for the bonded and loose-fill products before installation

Thermal insulation materials, either full, partial, or injected and blown fill, that will be placed in the cavity between the outer and inner leaf of masonry should be:

- satisfactorily assessed by an appropriate independent technical approvals authority accepted by NHBC as suitable for the proposed use
- assessed in accordance with Technical Requirement R3.

Thermal insulation materials may:

- either be built in during, or retrofitted after the construction process
- fully or partially fill the cavity.

Materials shall be considered as fully filled cavity insulation where:

- they are designed to be in full contact with both leaves of masonry
- described as fully filled in their technical approval document, although a narrow residual cavity is retained between the outer leaf and the outer face of the insulation.

Partial fill cavity insulation materials shall be installed on the cavity face of the inner leaf, and the appropriate residual cavity to the outer leaf as specified in Clause 6.1.7.4 should be maintained.

All injected and blown fill insulation systems, including blown mineral wool, and expanded polystyrene beads should be:

- installed by the certificate holder or their approved installers subject to the certification bodies' assessment and surveillance scheme, and
- installed by operatives trained by the assessment holder and approved by the assessment holder and the assessing organisation.

6.1.7.2 Installation

Workmanship should be maintained when installing insulation, to minimise the risk of damp penetration or condensation to the inner leaf. Gaps in the insulation layer can provide routes for moisture ingress from the outer leaf to the inner leaf and also create localised cold spots where condensation can form. Gaps between the board and the inner leaf can result in thermal bypass (this is exacerbated by gaps at board junctions). Insulation material should be:

- close butted with no gaps
- in full contact with the inner leaf
- taped at the joints where it is formed of rigid boards with non-compressible edges[1]
- fully engaged with the adjacent board edges where a ship lap or other interlocking edge detail is provided
- installed in accordance with the manufacturer's recommendations.

Note
1. Where the insulation has a low e facing the tape face shall have the same low e value.

Where cavity insulation is used:

- mortar joints, including perpends, should be solidly filled with mortar
- mortar droppings should be removed from wall ties and the edges of insulation materials
- excess mortar should be struck flush from the inside of the outer leaf
- excess mortar should be struck flush from the cavity side of the inner leaf.

The first row of insulation boards or batts should be supported on wall ties:

- with a minimum of two ties to each board or batt
- which coincide with horizontal joints in the insulation.

Where wall ties need to be closely spaced, eg at reveals, it is acceptable to make a neat cut in the insulation to accept the extra ties.

Rigid insulation boards should:

- be stored flat without bearers, otherwise they may distort, making them difficult to fix against the wall
- be rejected where warped.

When installing fully filled insulation:

- ensure fibres in the insulation are laid parallel to the wall
- butt joint slabs, and do not bend at internal and external corners
- cover all exposed areas of insulation slabs at the end of each day or in driving rain to prevent excessive moisture in the cavity and pressure on freshly laid masonry from expansion of the insulation
- ensure vertical joints are staggered when layering slabs of insulation.

Figure 7: Fully filled insulation

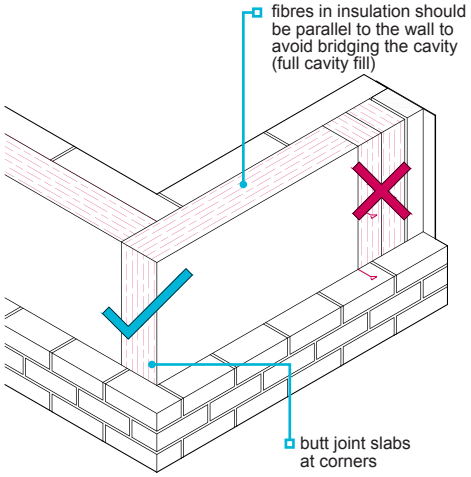


Figure 8: Insulation to combined lintel ends

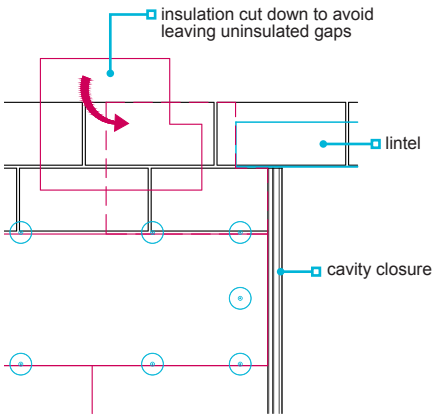
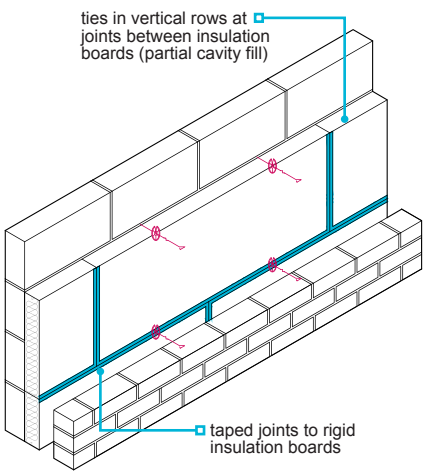


Figure 9: Cavity ties to rigid partial fill insulation



Rigid insulation should not be continuous across the end of a separating wall or floor. A flexible (mineral wool) cavity closer should be used in line with these elements, and the rigid insulation butted up to these.

6.1.7.3 Injected and blown fill insulation

Injected and blown fill insulation should comply with the relevant standards:

Material	Standard	Settlement class
Mineral wool	BS EN 14064-1 Thermal insulation products for buildings. In-situ formed loose-fill mineral wool (MW) products — Specification for the loose-fill products before installation BS EN 14064-2 Thermal insulation products for buildings. In-situ formed loose-fill mineral wool (MW) products — Specification for the installed products	S1
Expanded polystyrene (EPS) beads	BS EN 16809-1 Thermal insulation products of buildings. In-situ formed products from loose-fill expanded polystyrene (EPS) beads and bonded expanded polystyrene beads — Specification for the bonded and loose-fill products before installation BS EN 16809-2 Thermal insulation products of buildings. In-situ formed products from loose-fill expanded polystyrene (EPS) beads and bonded expanded polystyrene beads — Specification for the bonded and loose-fill products after installation	N/A

Injected and blown fill insulation systems should meet the requirements of the relevant standards and hold a satisfactory assessment by an appropriate technical approvals authority acceptable to NHBC, confirming suitability for use in a masonry cavity wall and for the exposure rating of the site.

Separating wall and floor constructions and their associated flanking walls should be detailed correctly when using injected and blown fill insulation. Cavity stops should be installed at the ends of separating walls and separating floors. Refer to the Robust Details Handbook for the specification of materials and construction details.

Before installing injected or blown fill insulation materials, the home should be in a condition ready to receive the insulation. This will be defined in each system's instruction documents but, as a minimum, would require that:

- the cavity wall is inspected by the installing team
- the roof is in place and the tops of the walls are protected from rain
- all edges of cavities at window, door and other openings are closed with the permanent cavity closers, as per the design.

Areas that cannot be accessed during the fill process by appropriate adaptation of the installation method (eg below gas membranes or low level continuous DPCs, where there is a cavity tray one course above a lintel, or where separate lintels are used for each leaf) should be insulated with appropriate built-in materials.

On completion of the work, the installer shall provide a declaration of compliance in accordance with the relevant standard for the product.

6.1.7.4 Construction type

The following are recommendations and guidance according to construction type:

Partial fill cavity insulation

Where partial cavity insulation is installed:

- it should only be fixed against the cavity face of the inner leaf
- a minimum 50mm clear cavity between the partial cavity insulation and the outer leaf should be maintained
- wall ties long enough to allow a minimum 50mm embedment in each masonry leaf should be used.

In areas of very severe exposure in England and Wales, a residual cavity of 75mm is required where the outer leaf is fair faced masonry.

Fully filled cavity insulation

Where the cavity is to be fully filled with insulation:

- the type of insulation, its thickness and the wall construction should be suitable for the exposure of the home (see Table 2)
- render on an external leaf of clay bricks (F2,S1 or F1,S1 designation bricks to BS EN 771) is not permitted in areas of severe or very severe exposure to wind-driven rain
- recessed mortar joints should only be used in sheltered areas
- fair faced masonry includes clay 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 used
- painted finishes on bricks or render are not acceptable where they are likely to cause damage (including frost damage or sulfate attack).

Where the cavity is to be fully filled using rigid insulation boards they should be installed in accordance with the current certification and manufacturers recommendations, including where required:

- provision of any residual cavity between the insulation board and the external wall leaf, and
- protection to the edges of boards at corners, etc with tapes or DPCs.

Table 2: Suitable wall construction for use with fully filled cavity insulation

Exposure category	Suitable wall construction	Minimum insulation thickness (mm)		
		Built-in insulation	Injected and blown fill (other than UF foam)	UF foam
Very severe	Any wall with impervious cladding	50	50	50
	Fair faced masonry with impervious cladding to all walls above ground storey	100	125	N/A
	Any wall fully rendered(1)	75	75	N/A
	Fair faced masonry(2)	150	150	N/A
Severe	Any wall with impervious cladding or render(1)	50	50	50
	Fair faced masonry with impervious cladding or render(1) to all walls above ground storey	50	75	50
	Fair faced masonry	75	75	N/A
Moderate	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	75	75
Sheltered	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. Render on an external leaf of clay bricks (F2,S1 or F1,S1 designation bricks to BS EN 771) in severe or very severe exposures is not permitted where the cavity is to be fully filled with insulation.
2. In very severe exposure locations, fair faced masonry with full cavity insulation is not permitted in cavity widths of less than 150mm.
3. This table covers walls where the external leaf does not exceed 12m in height.
4. The exposure category of the home is determined by its location on the map showing categories of exposure to wind-driven rain.
5. Fair faced masonry includes clay 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.

Multiple layers of insulation may be used where in accordance with the manufacturer's recommendations and within the scope of satisfactory assessment by an independent technical approvals authority accepted by NHBC.

The thickness of materials should be as required in the design, and in accordance with Building Regulations.

Insulated dry linings

Where an insulated dry lining contains a combustible insulant, to prevent early collapse of the lining in a fire, the plasterboard should be:

- a minimum of 12.5mm thick
- mechanically fixed to the masonry inner leaf.

6.1.8 Concrete blocks

Concrete blocks shall be capable of supporting intended loads, have appropriate thermal resistance and be resistant to the adverse effects of climate. Issues to be taken into account include:

1) **intended loads**
2) **freeze/thaw and sulfate attack**
3) **other characteristics.**

6.1.8.1 Intended loads

Concrete blocks should:

- comply with BS EN 771-3 and 4 and PD 6697, and be used in accordance with BS EN 1996-2 and PD 6697
- be of sufficient compressive strength for the application
- be used in accordance with the manufacturer's recommendations.

