# Part 6

## Superstructure (excluding roofs)



# Chapter 6.1

## External masonry walls

## CONTENTS



## SCOPE

This Chapter gives guidance on meeting the Technical Requirements and recommendations for external masonry walls.

## DESIGN STANDARDS

**6.1 - D1 Design shall meet the Technical Requirements**

Design that follows the guidance below will be acceptable for external masonry walls.

## STATUTORY REQUIREMENTS

**6.1 - D2 Design shall comply with all relevant statutory requirements**

Design should be in accordance with relevant Building Regulations and other statutory requirements.

## STRUCTURAL DESIGN

**6.1 - D3 External cavity and solid walls shall be designed to support and transfer loads to foundations safely and without undue movement**

Items to be taken into account include:

**(a) standards**
Structural design should be in accordance with BS EN 1996-1-1.

Intermediate floors and roofs should be designed to provide lateral restraint to external walls, in accordance with BS 8103 and ancillary components to BS EN 845-1.

Walls of dwellings or buildings containing dwellings over three storeys high should be designed in accordance with Technical Requirement R5.

**(b) lateral restraint provided by concrete floors**
Concrete floors, with a minimum 90mm bearing onto the wall, provide adequate restraint.

Concrete floors running parallel to and not built into walls require restraint straps to provide restraint to the wall (reference should also be made to Chapter 6.4 'Timber and concrete upper floors' (each section)).

**(c) lateral restraint provided by timber floors**
Timber joisted floors can provide adequate restraint when joists are carried by ordinary hangers to BS EN 845 and connected to the wall with restraint straps.

In buildings of not more than 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 restraint type hangers, as described in BS EN 845-1 with performance equivalent to a restraint strap at not more than 2m centres.

**(d) point loads**
Padstones and spreaders may be necessary and, where required, should be located beneath areas of concentrated loads.

**(e) chases**
The position and depth of chases for services should be considered. Horizontal chases should be limited to one-sixth the thickness of a single leaf, and vertical chases to one-third the thickness of a single leaf.

Particular care is needed where hollow blocks are specified. Hollow blocks should not be chased, unless specifically permitted by the manufacturer.

**(f) bonding**
When partition walls abut the external wall and are of similar materials, they may be either fully bonded or tied together. Where materials have dissimilar shrinkage or expansion characteristics, eg dense concrete and aerated concrete, a tied joint is preferable as this will reduce the risk of random cracking.

In the case of a connection between a loadbearing wall on foundations and a non-loadbearing wall supported on a ground bearing slab, it is preferable to tie, not bond, the walls. This will reduce the risk of cracking due to differential vertical movement.

Tied joints should be formed using expanded metal, wire wall ties or a proprietary equivalent, at maximum 300mm intervals.

**(g) movement joints**
Movement joints should be provided, where necessary, and in such a way that stability is maintained. If no provision is made for both initial and long term movements, masonry walls may crack.

Vertical movement joints should be provided in the outer leaf to minimise the risk of major cracking, as shown in the following table:

| Material | Joint width (mm) | Normal spacing |
|---|---|---|
| Clay brick | 16 | 12m (15m maximum) |
| Calcium silicate brick | 10 | 7.5 to 9m |
| Concrete block and brick | 10 | 6m |
| Any masonry in a parapet wall | 10 | half the above spacings and 1.5m from corners (double the frequency) |

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

When different materials are used together, consideration should be given to potential differential movement. Wall ties are needed on either side of movement joints (reference should be made to Clause D7 and Sitework clause 6.1 - S5).

Movement joints should run the full height of the masonry wall. Any movement joints provided in the substructure must be carried up into the superstructure. Movement joints may be needed in the superstructure where none are required in the substructure - however suitable allowance should be made for relative movement.

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

Details of suitable materials to form movement joints are given in the Materials section of this chapter.

Where movement joints are provided to control shrinkage in concrete blockwork, they may be simple vertical joints filled with mortar and sealed.

To ensure the sealant is effective, there should be a good bond with the masonry. The sealant should be at least 10mm deep or in accordance with manufacturers' instructions.

Movement joints are not normally necessary to 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. This is unnecessary for fired clay bricks
- bed joint reinforcement as an alternative to movement joints in areas of risk, eg under window openings.

To reduce cracking and to maintain the level of thermal resistance:

- bricks and blocks, or blocks of different densities, in a wall should not be mixed
- a joint should be formed where dissimilar materials abut
- the joint should be tied (eg with expanded metal in the bed joint) unless the joint is to act as a movement joint.

Where cracking is likely, walls should be dry lined or clad (reference should also be made to Sitework clause 6.1 - S2(g)).

**(h) calcium silicate brickwork**
Design of calcium silicate brickwork should follow the the brick manufacturer's recommendations.

**(i) cladding to framed structures**
Allowance should be made for differential movement between cladding and 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 at least two-thirds of its width supported securely by the concrete frame or a metal angle
- the inner leaf should be adequately tied to the structural frame. Forked plate ties held in dovetail slots, cast into the column or an equivalent are acceptable
- vertical movement joints should be provided at corners.

For timber framed construction, reference should be made to Chapter 6.2 'External timber framed walls' (Design).

**(j) corbelling**
The size of corbels should not exceed the dimensions given in Sitework clause 6.1 - S2(j).

## EXPOSURE

**6.1 - D4 External walls shall be suitable for their exposure and resist the passage of moisture to the inside of the dwelling**

In this Chapter, reference is made to exposure to:
- wind driven rain
- frost attack.

Details of how these are defined are contained in Appendices 6.1-A and 6.1-B.

Items to be taken into account include:

**(a) general aspects affecting durability**
Masonry in the following locations is particularly likely to become saturated and may remain so for long periods. Precautions as necessary should be taken to resist frost damage and sulfate attack in:
- parapet walls and copings
- sills and projections
- masonry below dpc at ground level
- freestanding walls.

The selection of bricks and mortar should follow the recommendations given in BS EN 1996-1-1 and manufacturers' recommendations.

In addition to the mortar designations given in BS EN 1996-1-1, the following mortar mixes can be used with ordinary Portland cement or sulfate-resisting cement:
- air-entrained 1 : 1 : 5½ cement : lime : sand, or
- air-entrained 1 :½ : 4½ cement : lime : sand.

Sulfate-resisting cement should be used where clay bricks with S1 designation are used as follows:

- below dpc where there are sulfates present in the ground
- below 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 be used only in accordance with Technical Requirement R3.

**(b) rain penetration**
Rainwater will penetrate the outer leaf of a masonry wall in prolonged periods of driving rain. Resistance to rain penetration of masonry walls can be improved by cladding the wall. Total resistance can only be achieved with an impervious cladding.

The following should be taken into account to minimise the risk of rain penetration:
- determination of the exposure to wind driven rain
- a suitable wall construction and insulation method
- design detailing for the local exposure, taking into account the likely quality of workmanship on site.

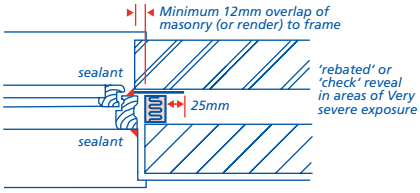
A very high standard of workmanship is required to ensure that cavities are not bridged. Where full or partial cavity insulation is proposed, the installation should follow the recommendations of any assessment and the manufacturer.

The most exposed part of the building should be given particular attention when selecting a suitable construction method as this may affect the choice for the whole building.

The following aspects of design can reduce the risk of rain penetration:
- *providing cladding (other than render)* to the wall. Even if cladding is only added to gable walls and upper floors, it reduces rain penetration
- *increasing the clear cavity width or the width of full cavity insulation.* Increasing the cavity width for full cavity insulation from 50mm to 75mm or more greatly reduces the risk of rain passing through the cavity. A nominal cavity of 50mm is always required on the outside of partial cavity insulation
- *rendering the wall* (reference should also be made to Clause D15). Specify backing material carefully to avoid cracking which can reduce the effectiveness of render against rain penetration
- *designing protective features to keep the wall dry,* eg projecting sills and deep overhanging eaves and verges
- *mortar joints.* All joints should be fully filled. Where full cavity insulation is proposed, recessed joints should not be used. Reference should also be made to Clause D5(c).

In areas of *Very Severe* exposure to driving rain and in Scotland the cavity should not contain full fill insulation.

In Scotland, Northern Ireland, the Isle of Man and in other places where the exposure to driving rain is *Very Severe*, masonry should form a rebate at the reveals of openings to avoid a straight through joint where the frame abuts the masonry.




Proprietary cavity closers may be an acceptable alternative provided they have been assessed in accordance with Technical Requirement R3. For information on doors and windows, reference should be made to Chapter 6.7 'Doors, windows and glazing' (each section).

In Scotland and areas of *Severe* or *Very Severe* exposure to driving rain, cavities should be continuous around enclosed porches and habitable areas.

Cavity trays should be used at junctions with roof (reference should also be made to Clause D6).

Sills, copings and the like should be weathered and throated unless adequate alternative provision is made to protect the brickwork from saturation, frost damage and staining.

**(c) frost attack**
The main factors affecting frost attack are:
- 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.

Areas of severe frost exposure are shown on the map in Appendix 6.1-B.

In areas of exceptionally severe frost exposure, which is defined as a location which is in a severe frost exposure area and, in addition, faces long stretches of open countryside, only frost-resistant bricks (F2,S2 or F2,S1 to BS EN 771) are acceptable for the superstructure.

In areas of severe frost exposure, the following are acceptable:
- clay facing bricks which are frost-resistant (F2,S2 or F2,S1 to BS EN 771). Reference should be made to Appendix 6.1-E for the freeze/thaw resistance classification of bricks to BS EN 771
- clay bricks which are classified in manufacturers' published recommendations as satisfactory for the exposure
- calcium silicate bricks (in accordance with BS EN 771)
- concrete bricks with a strength not less than 20N/mm$^2$

- concrete blocks with a density not less than 1500kg/m$^3$ or of strength not less than 7.3N/mm$^2$
- most types of aerated concrete blocks with render.

In Scotland, all clay bricks used as facings should be frost-resistant (F2,S2 or F2,S1 to BS EN 771).

If there are doubts about the suitability of a facing brick for sites in areas of exceptionally severe frost exposure classification, written confirmation should be obtained from the brick manufacturer that the brick is suitable for:
- its geographical location, and
- its location in the structure.

This applies particularly to bricks such as fletton facings which are moderately freeze/thaw resistant (F1,S2 or F1,S1). In addition, follow manufacturers' recommendations on suitability, including the choice and use of mortar and the type of pointing.

Recessed joints should only be used in compliance with Clause D5(c).

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.