The maximum load-bearing capacity of the wall should not be exceeded. Other factors may dictate the strength of blocks required in certain circumstances, eg sulfate resistance may require blocks of greater strength.

For one- and two-storey homes, blocks with a minimum compressive strength of 2.9N/mm^2 could be used.

For three-storey homes or those with storey heights over 2.7m, 7.3N/mm^2 blocks are required for certain parts of the structure, unless the structural design shows that strengths lower than 7.3N/mm^2 are suitable.

6.1.8.2 Freeze/thaw and sulfate attack

Concrete blocks used in the outer leaf without protective cladding or render should:

- have a compressive strength >7.3N/mm^2 or have a density of at least 1,500kg/m^3
- be made with dense aggregate to BS EN 12620, or
- be aircrete concrete blocks having had their suitability confirmed by the manufacturer.

Where the level of sulfates in the ground, at the level where blockwork is to be used, is DS-2 or above, their suitability for use should be confirmed by the manufacturer. Where this is permissible, the mortar should be sulfate resisting with a mix suitable for the level of sulfates in the ground.

6.1.8.3 Other characteristics

Concrete blocks may have been specified according to their specific characteristics.

Tolerances

Tolerances should be declared in accordance with the relevant product standard.

6.1.9 Bricks

Bricks shall be capable of supporting intended loads and have appropriate resistance to the adverse effects of freeze/thaw and sulfate attack.

The design strength of bricks should comply with:

- BS EN 1996-1
- the design.

Clay bricks

Table 3: Classification of clay bricks according to their freeze/thaw resistance and active soluble salt content in accordance with BS EN 771-1

Durability	Freeze/thaw resistance	Active soluble salt content
F2,S2	Freeze-/thaw-resistant (F2), durable in all building situations	(S2) low
F2,S1	Freeze-/thaw-resistant (F2), durable in all building situations	(S1) normal
F1,S2	Moderately freeze-/thaw-resistant (F1), durable except when saturated and subject to repeated freezing and thawing	(S2) low
F1,S1	Moderately freeze-/thaw-resistant (F1), durable except when saturated and subject to repeated freezing and thawing	(S1) normal
F0,S2	Not freeze-/thaw-resistant (F0), liable to be damaged by freezing and thawing	(S2) low
F0,S1	Not freeze-/thaw-resistant (F0), liable to be damaged by freezing and thawing	(S1) normal

Bricks that are freeze-/thaw-resistant (F2,S2 or F2,S1 to BS EN 771) should be used where there is a high risk of prolonged wetting and freezing, including:

- external facing work in Scotland
- exposed parts, including copings, sills, parapets and chimneys which have no overhang to provide protection
- areas of the country subject to exceptionally severe freeze/thaw exposure (see Clause 6.1.6).

In areas of severe freeze/thaw exposure outside Scotland, bricks that are moderately freeze-/thaw-resistant (F1,S1 or F1,S2 to BS EN 771) may be used for general wall areas, provided they are classified in the manufacturer's published recommendations as satisfactory for the exposure. Further guidance can also be found within the Brick Development Association (BDA) publication Severely Exposed Brickwork publication.

Bricks that are not freeze-/thaw-resistant (F0,S2 or F0,S1 to BS EN 771) are not acceptable for use externally, unless completely protected by a cladding which can satisfactorily resist the passage of water.

Where brickwork may become saturated, moderately freeze-/thaw-resistant bricks (F1,S1 or F1,S2 to BS EN 771) are not appropriate where there is a risk of vulnerability to frost. In saturated conditions, sulfate-resisting cement mortar is required for S1 designation bricks.

For one- and two-storey homes, clay bricks to BS EN 771, with a minimum compressive strength of 9N/mm^2, should be adequate.

For three-storey homes, clay bricks to BS EN 771, with a minimum compressive strength of 13N/mm^2, are acceptable.

Tolerances of clay bricks

Guidance on tolerances for clay bricks can be found within the BDA publication Designing to Brickwork Dimensions.

Concrete bricks

Concrete bricks have a direct relationship between strength and durability, including freeze/thaw resistance. Most concrete bricks have a strength of 22N/mm^2, 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. For one-, two- or three-storey homes, concrete bricks to BS EN 771-3, having a minimum compressive strength of 22N/mm^2, are acceptable.

Reclaimed bricks

Reclaimed bricks:

- should be used in accordance with Technical Requirement R3
- may require independent certification of suitability, if the durability category cannot be determined
- may require independent certification of suitability
- may be unsuitable for external work because of a high salt content or a lack of freeze/thaw resistance
- which have previously been used internally, or which were fully protected, may be unsuitable in external situations.

It is advisable to know where reclaimed bricks came from, and if they were used internally or externally.

Special shaped bricks (only applicable to clay bricks and concrete bricks)

Special shaped bricks should conform to BS 4729.

Projecting brickwork

Where architectural detailing of brickwork is used to form decorative patterns that include projecting brickwork, exposing either all or part of the width or length of the brick, consideration should be given to:

- perforations or frogs that may be exposed
- visual appearance of exposed bed or differing face surfaces
- suitable weathering of flat surfaces or 'ledges'.

Exposure of projecting bricks, particularly those with frogs or perforations, may affect the durability and service life of the brick. Written confirmation should be obtained from the brick manufacturer that the brick can achieve the required durability for the proposed use.

6.1.10 Stone masonry

Stone masonry shall be constructed to an acceptable standard, including the performance standards for brick and block where applicable. Walls shall be capable of supporting the intended loads and have appropriate resistance to the adverse effects of freeze/thaw.

Stone masonry as the outer leaf of a cavity wall should comply with the following:

Stone for masonry	BS EN 771-6 Specification for masonry units — Natural stone masonry units
Cast stone masonry units	BS EN 771-5 Specification for masonry units — Manufactured stone masonry units or BS 1217 Cast stone. Specification
Stone masonry, natural or cast	BS EN 1996 Design of masonry structures PD 6697 Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2
Stone for copings and sills	BS EN 12059 Natural stone products. Dimensional stone work. Requirements

Stone masonry as the outer leaf of a cavity wall will be acceptable where it:

- provides an adequate weather-resisting structure in conjunction with any brick or block backing and/or vertical DPMs
- complies with the guidance in this chapter for brickwork/blockwork
- complies with BS EN 12370 or has evidence that it is not susceptible to salt crystallisation when used below DPC level
- follows good local recognised practice to provide a high standard.

Where squared or random rubble is used, it is important that the stone masonry is brought to course at regular intervals of not more than 450mm. Bed joints of up to 25mm wide may be acceptable, and the selection and installation of the correct wall ties should be carefully considered.

6.1.11 Construction of masonry walls

Also see: Chapters 7.1, 9.1 and PD 6697

Construction shall ensure a satisfactory standard of brickwork and blockwork. Issues to be taken into account include:

1) **finished appearance**
2) **bonding**
3) **construction**
4) **openings**
5) **corbelling**
6) **chasing for services**
7) **protection of ancillary components.**

The construction of masonry walls should comply with the following:

- requirements of BS EN 1996-2 Eurocode 6: Design of masonry structures — Design considerations, selection of materials and execution of masonry
- and BS 8000-3 Workmanship on construction sites — Masonry. Code of practice.

6.1.11.1 Finished appearance

A site reference panel should be constructed to agree a benchmark for workmanship and products.

The appearance of a masonry wall depends upon the:

- materials used
- setting out
- workmanship.

When setting out masonry:

- avoid cutting bricks or blocks, except when it is essential
- avoid irregular or broken bonds, particularly at openings
- fair faced masonry bricks should be set out dry, prior to commencement of works.

All work should be reasonably level and true, and:

- the bond detailed in the design used
- perpendicular joints kept in line and plumb
- courses kept level by using lines and spirit levels
- meet the tolerances defined within Chapter 9.1 A consistent approach to finishes.

To keep courses to the correct height, use a gauge rod marked with the height of windows, doors and floors.

Where a number of openings of similar width are being formed, use a rod cut to the required size to check the width of openings as the work rises.

Brickwork and blockwork should not be subjected to vibration until the mortar has set.

6.1.11.2 Bonding

A regular bonding pattern should be maintained. External walls should be bonded to partitions and party walls as required by the design. Either:

- tooth every alternate course, or
- tie with wall ties, expanded metal or equivalent at maximum 300mm vertical centres.

Figure 10: Internal to external wall bonded connection

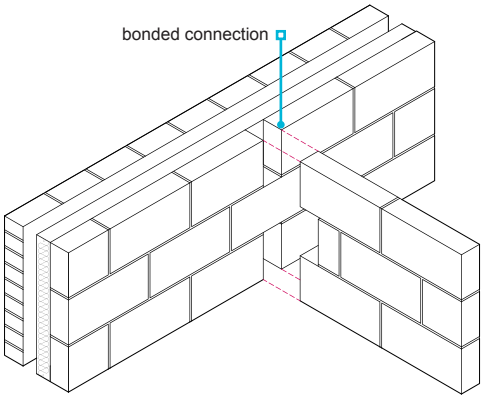
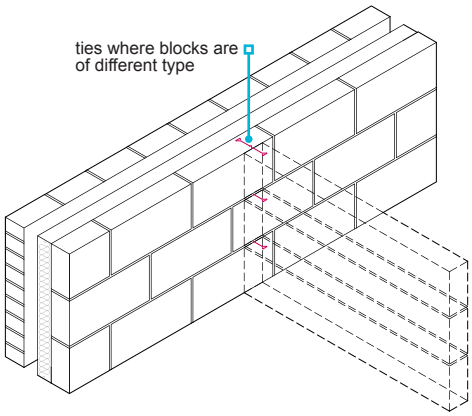


Figure 11: Internal to external wall tied connection



Where joist hangers are not used, joist filling should be brickwork or blockwork and without excessive mortar joints. The recessed portion of timber joists should be treated.

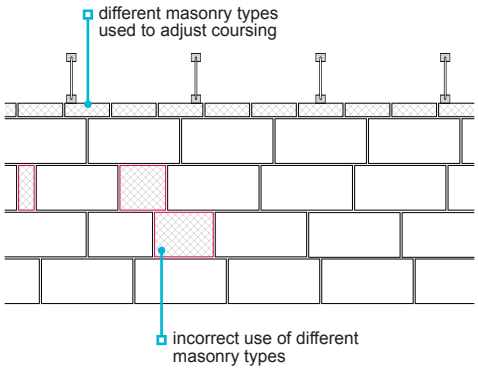
Joist filling should be:

- 12mm below the top of flat roof joists to allow for timber shrinkage
- checked to ensure the cold roof ventilation is not blocked.