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

For example:
- paths should drain away from walls to avoid saturating bricks near the ground
- sills, copings and the like should have a weathered upper surface
- a coping should be provided for all parapet walls, chimneys and freestanding walls unless clay bricks of F2,S1 or F2,S2 classification to BS EN 771 have been used. Copings should have a generous overhang, throatings at least 40mm clear of the wall and a continuous, supported dpc underneath which projects beyond the line of the wall. Single leaf parapet walls should not be rendered on both sides.

Where there is a risk that brickwork may be persistently wet, bricks should be specified that are low in soluble salts (if clay, F2,S2 or F1,S2 to BS EN 771).

**Note**
Only clay bricks designated L by BS EN 771 have a low limit on their soluble salt content. In persistently wet conditions, clay bricks of S1 designation may create sulfate attack on the mortar.

Painted or decorated finishes can trap moisture in external brickwork and increase the risk of frost damage, sulfate attack or other detrimental effects. They should not be applied to S1 designation bricks without the brick manufacturer's written agreement.

## MORTAR

**6.1 - D5 Mortar shall be of the mix proportions necessary to achieve adequate strength and durability and be suitable for the type of masonry**

Items to be taken into account include:

**(a) geographical location and position within the structure**
Recommended mortar mixes for different locations are given in Appendix 6.1-C.

**(b) sources of sulfate**
Ordinary Portland cement mortar can expand, crumble and deteriorate badly if attacked by sulfates. Sufficient soluble sulfate to cause this problem may be contained in clay bricks. Clay bricks with an S1 designation have no limit on their sulfate content. The problem is most acute when brickwork is saturated for long periods; mortar is vulnerable to attack by any soluble sulfates present.

To reduce the risk, sulfate-resisting Portland cement to BS 4027 should be used:
- below dpc level when sulfates are present in the ground
- when clay bricks (F2,S1 and F1,S1 to BS EN 771) are used, and there is a high saturation risk, for example in the following situations:
  - parapets
  - chimney stacks
  - retaining walls
  - freestanding walls
  - rendered walls
  - areas of Severe or Very Severe exposure to driving rain.

**(c) joints**
Struck (or weathered) and bucket handle joints are preferable.

Recessed joints should not be used where:
- bricks are perforated nearer than 15mm to the face
- bricks are not frost resistant (if clay F1,S1 or F1,S2 to BS EN 771), unless the brick manufacturer has agreed in writing for their use in a particular location
- there is no reasonable shelter from driving rain (reasonable shelter could be from buildings or groups of trees if these are within 50m and of similar height to the dwelling)
- the dwelling is built on steep sloping ground, facing open countryside or within 8km of a coast or large estuary
- the cavity is to be fully filled with cavity insulation.

Jointing is preferable to pointing because it leaves the mortar undisturbed.

**(d) admixtures and additives**
Calcium chloride should not be used as an admixture to mortar. The contents of admixtures should be checked to ensure that they do not contain calcium chloride.

Admixtures should only be used in accordance with manufacturers' recommendations/instructions.

Mortars containing an air-entraining plasticiser are more resistant to freeze/thaw damage when set.

White cement to BS EN 197 and pigments to BS 1014 may be used, but pigments should not exceed 10% of the cement weight or 3% if carbon black is used.

Further advice concerning admixtures is given in Appendix 6.1-C.

## DAMP-PROOF COURSES AND CAVITY TRAYS

**6.1 - D6 Damp-proof courses and related components shall be provided to prevent moisture rising or entering the building**

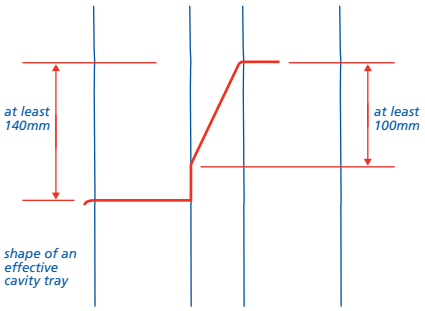
Items to be taken into account include:

**(a) dpcs**
Damp-proof courses should be provided in accordance with the Table in Appendix 6.1-D.

At complicated junctions, clear drawings should be provided and preformed profiles specified. Isometric drawings can sometimes be clearer than the combination of plan and section/elevation drawings.

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

A cavity tray should:
- provide an impervious barrier and ensure that water drains outwards
- project at least 25mm beyond the outer face of the cavity closure or, where a combined cavity tray and lintel is acceptable, give complete protection to the top of the reveal and vertical dpc where provided
- provide drip protection to door and window heads
- have an overall minimum upstand from the inside face of the outer leaf to the outside of the inner leaf of 140mm
- be shaped to provide at least a 100mm vertical protection above a point where mortar droppings could collect.




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 except at sloping abutments. In all other areas, the upstand should be returned into the inner leaf unless it is stiff enough to stand against the inner leaf without support.

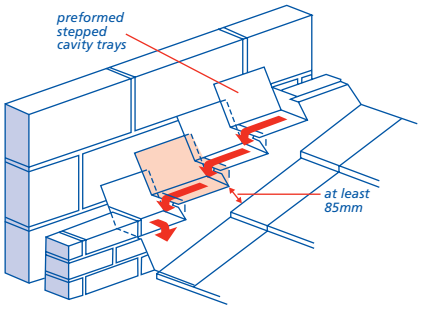
Where fairfaced masonry is supported by lintels:

- weep holes should be provided at 450mm (maximum) centres with at least two weep holes per opening
- cavity trays or combined lintels should have stop ends.

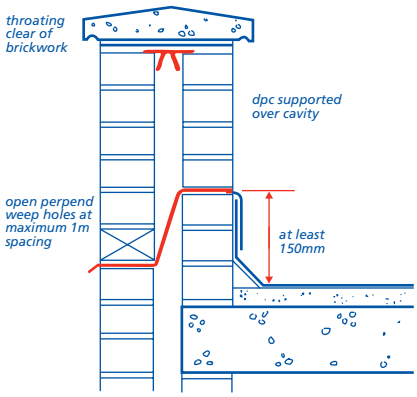
Where full fill insulation is placed in the cavity, a cavity tray should be used above the highest insulation level, unless the insulation is taken to the top of the wall. (Manufacturers' recommendations should be followed.)

**(c) abutment details**
Cavity trays should be provided at abutments of roofs and cavity walls. This will ensure that any water penetrating into the cavity does not enter the enclosed area. This only applies where the roof is over an enclosed area, including an attached garage, but does not apply to open car ports and open porches.

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




**(d) parapet details**
Dpcs below the coping should be supported over the cavity to prevent sagging. A dpc should be specified that can achieve a good key with the mortar.




**(e) materials**
Materials that are suitable for use as dpcs are given in Materials clause 6.1 - M6.

## WALL TIES

**6.1 - D7 Wall ties shall be provided, where required, to tie together the leaves of cavity walls**

The spacing of wall ties in masonry walls should be in accordance with Sitework clause 6.1 - S5.

Details of suitable wall ties are given in the Materials section of this Chapter.

## STONE MASONRY

**6.1 - D8 Elements constructed of natural or cast stone masonry shall comply with the performance standards for brick and block masonry, where applicable**

Stone masonry (natural or cast stone) should be designed to meet the requirements of BS EN 1996 'Design of masonry structures'.

## LINTELS

**6.1 - D9 Lintels shall safely support the applied loads**

Items to be taken into account include:

**(a) structural support**
Concrete, steel and reinforced brickwork are acceptable materials for use as lintels.

Timber lintels should not be used, unless:

- they are protected from the weather, and
- they do not support masonry or other rigid or brittle materials.

Lintels should be designed in accordance either with Technical Requirement R5 or manufacturers' published data. A lintel should be provided where frames are not designed to support superimposed loads.

Lintels should be wide enough to provide adequate support to walling above. Masonry should not overhang the lintel support by more than 25mm. A lintel should extend beyond the opening at each end by at least the following lengths:

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

To avoid overstressing, composite lintels should have the required depth of fully bedded brickwork stipulated by the manufacturer above the lintel, before point loads are applied. Where necessary, padstones and spreaders should be provided under the bearings of lintels. Reference should be made to Chapter 6.5 'Steelwork support to upper floors and partitions' (Design) for details of padstones.

**(b) adequate durability against corrosion and resistance to water entering the dwelling**
Cavity tray/damp-proof protection should be provided over all openings, either as a combined part of the lintel or separately. Reference should be made to Clause D6(b).

Steel and concrete lintels should comply with BS EN 845-2.

Separate cavity tray protection should be provided when:

- the profile of the lintel is not as shown in Clause D6(b), or
- steel lintels have materials coatings references L11, L14 and L16.1 and are used in external walls

Lintels used in aggressive environments (e.g. coastal sites) should be austenitic stainless steel.

In Scotland, Northern Ireland, the Isle of Man and areas of *Severe* or *Very Severe* exposure to driving rain, separate damp-proof protection should be provided over all lintels in accordance with the guidance for cavity trays given in Clause D6(b).

Lintels should be of such a size and be located so that the external edge of the lintel projects beyond, and therefore offers protection to, the window head.

**(c) cold bridging and condensation**
The BRE Report 'Thermal insulation: avoiding risks' discusses aspects of insulation relevant to external masonry walls. In England and Wales account should be taken of Accredited Details.

The risk of condensation at reveals and soffits becomes more likely as the wall insulation increases. Cold bridge paths should be avoided.

To avoid a cold bridge, the wall insulation should ideally abut the head of the window frame.

Clause D4(b) details methods of preventing rain penetration which may also be required.

**(d) adequate fire resistance**
Where steel lintels are used, manufacturers' recommendations for providing adequate fire resistance, particularly to the lower steel flange, should be followed.

## THERMAL INSULATION

**6.1 - D10 External walls shall be designed to provide the required standard of thermal insulation**

The insulation value of the wall must meet the requirements of the relevant Building Regulations.

Design should avoid cold bridging at openings and at junctions of external walls with roofs, floors and internal walls.

**6.1 - D11 External walls shall be designed to ensure the correct use of insulation materials**

Items to be taken into account include:

**(a) acceptable insulation materials**
Insulation, or lightweight aerated concrete blocks, or blocks with face bonded insulation, or voided blocks with insulation infill should be used in accordance with:
- an assessment which complies with Technical Requirement R3, or
- a British Standard and the relevant Code of Practice.

**(b) full cavity insulation**
In Northern Ireland and the Isle of Man, it is not permissible to fill cavities with pumped thermal insulants at the time of construction.

In Scotland, it is not permissible to fill the full width of the cavity with *any* thermal insulants at the time of construction.

The type of insulation, its thickness and the wall construction should be suitable for the exposure of the dwelling in accordance with Appendix 6.1-A.

Materials clause 6.1 - M9 sets out the range of acceptable insulation materials and the relevant British Standards.

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.

The following design points should be noted:
- stop ends should be provided to cavity trays or combined lintels
- weepholes should be provided at 450mm (maximum) centres with at least two per opening
- mortar joints should not be recessed
- painted finishes on bricks or render are not acceptable if they are likely to cause frost damage or sulfate attack or other damage.