Clay bricks and concrete blocks should not be mixed. Where a different size of masonry unit is needed to ensure correct coursing, small units of the same material should be used to reduce cracking and problems due to different thermal insulation properties.

Where the inner leaf of a cavity wall is being used for thermal insulation, and where a different size of masonry unit is used to ensure correct coursing, the unit should have similar thermal insulation properties to the masonry used for the rest of the wall.

Figure 12: Dissimilar masonry types



6.1.11.3 Construction

The difference in heights between the two leaves of a cavity wall under construction can be up to six block courses, provided the ties are sufficiently flexible to ensure coursing is achieved without breaking the bond. To keep the wall plumb, do not over-reach at changes of lift; wait for the next scaffolding lift. With thin layer mortar construction having an assessment which complies with Technical Requirement R3, it is normally permissible to build the inner leaf to storey height ahead of the outer leaf. In such cases, the recommendations of the assessment, and the manufacturer's recommendations, should be followed.

Cavities should be constructed so that:

- they are uniform and in accordance with the design, including wall tie specification and cavity width
- mortar is struck from all joints as work proceeds
- cavity trays and wall ties are clear of droppings and debris
- mortar droppings are removed
- where cavity insulation is used, mortar droppings are removed from the top edge
- where partial cavity insulation is used, it is against the inner leaf of the cavity
- the thickness of the external leaf is consistent; any stone used should not project into the cavity
- cavity barriers are installed as the work progresses.

Figure 13: Masonry cavity wall plumb level

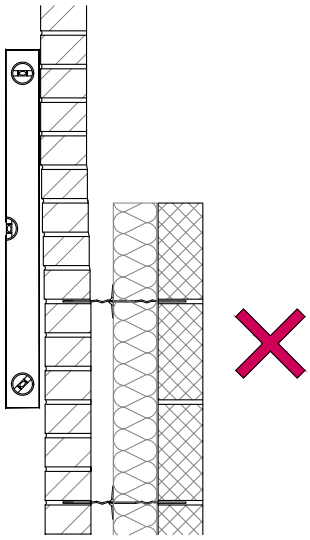
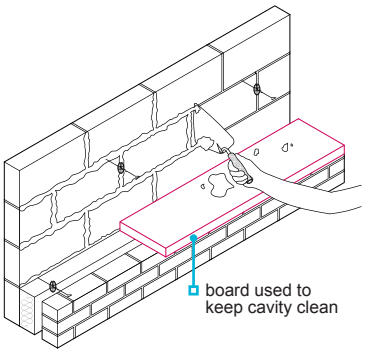


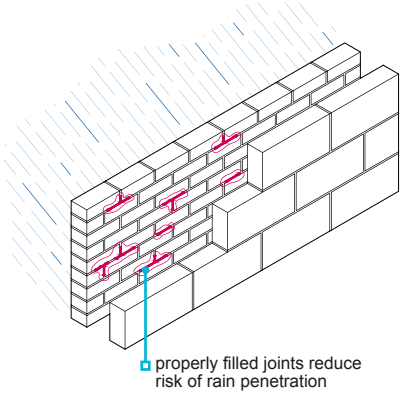
Figure 14: Striking of mortar



Laying bricks and blocks

Bricks and blocks should have a solid mortar bedding and fully filled perpends, to reduce the risk of rain penetration and dampness in the wall. The thickness of bed joints and perpend joints made with general purpose and lightweight mortars should be of a nominal thickness to suit gauge and masonry co-ordinating size and be not less than 6mm nor more than 15mm unless specific manufacturers recommendations are given. Joints should be consistent in width, profile and alignment to meet the tolerances defined with Chapter 9.1 A consistent approach to finishes.

Figure 15: Rain penetration to mortar joints



Unless otherwise advised by the manufacturer, bricks with single frogs should be laid with the frog facing upwards, and double frog bricks should be laid with the deeper frog facing upwards. All frogs should be fully filled with mortar.

Where cutting of bricks is required to achieve bond:

- standard work sizes of cut bricks should be used ie, quarter, half and three-quarter cuts
- bricks should be cut cleanly and accurately
- cutting of facing brickwork with a trowel should be avoided.

Special bricks in accordance with BS 4729 should be used to form curves, features (eg plinths or cappings) or angles other than 90 degrees (eg bay windows) which cannot be satisfactorily formed with standard bricks. Cut and stuck specials may be used in accordance with the design where a standard special is not available.

Note

1. Cut and stuck specials may not be appropriate for use depending on the specification of the adhesive bonding used, where the use of combustible materials in the external walls is restricted in certain buildings with a storey 18m or more above ground level.

Protection of cavity walls during construction

Masonry cavity walls shall be protected whenever work stops, eg for inclement weather or overnight. The tops of both leaves, as well as the cavity and any insulation, should be covered with sacking or plastic sheet and appropriately secured in place.

6.1.11.4 Openings

Masonry may be built around either:

- the frame in-situ, or
- a profile or template to enable the frame to be fitted later.

Openings should be the correct size, square and:

- the spacing between the masonry and frame should allow for movement and tolerance
- the frame should not be distorted by forcing bricks against the jamb.

When window and door frames are built in, they should be fixed with:

- frame cramps
- proprietary cavity closers, or
- plugs and fixings.

Proprietary cavity closers should be fitted in accordance with manufacturers' instructions. Cavity closers should be fitted in one continuous piece unless jointing is accepted by the manufacturer and suitable details and installation instructions are provided. The closer should be assessed as suitable for the exposure zone of the site.

Where opening sizes and locations do not match brickwork setting out, brick bonding pattern should be set out at the base of the wall to ensure that cut bricks occur below openings.

Figure 16: Squareness of window openings

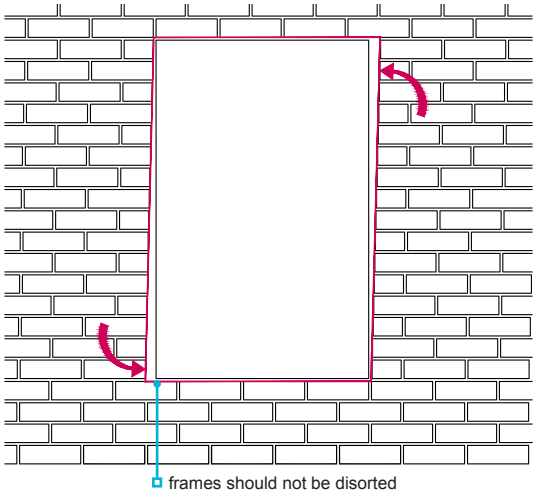
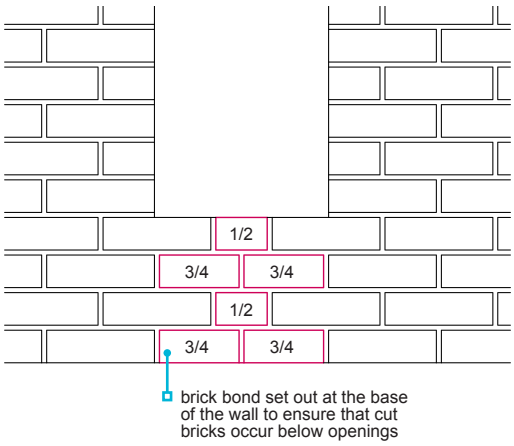


Figure 17: Masonry setting out at window openings



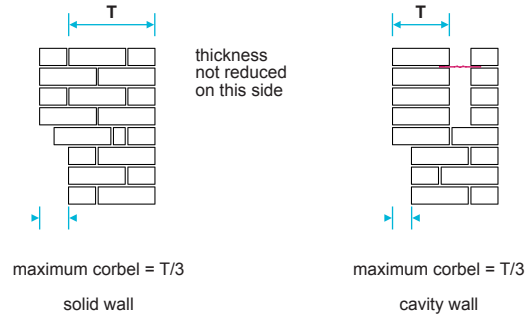
6.1.11.5 Corbelling

For feature brickwork sections, the masonry should only be self-supporting.

Where courses are corbelled outwards in ordinary masonry, one above another, the extent of corbelling should not exceed that shown in the figures on the right.

Where reinforcing is used, corbels should be designed by an engineer in accordance with Technical Requirement R5.

Figure 18: Corbelling



6.1.11.6 Chasing for services

Chases should:

- not be cut with impact power tools, as they can damage the wall
- not cut into hollow blocks unless specifically permitted by the manufacturer
- be cut with care
- be limited to 1/6 of the depth of the leaf where horizontal
- be limited to 1/3 of the depth of the leaf where vertical
- maintain a residual thickness of 15mm between the chase and the void for hollow or cellular blocks unless otherwise recommended by the manufacturer.

6.1.11.7 Protection of ancillary components

Table 4 contains guidance for a selection of ancillary components for use in buildings up to three storeys in height, in a non-aggressive environment.

Table 4: Protection of ancillary components

Product type	BS EN 845 ref [1]	Material/coating specification (the zinc coating masses are for one surface)
Wall ties, tension straps and hangers conforming to BS EN 845-1	1	Austenitic stainless steel (molybdenum chrome nickel alloys)
	3	Austenitic stainless steel (chrome nickel alloys)
	8 or 9	Zinc coated (940g/m^2) steel wire or component
Tension straps and hangers conforming to BS EN 845-1 (internal uses[2])	10	Zinc coated (710g/m^2) steel component
	11	Zinc coated (460g/m^2) steel component
	12.1 or 12.2	Zinc coated (300g/m^2) steel strip or sheet with organic coating over all outer surfaces of finished component
	13	Zinc coated (265g/m^2) steel wire
	14	Zinc coated (300g/m^2) steel strip or sheet with all cut edges organic coated
	15	Zinc precoated (300g/m^2) steel strip or sheet
	16.1 or 16.2	Zinc precoated (137g/m^2) steel strip or sheet with organic coating over all outer surfaces of finished component
	17	Zinc precoated (137g/m^2) steel strip or sheet with organic coating over all outer surfaces of finished component
Lintels conforming to BS EN 845-2	L1	Austenitic stainless steel (molybdenum chrome nickel alloys)
	L3	Austenitic stainless steel (chrome and nickel alloys)
	L10	Zinc coated (710g/m^2) steel component
	L11.1 or L11.2	Zinc coated (460g/m^2) steel component with organic coating over all outer surfaces of finished component
	L12.1 or L12.2	Zinc coated (300g/m^2) steel strip or sheet with organic coating over all outer surfaces of finished component
	L16.2	Zinc coated (137g/m^2) steel strip or sheet with organic coating over all outer surfaces of finished component
Lintels conforming to BS EN 845-2, where used with a separate DPC	L11	Zinc coated (460g/m^2) steel component
	L14	Zinc coated (300g/m^2) steel strip or sheet with all cut edges organic coated
	L16.1	Zinc coated (137g/m^2) steel strip or sheet with organic coating over all outer surfaces of finished component
Bed joint reinforcement conforming to BS EN 845-3	R1	Austenitic stainless steel (molybdenum chrome nickel alloys)
	R3	Austenitic stainless steel (chrome nickel alloys)
	R23	Austenitic-ferritic stainless steel to BS EN 10088 (all parts)
Windpost[3][4]	1	Austenitic stainless steel (molybdenum chrome nickel alloys)
	3	Austenitic stainless steel (chrome nickel alloys)

Notes
1. Material/coating reference in accordance with the relevant part of BS EN 845.
2. These products are not suitable for use in contact with the outer leaf of an external cavity wall or a single leaf cavity wall.
3. Outside the scope of BS EN 845 but meets the specification requirements of BS EN 845-1 for the material/coating reference.
4. Alternative material/coating specification may be provided in accordance with Clause 5.12 and Table 2 of PD 6697:2019 where windposts are not connected to, or embedded in the outer leaf of an external cavity wall.

Components in contact with, or embedded in, an inner leaf which is damp or exposed to periodic wetting (eg below the DPC) should be protected in the same way as components in contact with, or embedded in, an outer leaf.

6.1.12 Lintels

Also see: Chapter 6.5

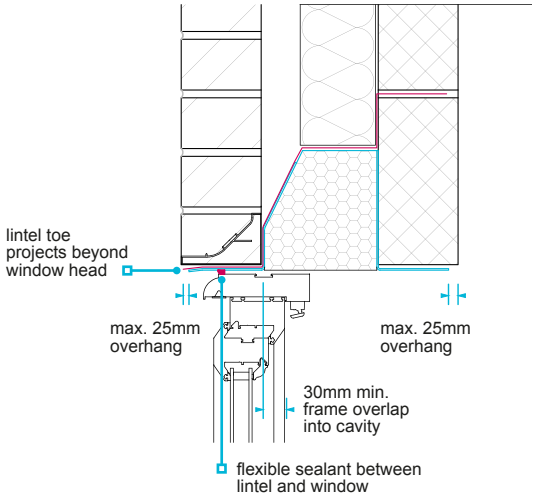
Lintels, and supporting beams, shall be installed correctly, safely support the applied loads, and be of the type and dimensions appropriate to their position within the structure. Issues to be taken into account include:

1) **thermal insulation and condensation**
2) **durability and resistance to water entering the home**
3) **placing lintels.**

Concrete, steel and reinforced brickwork are acceptable materials for use as lintels. Timber lintels should not be used, unless:

- protected from weather
- they do not support masonry or other rigid or brittle materials.

Figure 19: Masonry overhang to openings



Lintels should:

- comply with BS EN 845-2 Specification for ancillary components for masonry — Lintels, where steel or concrete
- be designed in accordance either with Technical Requirement R5 or the manufacturer's recommendations
- be provided where frames are not designed to support superimposed loads
- be wide enough to provide adequate support to the walling above
- not have brickwork or masonry which overhangs more than 25mm
- have cavity trays where they are specified in the design
- have padstones and spreaders provided under the bearings, where necessary
- not have concentrated loads applied before the manufacturer's requirement of fully bedded brickwork is met (this is to avoid overstressing).

Lintels should extend beyond the opening (at each end) by the minimum lengths shown in Table 5.

Table 5: Lintel bearing

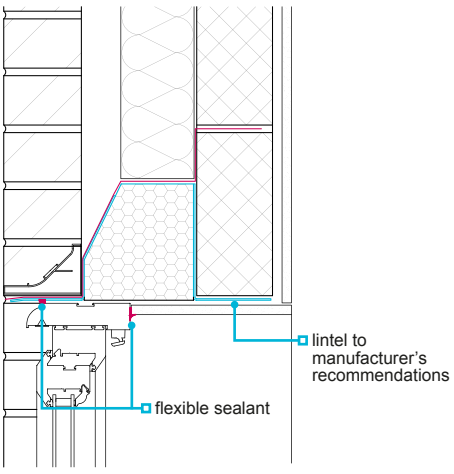
	Minimum bearing length (mm)	
Span (m)	**Simple lintel**	**Lintel combined with cavity tray**
Up to 1.2	100(1)	150
Over 1.2	150	150

Note
1. Minimum bearing lengths should be in accordance with the manufacturer's recommendations.

Where steel lintels are used:

- the manufacturer's recommendations for providing adequate fire resistance should be followed, particularly to the lower steel flange
- the inner and outer leaf should be built up together to avoid twisting the lintel flange
- the difference in height between the leaves should not exceed 225mm.

Figure 20: Combined lintel



Where separate lintels are used to support the inner and outer masonry leaves:

- the cavity, at the head of the opening, should be closed off with an insulated cavity closer
- a cavity tray should be installed to protect the cavity closer from moisture in the cavity
- the cavity tray should be built into the inner leaf and taken to the outer face of the external wall directly over the outer lintel and not between the cavity closer and lintel.

Figure 21: Separate lintels — reconstituted stone or concrete

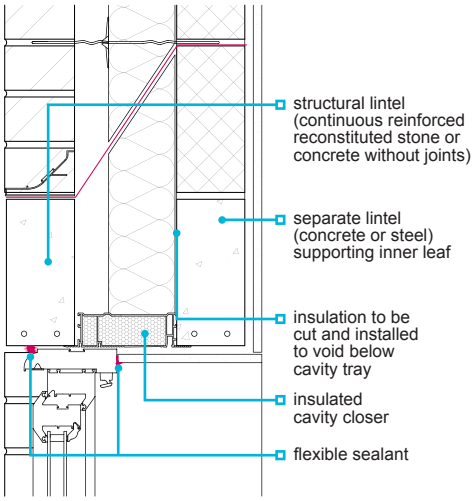
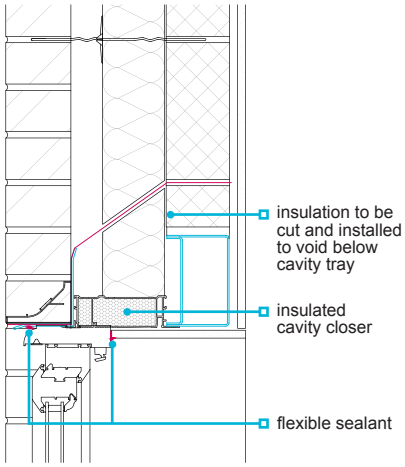


Figure 22: Separate lintels — steel



6.1.12.1 Thermal insulation and condensation

The risk of condensation at potential cold bridges, such as reveals and soffits, increases as the level of wall insulation increases. To avoid cold bridging:

- wall insulation should abut the head of the window frame
- insulation should be provided at the underside of the lintel unless the manufacturer produces an alternative.

6.1.12.2 Durability and resistance to water entering the homes

Cavity tray/damp proof protection should be provided:

- over all openings, either combined as part of the lintel or separate
- where the outer leaf is fair faced masonry, or where fully filled insulation is used, all cavity trays (separate or combined) should have stop ends.

Separate cavity tray protection should be provided when corrosion protection to the lintel is inadequate, or where required by the manufacturer, or the shape of the lintel is unsuitable, such as when:

- the profile of the lintel does not form a cavity tray
- steel lintels in external walls have material/coating in accordance with L11, L14 and L16.1 (see Table 4).

In Scotland, Northern Ireland, the Isle of Man and areas of severe or very severe exposure to driving rain, a separate cavity tray should be provided over all lintels.

Lintels should be:

- austenitic stainless steel (material reference L1, see Table 4) where used in aggressive environments, eg coastal locations
- located and sized so that the external edge of the lintel projects beyond, and therefore offers protection to, the window head.

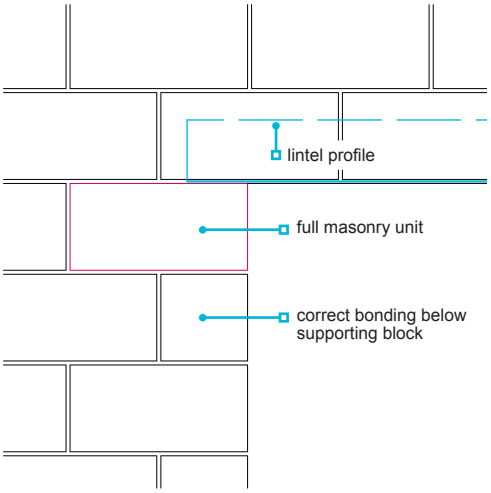
6.1.12.3 Placing lintels

The design should be checked, and lintels should:

- be an appropriate size for the opening and the end bearings (at each end)
- have padstones where required, eg for long spans
- be installed level on a solid bed of mortar (not soft or non-durable packing)
- be set out to ensure that lintels bear on a full masonry unit
- not have brickwork or masonry which overhangs more than 25mm.

Composite lintels and steel beams should be bedded on mortar to both leaves to ensure an even distribution of the loads. The thickness of the bedding should be sufficient to accommodate any unevenness between the support and a lintel and maintain coursing. Concrete floor units or other heavy components which bear on lintels should be positioned carefully to avoid damage or shock load.

Figure 23: Lintel end bearing



6.1.13 Materials suitable for mortar

Materials used for mortar should comply with the appropriate requirements and standards.

Relevant standards include:

BS EN 197-1	Cement — Composition, specifications and conformity criteria for common cements
BS EN 413-1	Masonry cement — Composition, specifications and conformity criteria
BS EN 459-1	Building lime — Definitions, specifications and conformity criteria
BS EN 998-2	Specification for mortar for masonry — Masonry mortar
BS EN 934-3	Admixtures for concrete, mortar and grout — Admixtures for masonry mortar. Definitions, requirements,conformity and marking and labelling
BS EN 12878	Pigments for the colouring of building materials based on cement and/or lime. Specifications and methods of test
BS EN 13139	Aggregates for mortar

6.1.14 Mortar

Also see: Chapter 3.2

Mortar shall be of the mix proportions necessary to achieve adequate strength and durability, and be suitable for the type of masonry. Issues to be taken into account include:

1) **sources of sulfate**
2) **admixtures and additives**
3) **preparing mortar**
4) **joints.**

Unless recommended otherwise by the brick manufacturer, the mixes in Table 6 should be used for clay bricks. In the case of concrete bricks, particular attention should be paid to the manufacturer's recommendations.