**(c) partial cavity insulation**
Partial cavity insulation should be fixed only against the cavity face of the inner leaf. The clear cavity width between partial cavity insulation and the outer leaf should be at least 50mm nominal. 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.

Wall ties should be long enough to allow a 50mm embedment in each masonry leaf.

**(d) inner leaf of insulated blockwork**
Types of blockwork include:
- lightweight aerated concrete
- lightweight aggregate blocks
- voided blocks with insulation infill
- blocks faced with insulation material.

Manufacturers' recommendations should be followed and particular note taken of the following:
- a clear 50mm wide cavity should always be maintained
- the blocks should be capable of supporting concentrated loads
- the correct type of joist hanger for the type and size of block and size of joist should be used
- long unbroken lengths of blockwork should be avoided
- precautions should be taken to reduce risk of shrinkage cracking
- dry lining should be used where shrinkage cracking might be unsightly and to avoid long term pattern staining at mortar joints
- restrictions on chasing for services when using voided blocks should be noted (reference should be made to Clause D3(e)).

**(e) dual insulation**
Where partial cavity insulation is used in addition to an insulated block inner leaf (reference should be made to Clause D11(c)), the whole composite construction should have been assessed in accordance with Technical Requirement R3.

**(f) insulated dry linings**
Where an insulated dry lining contains a combustible insulant, the plasterboard should be at least 12.5mm thick and mechanically fixed to the masonry inner leaf. This is to prevent early collapse of the lining in a fire.

## FIRE SAFETY

**6.1 - D12 Cavity walls shall adequately resist the passage of fire**

Cavities should be closed with cavity closers in accordance with statutory requirements.

## SOUND INSULATION

**6.1 - D13 External walls adjacent to sound-resisting walls shall be designed to adequately resist flanking sound transmission**

Acceptable levels of sound reduction between dwellings may be achieved by:
- the inner leaf of an external cavity wall having sufficient weight, and
- sealing of air paths
- allowing appropriate spacings between openings in external walls.

The density of external walls and the position of openings adjacent to sound-resisting walls should be in accordance with statutory requirements and, where relevant, an assessment which complies with Technical Requirement R3.

## CLADDINGS

**6.1 - D14 Cladding shall satisfactorily resist the passage of moisture**

Items to be taken into account include:

**(a) battens**
Where battens are required, they must be pre-treated with preservative, as described in Chapter 2.3 'Timber preservation (natural solid timber)' (each section).

**(b) joints**
Joints between claddings and adjacent materials should be detailed to be watertight under the particular exposure conditions of the site. Where necessary, provision should be made for differential movement.

**(c) moisture barriers**
Unless specifically not required for a proprietary cladding, moisture barriers should be provided between walls of solid masonry and any boarding, slating, tiling or other similar claddings. The moisture barrier may be roofing underfelt or equivalent.

Vapour barriers such as polyethylene sheet are not an acceptable moisture barrier as they can trap moisture in the structure.

For timber framed walls clad with masonry, reference should be made to Chapter 6.2 'External timber framed walls' for details.

**(d) vertical tile or slate cladding**
Every tile or slate should be nailed with two nails. Nails should be aluminium, copper or silicon bronze.

Bottom edges should be finished with an under-course and tilting batten.

**(e) timber cladding**
Timber claddings should be pre-treated with preservative in accordance with Chapter 2.3 'Timber preservation (natural solid timber)' (each section).

## RENDERING

**6.1 - D15 Rendering, in conjunction with the surface to which it is applied, shall satisfactorily resist the passage of moisture**

Items to be taken into account include:

**(a) rain penetration**

External rendered finishes should comply with BS EN 13914 'Design, preparation and application of external rendering and internal plastering' and the guidance given below.

It is important to prevent rainwater penetrating behind the rendering. Design features around openings and at the head of the rendering should provide shelter, where possible, and help to shed water away from the surface below.

**(b) exposed elements**

It is not advisable to render exposed parts of a building, such as parapets and chimneys constructed of clay bricks of S1 designation, without the use of sulfate-resisting cement.

**(c) movement**

Movements can occur at a change in material. In such cases, the render should be either stopped at specially formed movement joints or, if the expected movement is small, be reinforced by metal lathing carried across the joint. If metal lathing is used, three rendering coats should be applied.

**(d) background**

To achieve a good bond, the masonry backing should be moderately strong and porous to give some suction and a mechanical key. Dense masonry with a smooth surface should not be rendered.

Aerated or lightweight aggregate concrete blocks can be used, as a background, but more care is needed when selecting a rendering mix and surface treatment. Strong render mixes should not be used. Roughcast and dry dash finishes that require a strong mix are not recommended for use on aerated or lightweight aggregate blocks. Block manufacturers' recommendations should be followed.

In Scotland, render should be applied only to bricks:

- which are keyed, or
- where a spatterdash coat has been applied before the first render undercoat.

In other areas, render should be applied only to bricks where either:

- keyed bricks are used, or
- the joints are raked out at least 15mm deep.

Render may be applied to bricks (if clay F2,S1 or F1,S1 to BS EN 771) only if the following conditions are met:

- cement for brickwork mortar is sulfate-resisting to BS 4027
- the brick manufacturer has confirmed, in writing, that the brick is suitable, taking account of the brickwork detailing and the particular exposure of each rendered element. If sulfate-resisting cement is used in the mortar, it should also be used in spatterdash coats and base coats of the render.

Care should be taken when specifying render to walls with full cavity fill. The lack of a ventilated cavity can slow down the rate at which the wall dries out.

Rendered finishes should not be used over fully filled cavity walls if:

- the outer leaf is built in bricks with S1 designation (F2,S1 and F1,S1 to BS EN 771), and
- the site is in an area classed as Severe or Very Severe exposure to driving rain (see Appendix 6.1-A).

Rendering may be used on brickwork with partial cavity insulation provided a clear cavity width between insulation and outer leaf of at least 50mm nominal is maintained.

**(e) mixes**

The rendering mix should be appropriate to the strength of the background. No render coat should be stronger than the background or richer than the preceding coat. The render should be of adequate strength to achieve durability.

Mixes should comply with the recommendations of BS EN 13914 'Design, preparation and application of external rendering and internal plastering'. When rendering on bricks that are F1,S1 or F1,S2 to BS EN 771, the Table to Sitework clause 6.1 - S8(b) should be followed. The manufacturer of the background masonry should be consulted regarding particular requirements for the mix or its application.

Pigments complying with the requirements of BS 1014 may be added to the finishing coat up to a limit of 10% of the cement weight or 3% in the case of carbon black. White Portland cement may be used.

**(f) number and thickness of coats**

The number of coats should be chosen with regard to the background and the exposure conditions of the site.

For rendering on masonry cavity walls, one undercoat and one finishing coat is acceptable. On metal lathing or on solid wall construction, two undercoats and one finishing coat are required.

Initial undercoats should not be less than 10mm and not more than 15mm thick. Any further undercoat should be thinner than the preceding coat. Finishing coats should be generally between 6mm and 10mm thick.

Undercoats should be allowed to shrink and dry out before applying following coats. When rendering onto dense concrete blocks, adhesion can be improved by use of proprietary bonding agents or a spatterdash coat.

**(g) detailing of timber/brick/render**

Dwellings which incorporate rendered panels between timber boards should have at least one coat of render applied over the whole wall face before the boards are fixed. The second coat may be applied between the boards.

Rendering and timber can shrink causing gaps. Precautions should be taken to prevent rain from penetrating the junction as this might cause the render to fail as a result of frost damage.

All exposed timber, except naturally durable species, should be treated in accordance with Chapter 2.3 'Timber preservation (natural solid timber)' (each section).

Where timber is used on brick or render, it is essential that all cut ends, mortices, etc made after treatment are flood coated with preservative.

Large section timbers should be fitted with suitable weather bars, flashings, etc to prevent moisture penetration through joints with adjacent materials.

Non-ferrous fixings should be used. Aluminium is not suitable when the preservative is Copper/Chromium/Arsenic.

**(h) proprietary and local rendering systems**

Proprietary rendering finishes should be applied in accordance with manufacturers' recommendations.

Traditional local rendering should comply with the above guidance, as appropriate, and with established local practice.

## PROVISION OF INFORMATION

**6.1 - D16 Designs and specifications shall be produced in a clearly understandable format and include all relevant information**

For external masonry walls, the drawings should show:

- wall layout with all dimensions shown
- position and size of openings
- coursing of the bricks and blocks in relation to storey heights and opening positions
- details at 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
- details of cavity closers
- details at reveals

- details of how support is given to other elements, eg padstones and wall plates
- position and detail of movement joints
- acceptable methods of pointing or mortar joint finish
- type of insulant to be used
- type and location of wall ties.

**6.1 - D17 All relevant information shall be distributed to appropriate personnel**

Ensure that design and specification information is issued to site supervisors and relevant specialist subcontractors and/or suppliers.

Where proprietary products are to be used, manufacturers usually have specific requirements for fixing and/or assembly of their products. 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.

## MATERIALS STANDARDS

**6.1 - M1 All materials shall:**
**(a) meet the Technical Requirements**
**(b) take account of the design**

Materials that comply with the design and the guidance below will be acceptable for external masonry walls.

Materials for external masonry walls shall comply with all relevant standards, including those listed below. Where no standard exists, Technical Requirement R3 applies (see Chapter 1.1 'Introduction to the Standards and Technical Requirements').

References to British Standards and Codes of Practice include those made under the Construction Products Directive (89/106/EEC) and, in particular, appropriate European Technical Specifications approved by a European Committee for Standardisation (CEN).

## BRICKS

**6.1 - M2 Bricks shall:**
**(a) be capable of supporting intended loads**

Requirements for the design strength of bricks are given in BS EN 1996-1-1. The brick specified in the design should be used. Clay bricks to BS EN 771 with a minimum compressive strength of 9N/mm$^2$ should be adequate for one and two storey dwellings and 13N/mm$^2$ for three storey dwellings.

**(b) have appropriate resistance to the adverse effects of freeze/thaw and sulfate attack**

### CLAY BRICKS

BS EN 771 classifies clay bricks according to their freeze/thaw resistance and soluble salt content (see Appendix 6.1-E).

Only 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. Such areas include:

- all external facing work in Scotland
- exposed parts including copings, sills and parapets and chimneys which have no overhang to provide protection. Reference should be made to Design clause 6.1 - D4(c)
- areas of the country subject to *exceptionally severe* freeze/thaw exposure (see map in Appendix 6.1-B).

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 manufacturers' published recommendations as satisfactory for the exposure.

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 resist satisfactorily 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 if there is a risk of vulnerability to frost. In saturated conditions, sulfate-resisting cement mortar is required for S1 designation bricks.