Table 6: Mortar mixes using ordinary Portland or sulfate-resisting cements

Location		Recommended cement:lime: sand mix	Recommended cement:sand mix	Recommended masonry cement: sand mix	Mortar designation to BS EN 1996-1-1	Equivalent mortar class to BS EN 1996-1-1
General wall area above the DPC	In areas of severe or very severe exposure — high durability	1:½:4½	1:3½	1:3	(ii)	M6
	Other exposure categories — general use	1:1:5½	1:5½	1:4½	(iii)	M4
Below DPC level and in chimney stacks	High durability	1:½:4½	1:3½	1:3	(ii)	M6
Cappings, copings and sills	Low permeability	1:0 to ¼:3	–	–	(i)	M12

Air-entraining plasticiser can be incorporated in the following general use and high durability mortars:

- 1:1:5½, cement:lime:sand, or
- 1:1:4½, cement:lime:sand.

Retarded mortar

Retarded mortar and most premixed mortars can be used over a longer period of time than site-mixed cement:lime:sand mortars. When using retarded mortar:

- follow the manufacturer's recommendations and timescales
- do not use it beyond the time for which it is effective
- protect it against freezing prior to use
- temporary bracing of larger walls, eg at gable peaks and long walls, may be necessary due to delayed setting times.

6.1.14.1 Sources of sulfate

Mortar is vulnerable to deterioration by sulfates, especially when masonry is saturated for long periods of time. Clay bricks contain soluble sulfate (S1 designations have no limit on their sulfate content), so a suitable mortar should be used.

To reduce risk, cement types listed in BS EN 998-2 NA.1.2 with sulfate-resisting properties or alternatively CEM II cements based on blast-furnace slag are in widespread use where sulfate resistance is required, and should be used:

- below the DPC level when sulfates are present in the ground
- when clay bricks (F2,S1 and F1,S1 to BS EN 771) are used
- when there is a high saturation risk (examples below).

High saturation risk situations are:

- below the DPC
- areas of severe or very severe exposure to driving rain
- parapets
- retaining walls
- freestanding walls
- rendered walls
- chimney stacks.

6.1.14.2 Admixtures and additives

Admixtures should:

- only be used where agreed with the designer
- not contain calcium chloride
- be dosed and used in accordance with the manufacturer's recommendations.

Mortars containing an air-entraining plasticiser are more resistant to freeze and thaw damage when set, but do not prevent freezing before the mortar is cured.

White cement to BS EN 197 and pigments to BS EN 12878 may be used, but pigments should not exceed 10% of the cement weight, or 3% where carbon black is used.

6.1.14.3 Preparing mortar

When preparing mortar:

- ensure the mix is appropriate for the use and location
- plant and banker boards should be kept clean
- mixers should be kept clean to operate efficiently
- the colour should be consistent.

When laying bricks and blocks:

- mortar should be the correct mix and used within two hours, unless it is retarded mortar
- mortar which has started to set should not be retempered.

Note
1. Thin layer mortars are supplied in bag form and should be mixed with water on site strictly following the manufacturer's recommendations.

6.1.14.4 Joints

Jointing is preferable to pointing because it leaves the mortar undisturbed. Struck (or weathered) and bucket handle joints are preferable for external walls. Unless the design states otherwise, only bucket handle or weathered joints should be used.

Recessed joints should not be used where:

- bricks are not frost-resistant, eg clay F1,S1 or F1,S2 to BS EN 771, unless the brick manufacturer has confirmed their use for that particular location in writing
- the home is built 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, eg 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.

6.1.15 Render

Also see: Chapter 6.11

The surface to which render is applied shall be appropriately constructed and satisfactorily resist the passage of moisture.

Walls to be rendered should be constructed in accordance with the relevant parts of this chapter. For detailed guidance, see Chapter 6.11 Render.

6.1.16 Cladding

Also see: Chapters 3.3, 6.2 and 6.9

Cladding shall satisfactorily resist the passage of moisture and be of the quality, type and dimensions required by the design. Issues to be taken into account include:

1) masonry cladding to framed structures
2) joints
3) materials for cladding
4) vertical tile or slate cladding
5) stone veneer cladding.

This clause is for low-rise applications where the masonry is used directly for weathertightness or used in conjunction with other vertical cladding for weathertightness. Chapter 6.9 covers curtain walling and other structural cladding.

Refer to the Robust Details Handbook to check compatibility of lightweight external treatments.

Where external claddings such as fibre cement, timber or tile hanging are installed on masonry walls, cavity barriers should be provided:

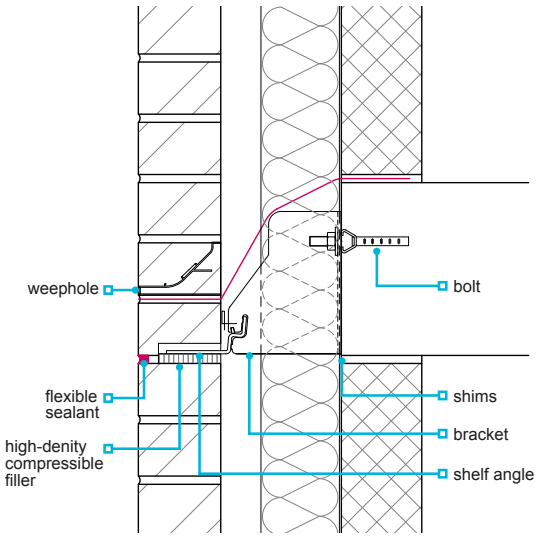
- at the edges of cavities, including eaves and verges, around openings such as windows and doors, and entry/exit points
- at the junction between an external cavity wall and every compartment floor and compartment wall.

6.1.16.1 Masonry cladding to framed structures

Allowance should be made for differential movement between cladding and the frame. The following precautions should be taken to prevent buckling and fracturing of masonry panels:

- flexible movement joints should be provided at the underside of each horizontal support member
- the masonry outer leaf should have a minimum two-thirds of its width supported securely by the concrete frame or a metal angle. See Figure 24 (water exclusion detail not included for clarity)
- appropriately detailed horizontal joint should be provided which can accommodate all movements anticipated at the joint, including deflection of substrate and the angle support system, as well as the limited compressibility of both the joint fillers and sealant
- additionally, horizontal movement joints should be capable of accommodating at least 1mm movement per continuous meter of vertical clay masonry
- vertical movement joints should be provided at corners, where appropriate
- the inner leaf should be adequately tied to the structural frame.

Figure 24: Masonry support



6.1.16.2 Joints

Joints between claddings and adjacent materials should:

- be detailed to be watertight under the particular exposure conditions of the site
- have provision for differential movement, where necessary.

6.1.16.3 Materials for cladding

Table 7: Materials for cladding

Component	Requirement	Notes
Tiles and slates	BS EN 1304, BS EN 490, BS EN 12326-1	Clay tiles for tile hanging, concrete tiles for tile hanging, slates for vertical slating
Timber boarding	BS EN 942	Timber should: • comply with and be at least class J50 • be a naturally durable species or pre-treated with preservative
Battens		Battens should be: • of the size specified in the design • pre-treated with preservative
Proprietary cladding systems	Technical Requirement R3	Satisfactory assessment by an appropriate independent technical approvals authority accepted by NHBC

Timber cladding should be in accordance with Chapter 3.3 Timber preservation (natural solid timber).

Prefabricated lightweight brick clad arches

Prefabricated lightweight brick clad arches comprising cement particle or fibre cement boards, injected polyurethane core and clay fired brick slips attached with epoxy adhesive for use as a decorative non load-bearing arch above openings in masonry cavity walls should:

- hold a satisfactory assessment by an appropriate technical approval's authority acceptable to NHBC
- be supported by a load-bearing lintel
- be installed in accordance with the manufacturer's instructions
- include a cavity tray over all openings (where the manufacturer's recommendations require a cavity tray to be located over prefabricated lightweight arches, a lintel with suitable profile and durability and proprietary stop ends and weepholes should be provided).

6.1.16.4 Vertical tile or slate cladding

Vertical tile or slate cladding to walls should:

- conform with Chapter 6.9 Curtain walling and cladding
- be fixed in accordance with the manufacturer's recommendations.

6.1.16.5 Stone veneer cladding systems

Stone veneer cladding systems should be in accordance with:

- BS 8298 when mechanically fixed
- Technical Requirement R3 when adhesive fixed
- Chapter 6.9 when used as a brick slip/rainscreen system.

6.1.17 DPCs and cavity trays

Also see: Chapters 6.2, 6.11 and BS 8215

DPCs and related components shall be provided to prevent moisture rising or entering the building. Issues to be taken into account include:

1) **provision of DPCs and cavity trays**
2) **stepped cavity trays**
3) **parapet details.**

6.1.17.1 Provision of DPCs and cavity trays

DPCs and flexible cavity trays should be of the correct dimensions to suit the detailed design.

High bond DPC can be used for applications including parapet walls, beneath copings and cappings.

High load DPC should be used where it will be subject to over three storeys of masonry.

The following materials are acceptable for use as DPCs:

Bitumen-based materials	BS 6398, BS EN 14967
Polyethylene (except as cavity trays in walls, below copings and in parapets)	BS 6515, BS EN 14909
Proprietary materials	Technical Requirement R3
Thermoplastics and Elastomers	BS EN 14909

Table 8: Positions where DPCs and cavity trays are generally required

Location	Provision of DPCs and cavity trays
Base of walls, piers, etc	A DPC should be provided a minimum 150mm above adjoining surfaces and linked with the DPM in solid floors
Base of partitions built off oversite where there is no integral DPM	The DPC should be the full width of the partition
Base of wall built off beam, slab, etc	Detail to prevent entry of damp by driving rain
Parapets	Beneath coping, and 150mm above adjoining roof surface to link with the roof upstand
In cavity walls over openings, air bricks, etc	A cavity tray should be provided to direct any water that enters the cavity to the outside. The cavity tray should fully protect the opening
At the horizontal abutment of all roofs over enclosed areas and balconies to walls	A cavity tray should be provided 150mm above any adjoining roof or balcony surface. The tray should be lapped over any roof upstand or flashing to ensure water penetrating into the cavity does not enter the enclosed area
At sloping abutments of all roofs over enclosed areas to cavity walls	Preformed stepped cavity trays should be provided above the roof surface and linked to the roof upstand or flashing to ensure any water penetrating into the cavity does not enter the enclosed area
Doorsteps	A DPC should be provided behind a doorstep where it is higher than a wall DPC
Sills	Where precast concrete or similar sills incorporate joints or are of a permeable material, a DPC should be provided beneath them for the full length and be turned up at the back and the end of the sill
Jambs in cavity	The reveal should be protected throughout its width by a continuous DPC. The width of the DPC should be sufficient to be fixed to, or overlap, the frame and fully protect the reveal For very severe exposure conditions, rebated reveal construction or a proprietary closer, suitable for the conditions, should be used
Stone heads	Where precast concrete or similar stone heads incorporate joints or are made of a permeable material, a DPC should be provided beneath them for the full length and built into, or fixed to, the inner leaf wall
Above gas membranes bridging the cavity	Where gas membranes bridge the cavity, a cavity tray should be provided. Cavity trays should be sealed to the gas membrane in accordance with the manufacturer's instructions to prevent capillary damp ingress at the joint

Figure 25: Low level DPC

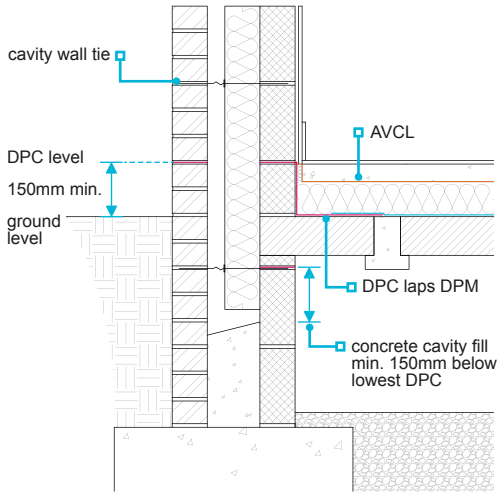


Figure 26: Cavity tray to air brick

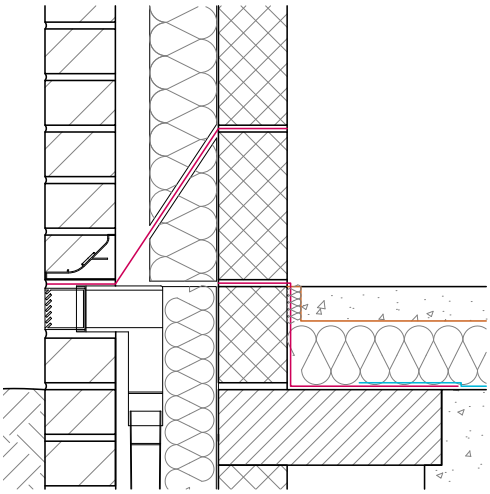


Figure 27: Cavity tray to inset meter box

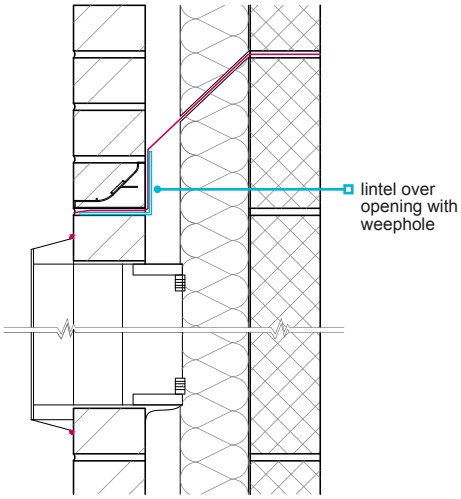
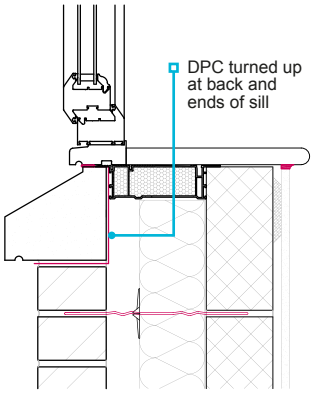


Figure 28: DPC to stone sill



Cavity trays

Cavity trays should be provided at all interruptions to the cavity (eg window and door openings, and air bricks) unless otherwise protected (eg by overhanging eaves). Cavity trays should:

- meet the requirements of BS EN 14909 and hold certification from an appropriate independent technical approvals authority accepted by NHBC confirming suitability for use as a cavity tray
- provide an impervious barrier and ensure that water drains outwards
- always be provided with stop ends where discontinuous
- project sufficiently beyond the lintel ends and cavity face of the cavity closer or vertical DPC, forming a stop end in the nearest naturally occurring perpend joint
- be laid on a wet, even bed of mortar, free from projections which could puncture or adversely affect the DPC material, with masonry above bedded on wet mortar to ensure the DPC material is ‘sandwiched’
- provide drip protection to door and window heads
- have a 140mm minimum upstand from the inside face of the outer leaf to the outside of the inner leaf
- not be low-density polyethylene (LDPE) to BS 6515
- be shaped to provide 100mm minimum vertical protection above points where mortar droppings could collect
- be provided where the cavity is bridged by air bricks, etc and the DPC should extend 150mm beyond each side of the bridge
- where not otherwise protected (eg by a roof at an appropriate level), be provided over meter boxes
- be in one continuous piece or, where necessary, have sealed or welded joints which are provided with rigid support and lapped at least 100mm
- be preformed where used at complicated junctions
- be used in accordance with the manufacturer’s recommendation.

On sites where radon or hazardous ground gases are present and cavities need to be sealed, it is still necessary to ensure downward movement water within the cavity is deflected from the cavity to the outside. To ensure all relevant functional performance requirements of DPC's, cavity trays and gas barriers are met when such site conditions occur and that all products are compatible and detailed to ensure continuity, specialist advice should be sought. Further guidance can be found in Clause 4.1.7.

Figure 29: Cavity tray to openings

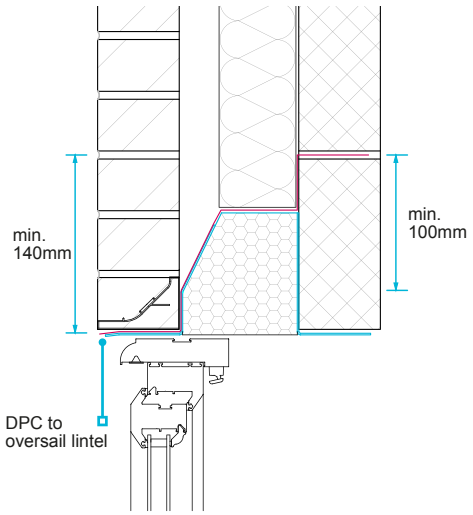
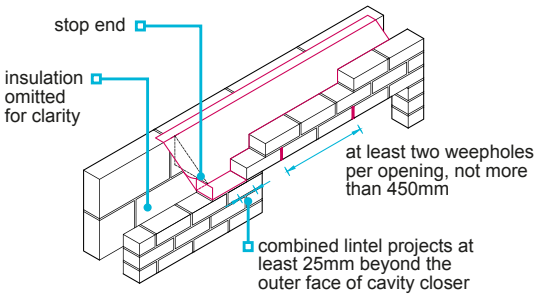


Figure 30: Cavity tray stop ends and weepholes



Stop ends should be of sufficient height to contain water and discharge it safely, and be the height of a full brick perpend. Stop ends may be formed by:

- turning up the end of a flexible sheet damp proof material, or
- proprietary plastic stop ends (where the lintel is a type that has the necessary corrosion protection and profile, and separate protection is not required by the manufacturer), specified to suit the profile and adhered to the surface of the lintel in accordance with manufacturer's instructions.

The upstand part of the cavity tray should be returned into the inner leaf unless it is stiff enough to stand against the inner leaf without support. In Scotland, Northern Ireland, the Isle of Man and areas of very severe exposure to driving rain, the upstand part of the damp proof protection should be returned into the inner leaf of masonry (this does not apply at sloping abutments).

Where fair faced masonry is supported by lintels:

- weepholes should be provided at a maximum of 450mm intervals
- each opening should have at least two weepholes
- cavity trays or combined lintels should have stop ends.

Where the lintel does not require a DPC, it should:

- have a suitable profile and durability
- give complete protection to the top of the reveal and vertical DPC, where provided.

Where the cavity has fully filled insulation, a cavity tray should be used above the highest insulation level, unless the insulation is taken to the top of the wall and is in accordance with the manufacturer's recommendations.

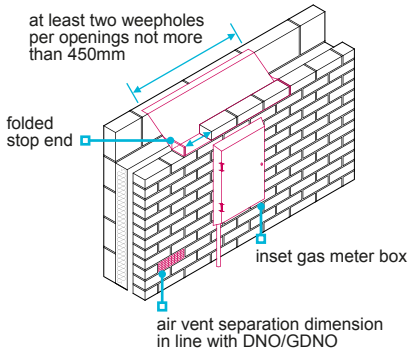
Weepholes

Weepholes in cavity walls should be the equivalent of a full brick perpend joint, eg 65mm x 10mm, where exposed within the cavity. The size of the discharge opening in proprietary weepholes may be smaller, provided it is designed to discharge any water collected, safely. The end of the weephole within the cavity should be kept clear of mortar droppings.

Weepholes to cavity walls should be provided:

- to cavity trays above openings and penetrations through the wall (such as sub-floor vents, ducts or flues), at least two per opening at not more than 450mm centres
- at least one to the bottom tray in a series of stepped cavity trays, eg at pitched roof abutments
- on cavity trays in parapet walls or at horizontal roof abutments at not more than 1m centres.

Figure 31: Weepholes to inset gas meter box



For guidance on weepholes to rendered walls, see Chapter 6.11 Render.

Where masonry cladding is installed to timber framed structures, the guidance on design of weep vents in Chapter 6.2 External timber framed walls should be followed.

Complicated junctions

Changes of direction of a cavity tray or interfaces with other elements in the cavity are more complicated than simple joints and would involve complex bending, folding, or cutting and sealing if fabricated on site. At complicated junctions, clear drawings and the design should be provided, and preformed cavity trays used.

Complicated junctions include:

- pitched roof abutments (ie, stepped trays)
- steps in horizontal level
- internal corners
- external corners
- t-junctions (ie, intersection of parapet wall)
- door thresholds (in conjunction with gas membranes, flat roofing detailing, etc)
- penetrations in horizontal cavity tray arrangements (ie, telescopic vents, services, etc)
- interfaces with windposts, balcony supports, balustrading or guarding.

Site folding of internal and external corners may be permitted where the quality of the installation is of the highest standard and installed in accordance with manufacturers recommendations.

Where preformed cavity trays are used, the joint with the flexible DPC cavity tray should be sealed in accordance with the manufacturer's recommendations.