### CALCIUM SILICATE BRICKS

Bricks of compressive strength Class 20 (to BS EN 771-2) are suitable for most applications. Bricks of strength Class 30 and declared as freeze/thaw resistant (to BS EN 771-2) are recommended in areas of severe freeze/thaw exposure (see map in Appendix 6.1-B) or for use where bricks may be persistently wet (eg parapets, chimneys, sills and below dpc).

Calcium silicate bricks do not contain significant amounts of soluble sulfates and may be suitable where sulfate bearing soil and ground water conditions exist. Manufacturers' recommendations should be followed.

### CONCRETE BRICKS

In concrete bricks there is a direct relationship between strength and durability, including freeze/thaw resistance. Most concrete bricks in production have a strength of 20N/mm$^2$ and are durable in most situations. For copings and sills, bricks with a compressive strength of 36N/mm$^2$ should be used.

### RECLAIMED BRICKS

Reclaimed bricks could be unsuitable for external work because of a high salt content or a lack of freeze/thaw resistance. Their use is permitted only in accordance with Technical Requirement R3. It is advisable to know where they come from, both geographically and within the previous building. Bricks used internally or fully protected may be unsuitable in external situations.

Reclaimed bricks should be considered as F1,S1 or F1,S2 to BS EN 771 and used accordingly. Independent certification of suitability may be required.

### SPECIAL SHAPED BRICKS

Special shaped bricks should conform to BS 4729.

## BLOCKS

**6.1 - M3 Concrete blocks shall:**
**(a) be capable of supporting intended loads**

Blocks should comply with BS EN 771 and be used in accordance with BS EN 1996-2.

In general, 2.9N/mm$^2$ blocks are suitable for one and two storey dwellings.

For three storey dwellings or dwellings with storey heights over 2.7m, 7.3N/mm$^2$ blocks are required for certain parts of the structure.

Structural design may show that strengths lower than 7.3N/mm$^2$ are adequate.

Other factors may dictate the strength of blocks required in certain circumstances, eg sulfate-resistance may require blocks of greater strength.

The maximum loadbearing capacity of the wall should not exceed manufacturers' recommendations.

**(b) have appropriate resistance to adverse effects of freeze/thaw and sulfate attack**

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

- have a compressive strength exceeding 7.3N/mm$^2$, or
- have a density exceeding 1500kg/m$^3$, or
- be made with dense aggregate to BS EN 12620, or
- be lightweight aerated concrete blocks having had their suitability confirmed by the manufacturer.

Concrete blocks should not be used below dpc where there are sulfates in the ground, unless suitability is confirmed by the block manufacturer. Sulfates may attack the cement used in the block. Sulfate-resisting cement will be required in the mortar. The proportions will depend on the level of sulfates in the ground.

**(c) have an adequate thermal resistance, where required**
The designer may have specified a particular type and thickness of concrete block because of its thermal insulation performance in addition to its strength. Alternative concrete blocks should not be used without the designer's acceptance.

## STONE MASONRY

**6.1 - M4 Stone masonry shall be capable of supporting the intended loads and have appropriate resistance to the adverse effects of freeze/thaw**

Stone for masonry should conform to the requirements of BS EN 771-6.

Cast stone masonry units should comply with BS EN 771-5 or BS 1217 as appropriate.

## MORTAR AND RENDERING

**6.1 - M5 Mortar and rendering materials shall be of the mix proportions to achieve adequate strength and durability to comply with the design**

Items to be taken into account include:

**(a) cement and lime**
Ordinary Portland cement should be to BS EN 197. Sulfate-resisting Portland cement should be to BS 4027. Masonry cement should be to either BS EN 197 or BS EN 413.

Limes should conform to BS EN 459.

**(b) sand type**
Sand and aggregate from natural sources should conform to BS EN 13139.

**(c) mortar type**
Ready-mixed mortars should comply with BS EN 998. For recommended mortar mixes, see Appendix 6.1-C.

**(d) additives**
Air entraining and set retarding admixtures should comply with BS EN 934.

Pigments for colouring mortars should conform to BS EN 12878.

**(e) render**
Sand for render should be sharp sand to BS EN 13139, preferably from the coarse end of the grading scale. Sand with excessive fine material will shrink and crack.

Reinforcement for render, including angle beads, corner beads, stop beads and render stops, should be stainless steel or PVC.

Decorative finishes that contain asbestos are not acceptable.

## DPC MATERIALS

**6.1 - M6 Materials for damp-proofing shall resist adequately the passage of moisture**

Items to be taken into account include:

**(a) dpcs**
The following materials are acceptable for use as dpcs:
- bitumen to BS 6398
- polyethylene to BS 6515 (except below copings and in parapets)
- proprietary materials assessed in accordance with Technical Requirement R3.

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

For complicated junctions, preformed cavity trays are recommended. Care should be taken to order the correct type and shape.

**(b) flashings**
The following are acceptable as flashings:
- rolled lead sheet (at least Code 4) complying with BS EN 12588
- aluminium and aluminium alloys complying with BS 1470 (0.6mm to 0.9mm thick)
- zinc alloy complying with BS 6561 and 0.6mm thick.

## WALL TIES

**6.1 - M7 Wall ties shall be appropriate for their location and intended use**

Wall ties shall be in accordance with either:
- BS EN 845, or
- an assessment in accordance with Technical Requirement R3.

Ties should be long enough to be embedded at least 50mm into each leaf.

In England and Wales, wall ties should be stainless steel or non-ferrous. In Northern Ireland, stainless steel or non-ferrous ties should be used where the cavity is fully filled with insulation and 75mm wide or more. In Scotland, galvanised ties may be used.

Where partial cavity insulation is used, it should be held in place by retaining devices which may be clipped to the wall ties. These devices should be assessed in accordance with Technical Requirement R3 and used only with compatible wall ties.

## LINTELS

**6.1 - M8 Lintels shall be of the type and dimensions appropriate to their position within the structure**

Steel and concrete lintels should comply with BS EN 845-2, 'Specification for ancillary components for masonry'.

Lintels up to 1.2m length which do not need a separate dpc tray should have a minimum 100mm end bearing and project beyond the cavity closer by at least 25mm. Normally, other lintels should be long enough to have a minimum 150mm end bearing each side of the opening.

Cavity trays may be required over the lintels. This should be specified in the design. Reference should be made to Design clause 6.1 - D9(b).

## THERMAL INSULATION

**6.1 - M9 Insulation materials shall provide the degree of insulation to comply with the design**

All retro-fill insulation materials (UF foam, blown mineral fibre and expanded polystyrene beads) should be installed by installers trained by the assessment holder and approved jointly by the assessment holder and the assessing organisation.

The installer should be a member of a surveillance scheme acceptable to NHBC.

Insulation materials should be installed in accordance with the following:
- UF foam to BS 5617 installed in accordance with BS 5618
- all other insulation materials, whether for full or partial cavity insulation, insulated blockwork or internal insulation may only be used if assessed in accordance with Technical Requirement R3.

The thickness of materials required by the design and Appendix 6.1-A should be used.

## CLADDING MATERIALS

**6.1 - M10 Cladding materials shall be of the quality, type and dimensions required by the design**

Items to be taken into account include:

**(a) tiles and slates**
Clay tiles for tile hanging should be to BS 402.

Concrete tiles for tile hanging should be to BS 473.

Slates for vertical slating should be to BS 680.

**(b) timber boarding**
Timber should comply with BS 1186 and be Class 3 or better.

Timber should be a naturally durable species or pre-treated with preservative. Reference should be made to Chapter 2.3 'Timber preservation (natural solid timber)' (each section) for guidance on preservative treatments.

**(c) underfelt behind cladding**
Type 1F felt to BS 747 is acceptable as an underfelt behind cladding.

**(d) battens**
Battens should be of the size specified in the design and pre-treated with preservative treatments. Reference should be made to Chapter 2.3 'Timber preservation (natural solid timber)' (each section) for guidance on preservative treatments.

**(e) proprietary cladding systems**
Proprietary systems should be assessed in accordance with Technical Requirement R3.

## MOVEMENT JOINTS

**6.1 - M11 Materials for movement joints shall be suitable for their intended purpose**

When choosing materials, account should be taken of the following:
- joint width
- joint depth
- anticipated movement
- movement capability of material
- surface preparation
- backing materials
- projected life span of joint.

Acceptable materials for movement joints in clay brick walls are:
- flexible cellular polyethylene
- cellular polyurethane
- foam rubber.

Materials which are acceptable for use in contraction joints with concrete bricks or blocks, but not acceptable for use as expansion joints in fired clay bricks, are:
- hemp
- fibreboard
- cork.

In concrete blockwork, the construction joint may be a simple vertical joint filled with mortar and sealed.

## SITEWORK STANDARDS

**6.1 - S1 All sitework shall:**
**(a) meet the Technical Requirements**
**(b) take account of the design**
**(c) follow established good practice and workmanship**

Sitework that complies with the design and the guidance below will be acceptable for external masonry walls.

## CONSTRUCTION

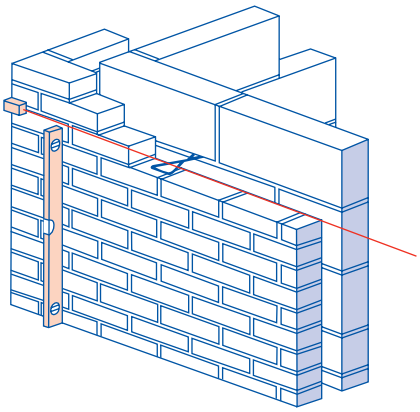
**6.1 - S2 Construction shall ensure a satisfactory standard of brickwork and blockwork**

Items to be taken into account include:

**(a) appearance**
The appearance of a masonry wall depends upon the materials used, the setting out and the workmanship. Further details are given in Clauses S2 to S10.

**(b) setting out**
When setting out masonry, avoid cutting bricks or blocks except when it is essential and avoid irregular or broken bonds, particularly at openings.

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.



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

All work should be reasonably level and true. The bond detailed in the design should be used. Perpendicular joints should be kept in line and plumb. Courses should be kept level by using lines and spirit levels.

**(c) mortar**
Different types of bricks and blocks need different strength mortar mixes. Some parts of the building, such as below dpc, chimneys and copings, may need a different mix to the main walling. Make sure the mix is right for the job.

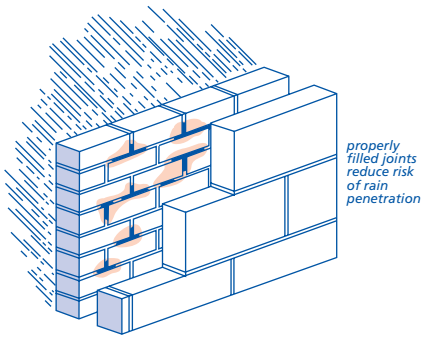
Recommended mortar mixes are given in Appendix 6.1-C.