Horizontal DPCs

DPCs should:

- be the correct width
- lap the DPM where appropriate
- be laid on a wet, even bed of mortar, free from projections which could puncture or adversely affect the DPC material, with masonry above bedded on wet mortar to ensure the DPC material is 'sandwiched'
- at ground level, generally be a minimum of 150mm above finished ground or paving level
- lapped a minimum of 100mm at joints, or be sealed or welded, where intended to prevent rising damp
- be considered in the design of masonry wall panel
- be used in accordance with the manufacturer's recommendations.

The concrete fill in a cavity wall should stop at least 225mm below the base DPC. This may be reduced to 150mm where special foundations, such as rafts, are used.

Figure 32: Concrete cavity fill

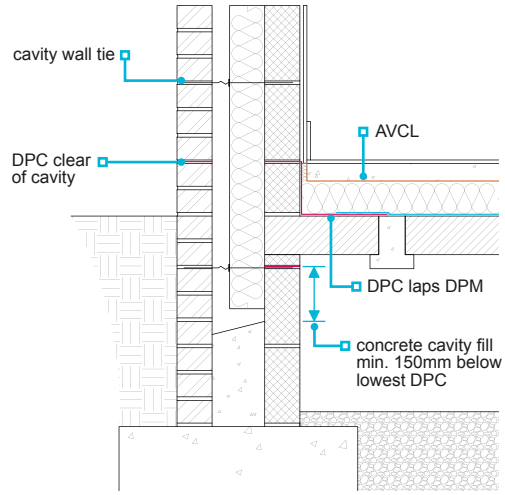
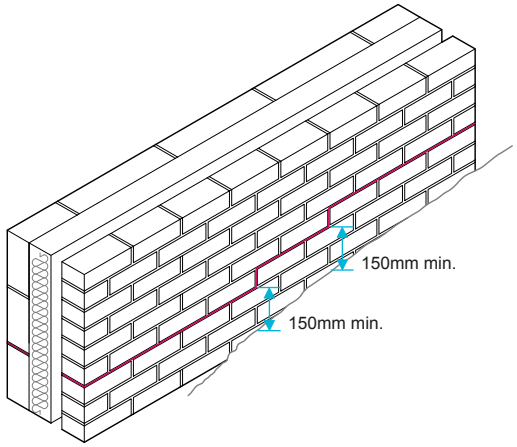


Figure 33: Stepped horizontal DPC



Where a jointed or permeable sill is used, a DPC should be:

- placed between the sill and the outer leaf
- turned up at the back and ends of the sill.

At sills where there is:

- a DPC, it should be lapped with the reveal DPC
- no DPC, the vertical DPC should be continued 150mm below the sill level.

Special DPC detailing may be required at accessible thresholds.

Vertical DPCs

A separate vertical DPC should be provided around openings, extend to the underside of the lintel, and:

- be of a proprietary material assessed in accordance with Technical Requirement R3, or
- 150mm wide DPC material, nailed to the full height of the frame, and protrude 25mm into the cavity.

A fillet joint of sealant should not be considered a substitute for good workmanship or DPCs. However, a bead of mastic should be used around openings.

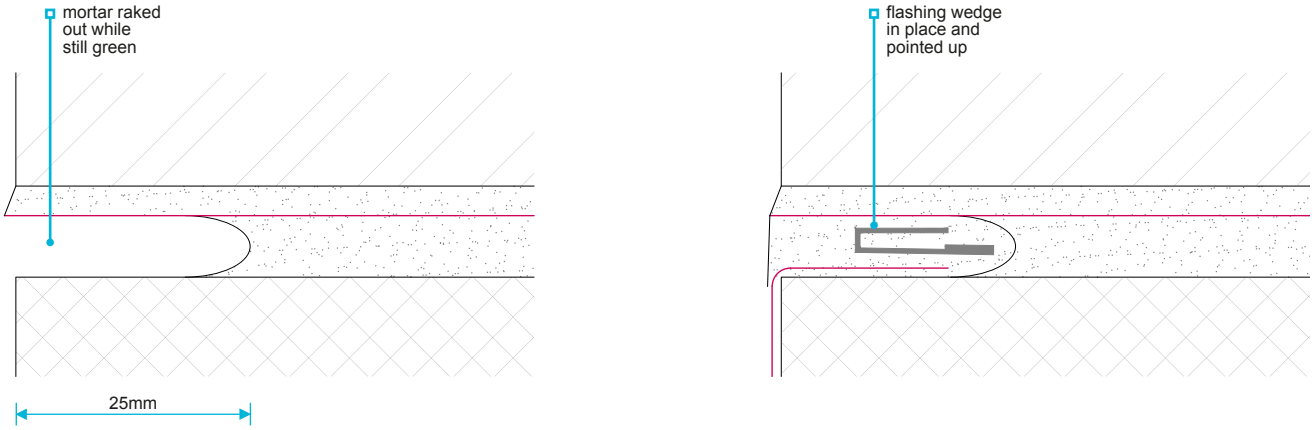
Cavity trays and insulation material

Where fully filled or partial fill insulation is installed, particular care needs to be taken to ensure the insulation continuity is maintained around the cavity tray.

Connections with flashings

Where flashings link with DPCs (eg horizontal or preformed stepped cavity trays), 25mm of mortar below the DPC should also be raked out as the work proceeds to allow for the flashing to be tucked in.

Figure 34: DPC to flashing interface



Joints between the masonry and flashing should be pointed with cement mortar or suitable exterior grade sealant (polysulfide or neutral-cured silicone) in accordance with the manufacturer's recommendations.

Arches

At openings with an arched head or circular windows, it is not practical to shape a flexible DPC and achieve the correct protection, and a preformed cavity tray should be used.

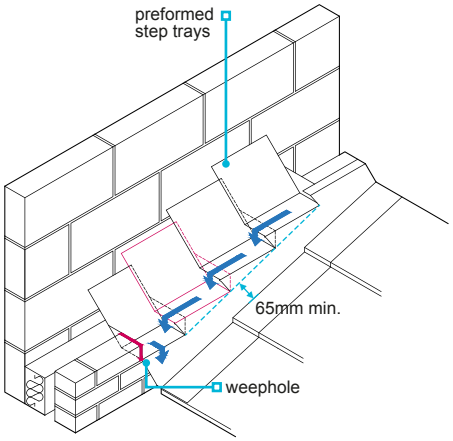
6.1.17.2 Stepped cavity trays

Where the roof abuts at an angle with the wall, preformed stepped cavity trays should be provided.

To minimise the risk of water ingress below the abutment, preformed stepped cavity trays:

- should be provided where a roof abuts a cavity wall above an enclosed area, eg an attached garage
- should have two stop ends at the lowest cavity tray and a weephole to allow water to drain from the cavity
- are not necessary where the roof is not over an enclosed area, eg open carport and open porch.

Figure 35: Stepped cavity trays



Preformed stepped cavity trays should be installed in accordance with the manufacturer's recommendations and positioned:

- to suit the dimension of the flashing (which should be in accordance with the manufacturer's recommendations or a minimum width of 65mm)
- so that the stepped cavity tray cannot discharge behind flashing (where it is necessary to cut bricks or blocks, the bond should be maintained in the following joint).

6.1.17.3 Parapet details

Parapet walls should have:

- a DPC under the coping, and a DPC tray starting 150mm minimum above the roof
- coping throating which is 30mm clear of the brickwork
- copings that comply with BS 5642 Parts 1 and 2.

DPCs in parapet walls should be:

- supported over the cavity to prevent sagging below copings
- fully bedded in mortar
- specified to achieve a good key with the mortar
- sealed to prevent water seeping through the joints.

Figure 36: Parapet walls

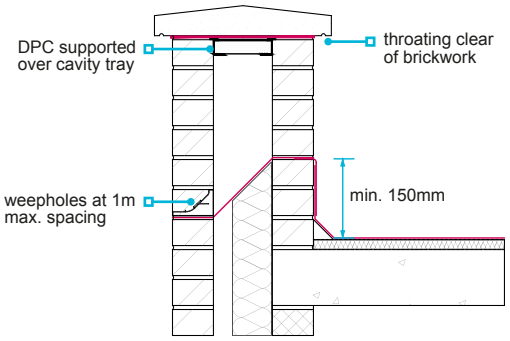


Figure 37: Copings/cappings to parapet walls

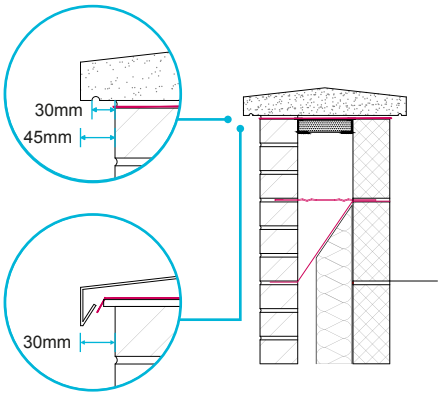
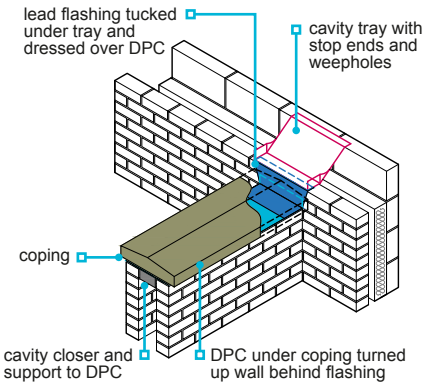
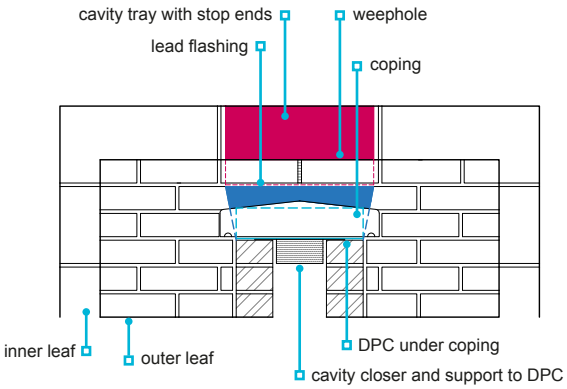
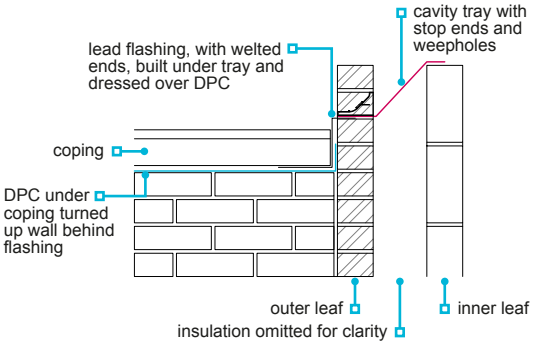


Figure 38: Parapet to external wall junction — DPC/cavity tray arrangement







6.1.18 Wall ties, bed joint reinforcements and windposts

Wall ties, bed joint reinforcements and windposts of the correct type shall be installed where required, and be suitable for their intended use and location. Issues to be taken into account include:

1) position
2) ties for partial fill insulation
3) cavity widths of over 100mm.