Plant and banker boards should be kept clean. Mixers should be kept clean to operate efficiently. The mortar colour should be consistent.

Mortar which has started to set should not be re-tempered.

All bricks and blocks should be laid on a full bed of mortar and all perpends should be solidly filled.

Joints should be filled to reduce the risk of rain penetration and dampness in the wall. Solid mortar bedding and fully filled perpends are particularly important in exposed areas and where the cavity is to be fully filled with insulation.



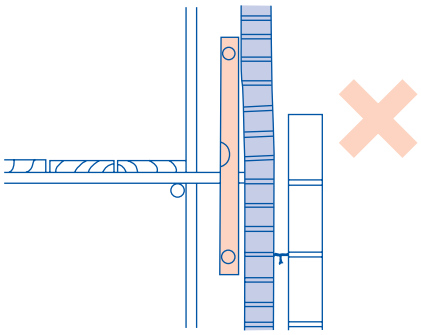

Unless the design states otherwise, only bucket handle or weathered joints should be used. Recessed joints should not be used where the cavity is to be fully filled with insulation.

Where pigments (to BS 1014) are used they should not exceed 10% of the cement weight or 3% if carbon black is used.

For precautions to take in cold weather, reference should be made to Chapter 1.4 'Cold weather working'.

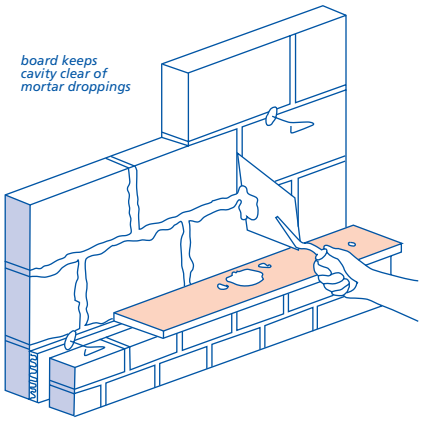
**(d) cavity walls**
Cavities should be uniform and of the width specified in the design. All cavities should be at least 50mm nominal clear width. Partial cavity insulation should be fixed against the inner leaf of the cavity. Check that the correct wall tie is being used (reference should be made to Clause S5).

To keep the wall plumb, do not over-reach at changes of lift. It is better to wait for the next scaffolding lift.



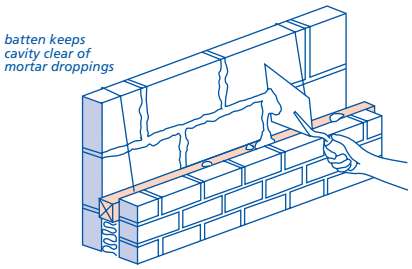
The difference in heights between the two leaves of a cavity wall under construction can be up to 6 block courses, provided the ties are sufficiently flexible to ensure coursing is achieved without breaking the bond.

Cavities should be constructed so that:
- mortar is struck off from all joints as work proceeds
- wall ties are kept free of droppings and debris
- cavity trays are clear of droppings and debris.




Clean cavities with mortar droppings removed are particularly important in exposed areas and where partial cavity fill is used.

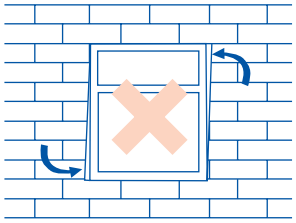
Where cavity insulation is used, mortar droppings should be cleaned off from the top edge. Mortar left on the top edge may transmit dampness to the inner leaf. The use of a cavity batten will prevent this. Cavity battens should be wrapped with flexible material to allow easy withdrawal.




**(e) movement**
Brickwork/blockwork should not be subjected to vibration until the mortar has set.

**(f) openings**
Masonry may be built around either:
- the frame in-situ, or
- a profile or template to enable the frame to be fitted later.

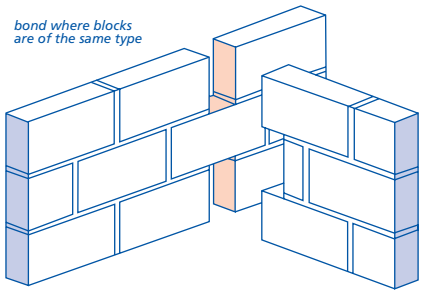
Openings should be the correct size and square. The brickwork should butt closely against the frame. The frame should not be distorted by forcing bricks against the jamb.

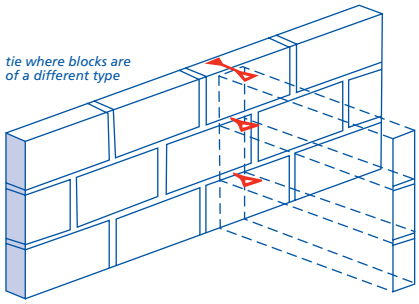


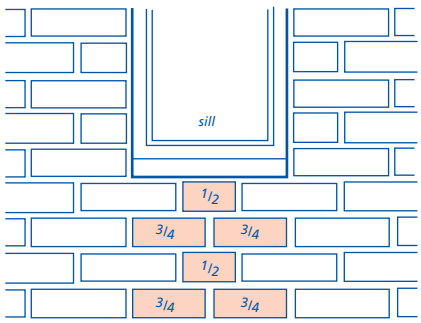

Window and door frames, when built-in, should be fixed with:
- frame cramps, or
- proprietary cavity closers, or
- plugs and fixings.

Timber plugs should not be used in vulnerable positions, such as the outer leaves of walls.

**(g) 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 centres not exceeding 300mm vertically.

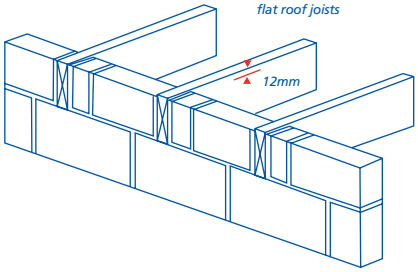


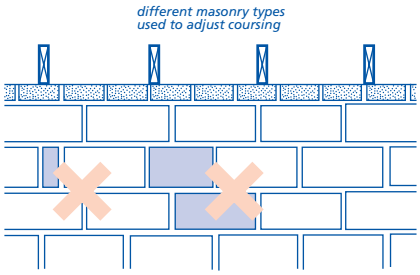




*brick bond set out at base of wall so that cut bricks occur below openings*

Where joist hangers are not used, joist filling should be brick or blockwork, without excessive mortar joints. Clay bricks and concrete blocks should not be mixed. Joist filling should be kept 12mm below the top of flat roof joists to allow for timber shrinkage, but check also that cold roof ventilation is not blocked (reference should be made to Chapter 7.1 'Flat roofs and balconies' (Design and Sitework)).



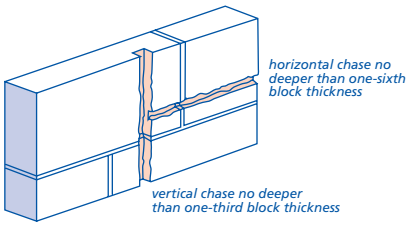

Where a different size of masonry unit is needed to ensure correct coursing, small units of the same material should be used to reduce cracking and problems due to different thermal insulation properties.




*incorrect use of different masonry types*

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. For example aerated concrete blocks should not be mixed with clay bricks.

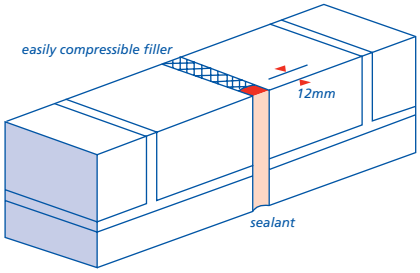
**(h) chasing for services**
Chases should be cut with care. Impact power tools can damage the wall and should not be used.




The depth for horizontal chases should be limited to one-sixth of the thickness of the single leaf. The depth for vertical chases should be limited to one-third of the thickness of the single leaf. Hollow blocks should not be chased unless specifically permitted by the manufacturer.

**(i) movement joints**
Movement joints should be formed where required by the design. Movement joints are necessary in long lengths of walling to reduce unsightly cracking. Joints are often hidden in corners, or behind rainwater pipes.

The correct materials should be used to form movement joints. Clay bricks expand and require an easily compressible material.




Suitable materials are:

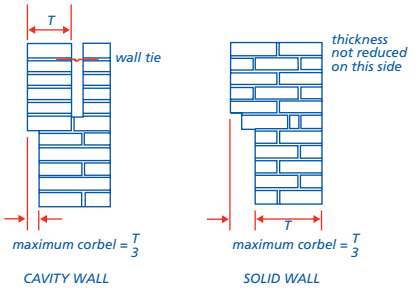
- flexible cellular polyethylene
- cellular polyurethane
- foam rubber.

The sealant should be at least 10mm deep to ensure a good bond. If the joint is in a freestanding wall, the filler will require sealant to both exposed edges and the top (where the joint is carried through the coping).

**(j) corbelling**

Where courses are corbelled out in ordinary masonry, one above another, the extent of corbelling should not exceed that shown in the following diagrams.

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




**(k) calcium silicate bricks**

Where calcium silicate bricks are used, the brick manufacturer's recommendations should be followed.

## STONE MASONRY

**6.1 - S3 Stone masonry shall be constructed to an acceptable standard**

Stone masonry will be acceptable if it:

- complies with brickwork/blockwork clauses (where appropriate)
- gives an adequate weather-resisting structure (in conjunction with any brick or block backing and/or vertical damp-proof membranes)
- is prepared and laid on its natural bed (unless local practice is otherwise)
- follows good local recognised practice.

## DAMP-PROOF COURSES AND CAVITY TRAYS

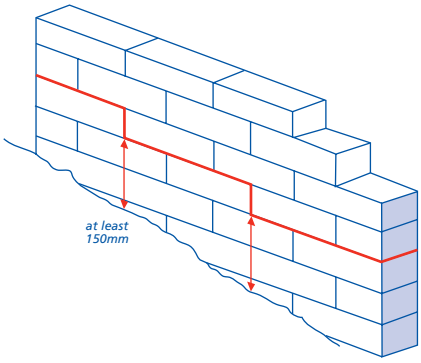
**6.1 - S4 Dpcs and cavity trays shall be installed to prevent moisture entering the building**

Items to be taken into account include:

**(a) horizontal dpcs**

Dpcs and cavity trays should be in one continuous piece, whenever possible. Joints in horizontal wall dpcs positioned to prevent rising damp should be lapped 100mm or sealed or welded. The manufacturer's recommendations should be checked. Elsewhere, joints in dpcs and cavity trays should be sealed to prevent water seeping through the joints.

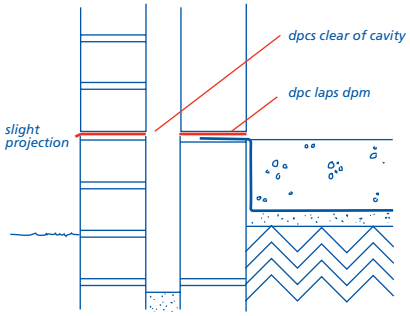
At ground level, all parts of the dpc should be at least 150mm above finished ground or paving level.



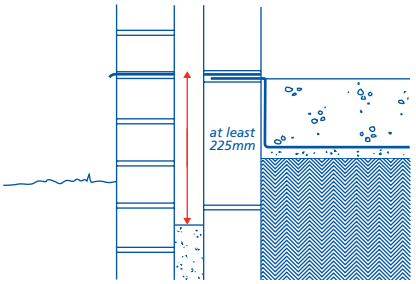

Special dpc detailing may be required at doorways where the dwelling is to be designed to allow access for the disabled.

Dpcs should:

- be laid on a surface, free from projections which could puncture or adversely affect the dpc material
- be fully bedded on fresh mortar where required by the design, or where the building is over three storeys in height
- be of correct width
- not project into the cavity
- not be set back from the edge of the masonry
- lap the dpm.




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.



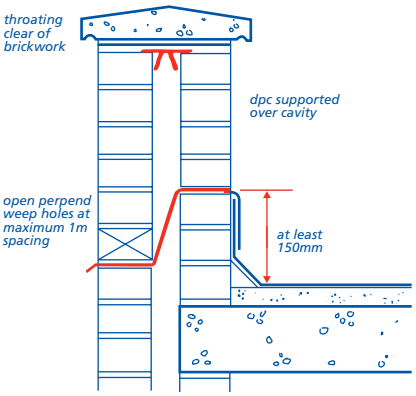

**(b) dpcs in parapet walls**

Parapet walls should have:

- a dpc under the coping, and
- a dpc tray starting 150mm minimum above the roof.

The coping throating should be clear of the brickwork. Reference should be made to Clause S4(d) for guidance on sealing dpcs.

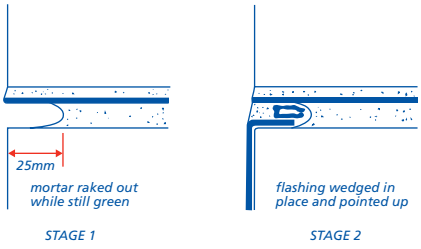
All dpcs should be fully bedded in mortar.




**(c) dpcs to prevent downward flow of water**

Where dpcs are intended to prevent the downward movement of water, joints should be sealed or welded. Lapped joints, unsealed, are unacceptable.

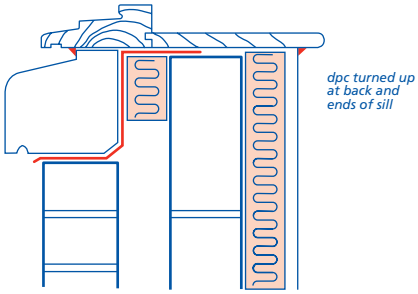
Where flashings link with dpcs, rake out 25mm of mortar *below* the dpc to allow for the flashing to be tucked in. It is easiest to rake out the joints as the work proceeds.



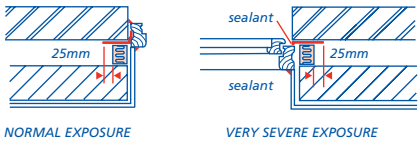

**(d) dpcs around openings**

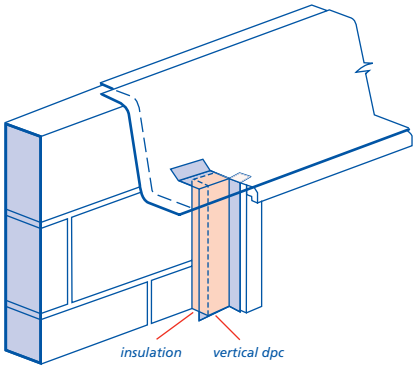
A dpc (either separate or combined as part of a proprietary cavity closer) should be provided at jambs of openings and at heads and sills as required by the design.

Where a jointed or permeable sill is used (all sills in Northern Ireland and the Isle of Man), a dpc should be placed between the sill and the outer leaf, turned up at the back and ends of the sill.




Where a separate vertical dpc is used it should be 150mm wide and be nailed to the full height of the frame. The dpc should protrude into the cavity by about 25mm and extend up to the underside of the lintel where it should be turned back towards the inner leaf.




Where there is a sill dpc, it should be lapped with the reveal dpc.

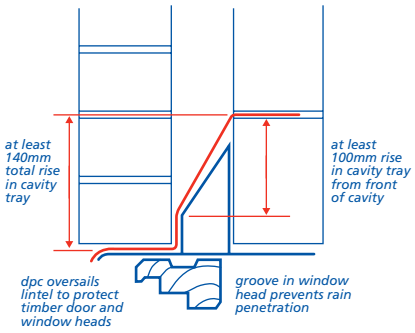
If there is no sill dpc, the vertical dpc should be continued 150mm below the sill level.

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

**(e) cavity trays**

The single brick thick external leaf of a cavity wall can allow moisture into the cavity. Cavity trays should be used so that water drains outwards above openings.

Cavity trays over lintels should extend at least 25mm beyond the outer face of the cavity closer and cover the ends of the lintel. Where the lintel does not require a dpc, the lintel itself should have a suitable profile and durability and give complete protection to the top of the reveal and vertical dpc where provided.



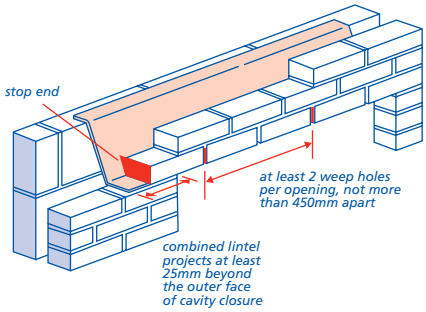

The upstand part of the cavity tray should be returned into the inner leaf masonry unless stiff enough to stand against the inner leaf without support.

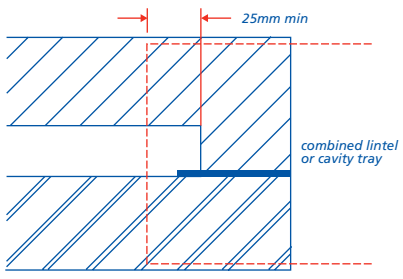
In Scotland, all lintels should have a dpc built into the inner leaf.

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.

Where fairfaced masonry is supported by lintels:

- weep holes should be provided spaced at maximum 450mm intervals. Each opening should have at least two weep holes.
- cavity trays or combined lintels should have stop ends.

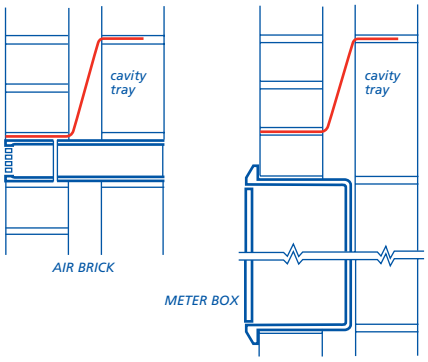



A cavity tray should be provided where the cavity is bridged by air bricks, etc. The dpc should extend 150mm beyond each side of the bridge.

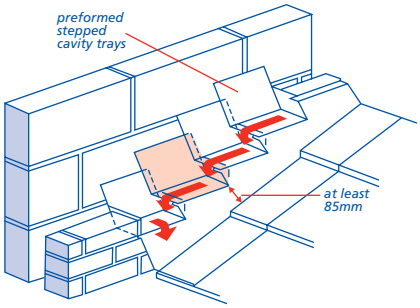
Where not otherwise protected (eg by a roof at an appropriate level), a dpc tray should be provided over meter boxes.

A dpm should be provided behind meter boxes in areas of very severe exposure to driving rain.




**(f) stepped cavity trays**

At the abutment of pitched roofs to cavity walls, preformed stepped cavity trays should be provided as shown below. The lowest cavity tray should have two stop ends and a weep hole to allow water to drain from the cavity.




## WALL TIES

**6.1 - S5 Wall ties shall be of the correct type correctly installed**

Items to be taken into account include:

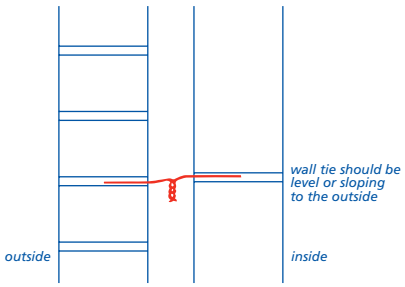
**(a) type**

The type of wall tie specified by the designer should be used.

**(b) position**

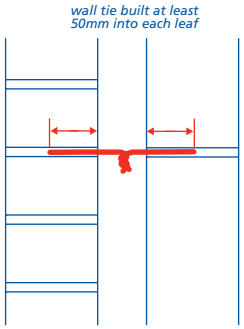
If ties slope down to the inner leaf, if drips are off-centre or if ties have mortar droppings on them, water can cross the cavity.

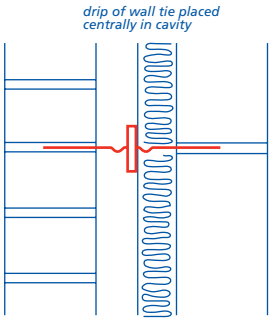
The two leaves should be coursed so that the wall tie is level or slopes outwards.



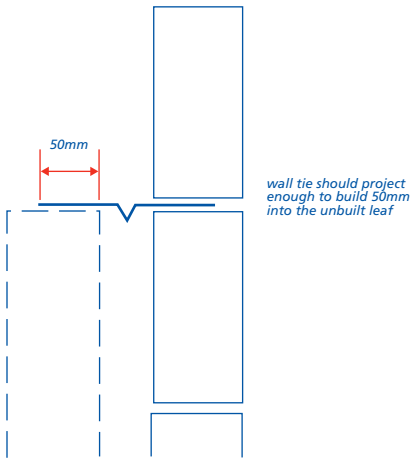

Ties should be bedded a minimum of 50mm into each leaf of the wall as work

proceeds. The drip should face downwards. Ties should be built-in, not pushed into joints.



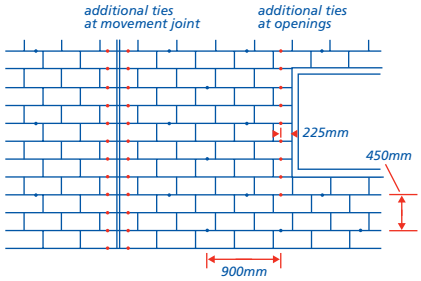

Where one leaf is built in advance of the other, the wall ties should project enough from the built leaf to bed at least 50mm into the unbuilt leaf.