Wall ties should:

- be in accordance with BS EN 845-1 or Technical Requirement R3
- be of the type specified in the design
- be long enough to be embedded a minimum of 50mm into each leaf
- be stainless steel or non-ferrous materials in accordance with Technical Requirement R3
- be spaced above and below the DPC in accordance with Table 9
- be of the type or classification that is appropriate for the end use (including cavity width) and geographical location
- be specified to accommodate movement where required by the design
- be used in accordance with the manufacturer's recommendations.

Bed joint reinforcements should:

- be in accordance with BS EN 845-3 or Technical Requirement R3
- be of the type specified in the design
- be sufficiently wide so that minimum cover of 20mm is provided from the external face of masonry
- be stainless steel or non-ferrous materials in accordance with Technical Requirement R3
- have a minimum lap length of 225mm, and laps between lengths should always be staggered
- be used strictly in accordance with the manufacturer's recommendations.

Windposts should:

- be designed by an engineer in accordance with Technical Requirement R5
- comply with Clause 5.12 and Table 2 of PD 6697:2019 Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2
- be austenitic stainless steel (material reference 1 or 3, see Table 4) where connected to or embedded in an outer leaf of an external cavity wall in buildings exceeding three storeys
- be austenitic stainless steel (material reference 1, see Table 4) where used in aggressive environments eg coastal locations.

6.1.18.1 Position

Table 9: Spacing of wall ties

	Maximum horizontal spacing (mm)	Maximum vertical spacing (mm)
General wall area	900	450
Jamb openings, movement joints, etc	Within 225 of opening	Not more than 300(1)
Top of gable walls	225 (parallel to the top of the wall)	Not more than 300(2)
Top and bottom of openings	450	N/A

Notes

1. Vertical spacing and number of ties may need adjusting to produce equivalent number of ties when using insulation boards.
2. Vertical spacing and number of ties may need adjusting to produce equivalent number of ties when using studded or spandrel panels.

Water should be prevented from crossing the cavity. Care should be taken to avoid:

- ties sloping down to the inner leaf
- drips being off-centre
- ties having mortar droppings on them.

Cavity walls should be coursed so that the wall tie is level or slopes outwards.

Figure 39: Wall tie locations

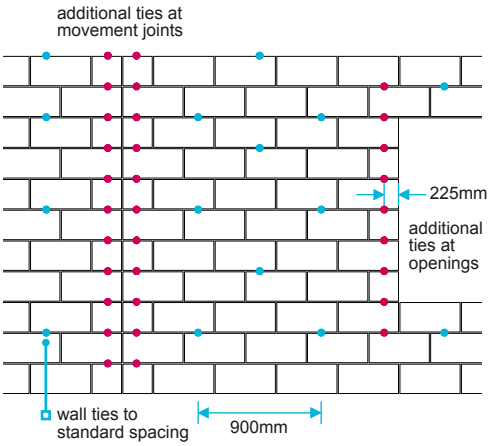


Figure 40: Wall tie embedment

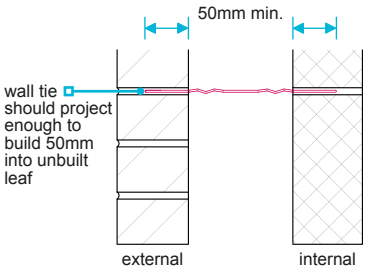
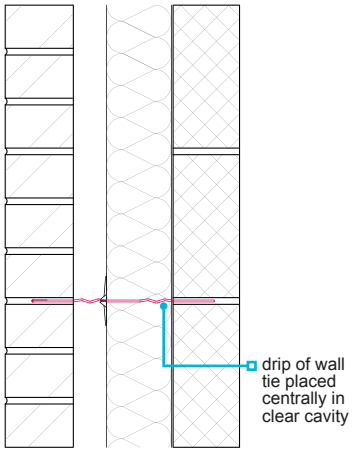


Figure 41: Wall tie to partial fill insulation



Wall ties should be:

- built in and not pushed into joints
- of sufficient length to achieve a minimum 50mm embedment into each leaf of masonry, allowing for normal tolerances in cavity width
- positioned so that the drip is centred in the clear cavity and faces downwards.

6.1.18.2 Ties for partial fill insulation

Where partial cavity fill insulation is being used, it should be held against the inner leaf by retaining devices, which may be clipped to the wall ties. Retaining devices should be:

- compatible with the wall ties
- used in accordance with Technical Requirement R3.

Where 1,200mm boards are used with partial fill cavities, the wall ties should:

- be spaced closer to provide adequate support and restraint
- be spaced at 600mm centres in rows ie, not staggered.

6.1.18.3 Cavity widths of over 100mm

Where cavity to masonry walls is to be 100-150mm, wall tie spacing in Table 9 may still be used in dwellings of up to three storeys high in sheltered and moderate exposure locations, provided they are of the right length with 50mm minimum embedment in the masonry.

Where dwellings are exposed to severe and very severe winds, including on exposed and elevated locations of over 150m above sea level as well as coastal locations, site-specific assessment of wall tie requirements should be undertaken. The wall tie spacing in Table 9 may still be acceptable, if used in conjunction with stiffer wall tie types — eg Type 1 or 2 in accordance with PD 6697.

6.1.19 Handling materials

Materials shall be handled in such a way as to ensure that the construction is neat, clean and undamaged upon completion.

Materials should be stored properly. Issues to be taken into account include the following:

- deliveries should be undertaken safely to protect both the operatives and materials only using pallets provided by the manufacturer
- stacks of bricks and blocks should be protected from rain and mud splashes, etc by covering them with waterproof covers
- a suitable level and safe place should be identified on each site for the masonry deliveries
- cement should be stored off the ground and protected from weather
- sand should be prevented from spreading and be protected so that it remains clean
- insulation materials should be handled and stored in accordance with the manufacturer's instructions. Normally, insulation materials should be protected from the weather.

Materials should be handled with care during construction to avoid damage and staining. Chipped or fractured bricks are not acceptable for facework.

Bricks that are tipped on delivery or moved about the site in dumper trucks often have a high degree of wastage.

The unloading of all bricks and blocks, especially facing bricks, should be:

- by mechanical means
- directly onto a firm level surface.

Unless bricks have been blended by the manufacturer, bricks from different batches should be mixed to avoid colour patching.

To reduce the risk of efflorescence, newly erected masonry should be covered. This also prevents the mortar being washed out of the joints by rain and stops masonry becoming saturated. Bricks and blocks that become excessively wet can suffer from:

- staining and efflorescence
- lack of mortar adhesion to mud-stained surfaces.
- increased drying shrinkage, with a greater risk of cracking

The work place should be kept clean to reduce mortar splashes to a minimum. Any accidental mortar smears should be lightly brushed off the face after the mortar has taken its first set.

6.1.20 Protection of the works during construction

Also see: Chapter 3.2

Precautions shall be taken to protect walls from damage during construction. Issues to be considered include:

1) **cold weather working**
2) **hot weather working**
3) **excessive rain working.**

6.1.20.1 Cold weather working

Freshly laid mortar may fail where it freezes.

The use of air-entraining agents in cold weather gives better frost resistance to set mortar but does not aid the set. The use of accelerating admixtures and other admixtures should not:

- be relied on as an anti-freeze precaution
- contain calcium chloride.

The setting times of additives should be checked and adhered to in accordance with the manufacturer's recommendations. Cold weather retarders increase setting times.

In cold weather:

- brickwork and blockwork should not be built when the air temperature is below 3°C and falling
- work can resume when the temperature is 1°C and rising, with the expectation the temperature will exceed 3°C
- walls should be protected from frost until the mortar has set sufficiently to resist frost damage
- covers should be provided to form a still air space to insulate the wall
- walling damaged by frost will not regain strength and should be taken down and rebuilt when conditions improve.

Note

1. Thin joint mortars that can be shown to have been successfully tested for use down to 0°C are acceptable when the temperature is 0°C and rising. The mortar should be used strictly in accordance with the manufacturer's instructions and Chapter 3.2 Cold weather working.

6.1.20.2 Hot weather working

In very hot weather above 30°C, the main concern is the rate that water is removed from the mortar either by suction of the warm masonry or evaporation. The mortar will also tend to lose its plasticity at a faster rate due to the evaporation of the water from the mix.

Mortar mixed at high temperatures may have a higher water content, a lower air content and a shorter board life. The quality of the bond between the mortar and the brick or block is dependent on having the correct amount of water, so this bond may be affected.

To reduce the impact of higher temperatures:

- store bricks and blocks in the shade to help control heat gain
- spraying with modest amounts of clean water can keep their temperature down and stop the suction, but do not soak them
- mixing equipment can be shaded from direct sunlight prior to use
- mortar tubs and mortar boards should be rinsed with cool water before coming into contact with the mortar
- where ready-to-use mortar is being stored on site, it is important to keep it well covered in the tub
- dry silo mortar — where the dry sand and cement mortar is stored on site in a hopper and mixed with water on demand, this offers the added advantage of being able to mix small batches which can be used up quickly.

In dry hot weather, absorbent clay masonry units may be wetted by lightly spraying to reduce suction. Care should be taken not to over-wet units. Low absorption units such as engineering bricks should not be wetted.

Newly built masonry should be protected with suitable material ie, hessian or sheeting, to insulate and prevent drying out too quickly. Hessian should not be wetted and laid dry.

6.1.20.3 Excessive rain working

Bricks or blocks should not be laid in excessive wet conditions.

New brickwork and blockwork should be completely covered to protect it from the elements.

If brickwork and blockwork is exposed to water for a prolonged period of time, the risk of leaching, cement residues and efflorescence will increase.

Protection of cavity walls during construction

Masonry cavity walls should be protected whenever work stops, eg for inclement weather or overnight. The tops of both leaves, as well as the cavity and any insulation, should be covered with sacking or plastic sheet and appropriately secured in place.

6.1.21 Further information

- *BS 8215 — Code of practice for design and installation of damp-proof courses in masonry construction*
- *PD 6697 — Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2*

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