**(c) spacing**
Wall ties should be spaced above and below dpc as follows:

| | Maximum spacing (mm) | |
|---|---|---|
| | Horizontally | Vertically |
| General wall area | 900 | 450 |
| At jamb openings, movement joints, etc. | within 225 of opening | not more than 300 |

At openings and movement joints, wall ties should be spaced at maximum 300mm centres vertically even if this means cutting cavity insulation to insert the tie.




**(d) use of partial fill insulation**
Where partial cavity fill insulation is being used, it should be retained against the inner leaf by retaining devices. The retaining devices should be compatible with the wall ties and used in accordance with an assessment which complies with Technical Requirement R3.

Unless the independent assessment states otherwise, where partial cavity fill is being used the wall ties should be spaced more closely to provide adequate support and restraint for the 1200mm long boards. Ties should be spaced at 600mm centres horizontally and in vertical as well as horizontal rows, ie not staggered.

## LINTELS

**6.1 - S6 Lintels and beams shall be installed correctly**

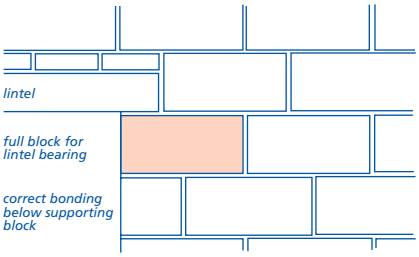
Items to be taken into account include:

**(a) span and placing**
Lintels should be the correct size for the opening and have the correct bearing at each end:

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

Longer span lintels may require padstones (the design should be checked).

Setting out should ensure that lintels bear on a full block, where possible, or on a whole brick, and be installed level on a solid bed of a mortar. Soft or non-durable packing should not be used. Small pieces of cut brick or block should not be used around lintel bearings.

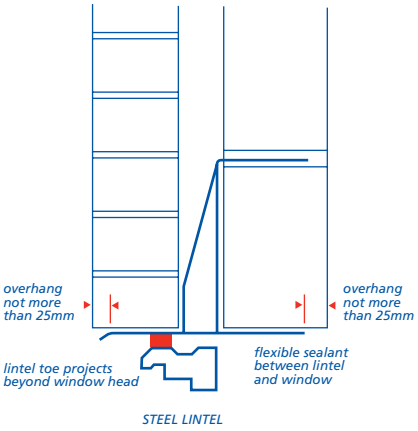



Lintels and masonry should form openings of the correct size for the frame of the window or door.

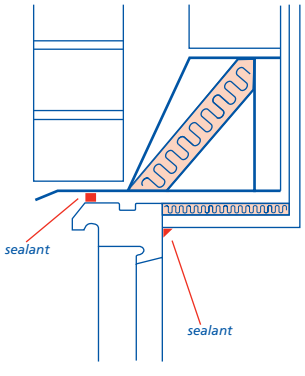
Concrete floor units or other heavy components which bear on lintels should be positioned carefully to avoid damage or shock load.

The lintel toe should:
- project past the window head
- have a flexible sealing compound between toe and window.

Brickwork or masonry should not overhang the lintel by more than 25mm.




**(b) thermal insulation**
Insulation may help to prevent cold bridges at the heads of openings in external walls. The design should be checked for this requirement. Insulation should be provided to the underside of the lintel unless the manufacturer shows an alternative to prevent cold bridging.




**(c) use of dpc cavity trays**
A separate cavity tray should be provided over some lintels if:

- the corrosion protection to the lintel is inadequate, and
- the shape of the lintel is unsuitable.

This should be checked with the designer or buyer.

In Scotland, Northern Ireland, the Isle of Man and areas of *Severe* or *Very Severe* exposure to driving rain, a cavity tray is required over all lintels. Reference should be made to Clause S4(e) for details of cavity trays.

All cavity trays should have stop ends where the outer leaf is fairfaced masonry.

**(d) use of steel lintels**
Where steel lintels are being used, 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.

## THERMAL INSULATION

**6.1 - S7 Thermal insulation shall be installed correctly**

A high standard of workmanship should be maintained to minimise the risk of damp penetration to the inside of the dwelling where cavity insulation is used.

In particular:
- 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 smooth from the inside of the outer leaf.

Where insulation is built-in, manufacturers' instructions should be followed. These are normally printed on the insulation packaging and include a recommended sequence of construction.

Recessed joints should not be used where the cavity is to be filled with insulation.

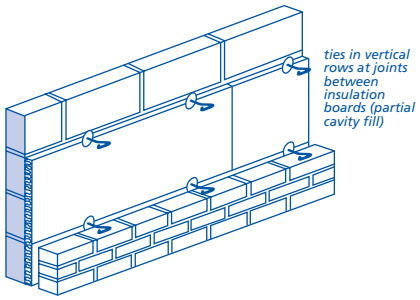
In Northern Ireland and the Isle of Man it is not permissible to fill the cavity with pumped insulants, eg UF foam, at the time of construction.

In Scotland, it is not permissible to fill the full width of the cavity with any thermal insulants at the time of construction.

All retro-fill insulation materials (UF foam, blown mineral fibre and expanded polystyrene beads) should be installed by installers trained by the assessment holder and approved jointly by the assessment holder and the assessing organisation. The installer should be a member of a surveillance scheme acceptable to NHBC.

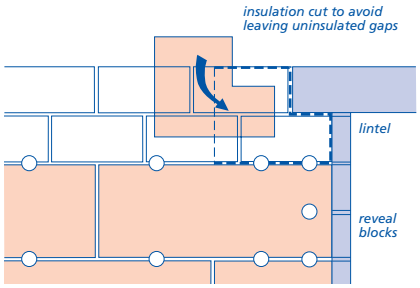
The first row of insulation boards or batts should be supported on wall ties, two ties to each board or batt.

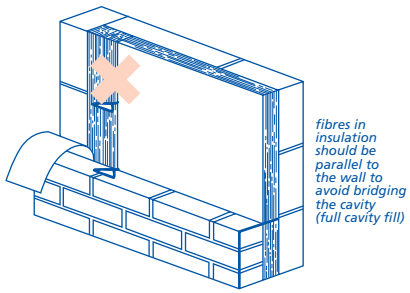
Wall ties should coincide with horizontal joints in the insulation.




Where wall ties need to be closely spaced, for example at reveals, it is acceptable to make a clean cut neatly in the insulation to accept the extra ties. The insulation manufacturer's instructions should be followed.

Insulation should be close butted with no gaps. Gaps provide routes for dampness, and condensation can form on the cold spots where insulation is missing.




Insulation boards for partial fill should be stored flat without bearers otherwise they may distort making them difficult to fix against the wall. Warped boards should be rejected.

## RENDERING

**6.1 - S8 Rendering shall be to the correct mix, have a good bond and be free from significant cracking and crazing**

Items to be taken into account include:

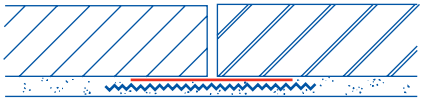
**(a) preparation of backing surface**
The surface to be rendered should be free from dust, loose particles, efflorescence and organic growth.

Where necessary, surfaces should be treated to provide an adequate key by:
- raking out joints
- hacking the surface
- applying a bonding agent
- applying metal lathing
- applying a spatterdash coat, or
- other appropriate means.

The surface suction should be checked by splashing water onto the wall. The result should be observed and appropriate action taken as follows:
- if too much suction, spraying with water may be needed - do not use too much water
- if too little suction, a spatterdash coat or bonding agent may be needed
- if the background is too wet, delay rendering until conditions improve.

The design requirements should be checked where rendering is continuous over different materials. Corrosion-resistant metal lathing should be fixed across the joints or, alternatively, provision made to accommodate movement.

Expanded metal should be fixed with the correct side towards the wall (see manufacturers' literature). If metal lathing is used to bridge changes in background material, a separating strip, eg breather paper, should be fixed behind the lathing so that the render does not bond at the background joints. Lathing should be set away from the wall so that rendering can be forced through the mesh to achieve a good bond.



*separating strip used behind expanded metal when plastering across dissimilar backgrounds*

**(b) mix**
The mix proportions should be checked against the specification, especially whether sulfate-resisting cement should be used.

Mixes for rendering on brickwork using clay bricks with no limit on their soluble salt content (F2,S1 or F1,S1 to BS EN 771) should be as follows:

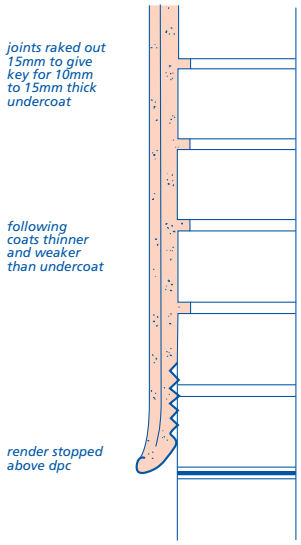
| Exposure conditions | Undercoat mix proportions (by volume) | Finishing coat mix proportions (by volume) |
|---|---|---|
| Parapets, freestanding walls, pillars, retaining walls and chimneys | rendering not recommended | |
| All walls other than those above | 1 : 5, sulfate-resisting Portland cement : sand, plus integral waterproofer | 1 : 5, ordinary Portland cement : sand, dry dashing strongly advised |

For backing brickwork, it should be

ensured that sulfate-resisting cement which complies with Appendix 6.1-C is used in the mortar.

If water-resisting properties are required, Portland cement with a waterproofing agent already incorporated may be available. Otherwise, a waterproofing agent should be used and added to the rendering mix in strict accordance with manufacturers' instructions.

**(c) application**
The number and thickness of coats should be in accordance with the design.




In Scotland, a spatterdash coat should be applied before the first render coat if the background is of Scottish common bricks and bricks to BS EN 771.

Undercoats should be applied at least 3 days before applying the following coat.

If coloured pigments are specified, batching should be undertaken with care to ensure colour consistency.

**(d) cracking and crazing**
Rendering should be free from significant cracking and crazing.

To avoid surface crazing:
- use properly graded sand (fine sand increases the risk of crazing)
- strong mixes should not be used as the finishing coat
- overworking, which causes laitance to be drawn to the surface, should be avoided
- the finishing coat should be kept damp for at least 3 days. In warm dry weather, spraying or protection by polyethylene sheet may be needed. Rendering should not be carried out during hot weather or in bright sunshine.

## COLD WEATHER WORKING

**6.1 - S9 Precautions shall be taken to protect walls and rendering from damage by frost during construction**

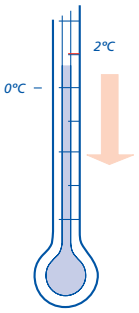
Freshly laid mortar and render may fail if it freezes because the frozen water expands and forces apart the particles of mortar.

Admixtures which contain calcium chloride should not be used.

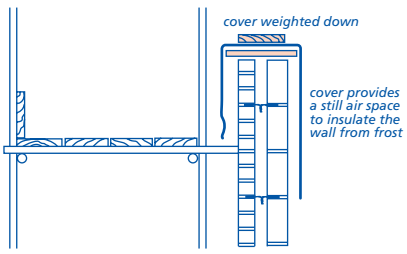
The use of air entraining agents in cold weather gives better frost resistance to set mortar but does not aid the set. The use of accelerating admixtures and other admixtures should not be relied on as an anti-freeze precaution.

Check what effect additives have on setting times. Cold weather slows setting, as do retarders. If the set is retarded too much, the next lift might squeeze out the mortar below.

Brick and blockwork should not be built nor rendering carried out when the air temperature is 2°C and falling.




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 re-built when conditions improve.




Reference should be made to Chapter 1.4 'Cold weather working' for more detailed advice.

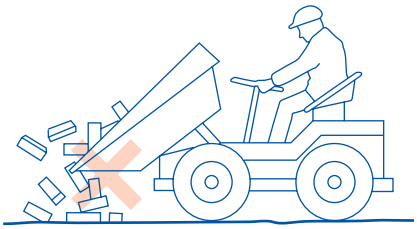
## HANDLING AND PROTECTION

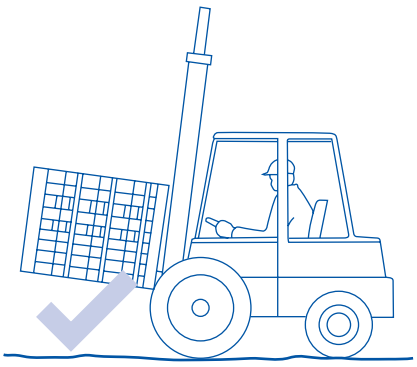
**6.1 - S10 Materials shall be handled, stored, used and protected in such a way as to ensure that the construction shall be neat, clean and undamaged upon completion**

Items to be taken into account include:
**(a) avoidance of damage**

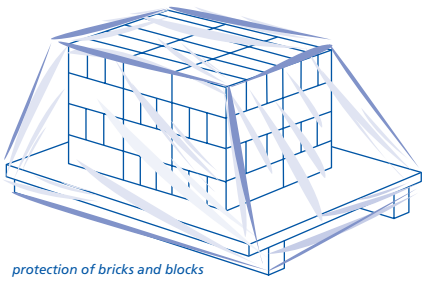
It is cost effective to protect and store materials properly and maintain good quality control during construction.

**(b) handling**
The unloading of all bricks and blocks, especially facing bricks, preferably should be by mechanical means, directly onto a firm level surface. Bricks that are tipped on delivery or moved about the site in dumper trucks often have a high degree of wastage. Chipped or fractured bricks are not acceptable for facework.





**(c) storage**
Stacks of bricks and blocks should be protected from rain, mud splashes, etc by covering with waterproof covers. Bricks and blocks that become excessively wet can suffer from:
- staining and efflorescence
- increased drying shrinkage with a greater risk of cracking
- lack of mortar adhesion to mud stained surfaces.



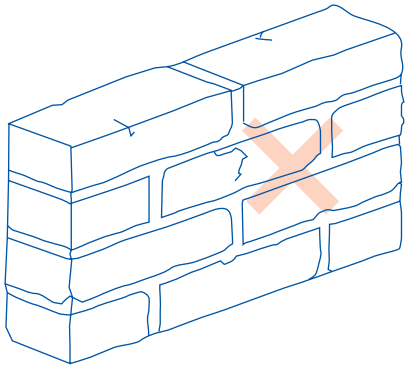
protection of bricks and blocks

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.

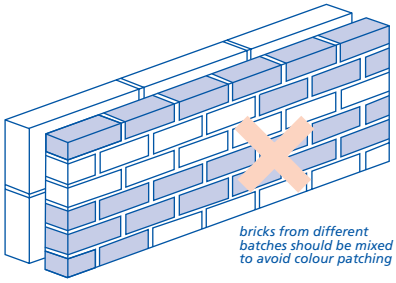
The work place should be kept clean to reduce mortar splashes to a minimum. Any accidental mortar smears should be lightly

brushed off the face after the mortar has taken its first set.

**(d) workmanship**
Materials should be handled with care during construction to avoid damage and staining. Badly chipped bricks should not be used for facework.



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.

## APPENDIX 6.1-A

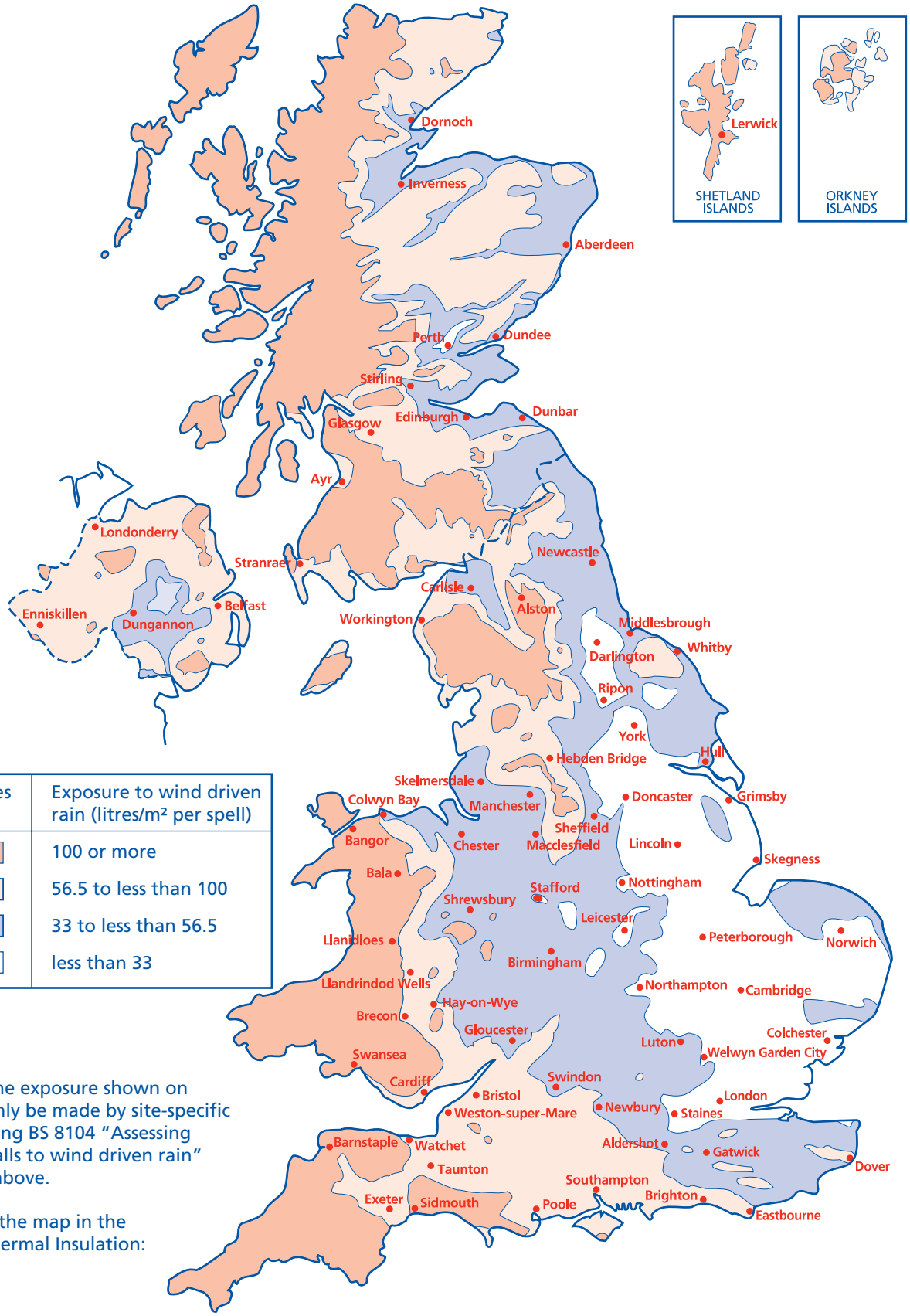
### Suitable wall constructions for use with full cavity insulation

| | | Minimum insulation thickness (mm) | | |
|---|---|---|---|---|
| **Exposure category** | **Suitable wall construction** | **Built-in insulation** | **Retro-fill (other than UF foam)** | **UF foam** |
| **Very Severe** | Any wall with impervious cladding | 50 | 50 | 50 |
| | Fairfaced masonry with impervious cladding to all walls above ground storey | 100 | 100 | N/A |
| | Any wall fully rendered[2] | 75 | 75 | N/A |
| | Fairfaced masonry[1] | N/A | N/A | N/A |
| **Severe** | Any wall with impervious cladding or render[2] | 50 | 50 | 50 |
| | Fairfaced masonry with impervious cladding or render[2] to all walls above ground storey | 50 | 75 | 50 |
| | Fairfaced masonry | 75 | 75 | N/A |
| **Moderate** | Any wall with impervious cladding or render | 50 | 50 | 50 |
| | Fairfaced masonry with impervious cladding or render to all walls above ground storey | 50 | 50 | 50 |
| | Fairfaced masonry | 50 | 75 | 75 |
| **Sheltered** | Any wall with impervious cladding or render | 50 | 50 | 50 |
| | Fairfaced masonry with impervious cladding or render to all walls above ground storey | 50 | 50 | 50 |
| | Fairfaced masonry | 50 | 50 | 50 |

N/A - not applicable

**Notes**
1 In *Very Severe* exposure locations fairfaced masonry with full cavity insulation is not permitted.
2 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.
3 This table covers walls where the external leaf does not exceed 12m in height.
4 The exposure category of the dwelling is determined by its location on the map showing categories of exposure to wind driven rain.
5 Fairfaced masonry includes clay, calcium silicate and concrete bricks and blocks and dressed natural stone laid in an appropriate mortar (see Appendix 6.1-C) preferably with struck or weathered or bucket handle joints. Cavity walls of random rubble or random natural stone should not be fully filled.
6 Recessed mortar joints should not be used.
7 In Scotland, it is not permissible to fill the full width of the cavity with any thermal insulation at the time of construction.
8 In Northern Ireland and the Isle of Man it is not permissible to fill the cavity with pumped thermal insulants (for example, UF foam) at the time of construction.

## MAP SHOWING CATEGORIES OF EXPOSURE TO WIND DRIVEN RAIN




| Exposure zones | Exposure to wind driven rain (litres/m² per spell) |
|---|---|
| very severe | 100 or more |
| severe | 56.5 to less than 100 |
| moderate | 33 to less than 56.5 |
| sheltered | less than 33 |

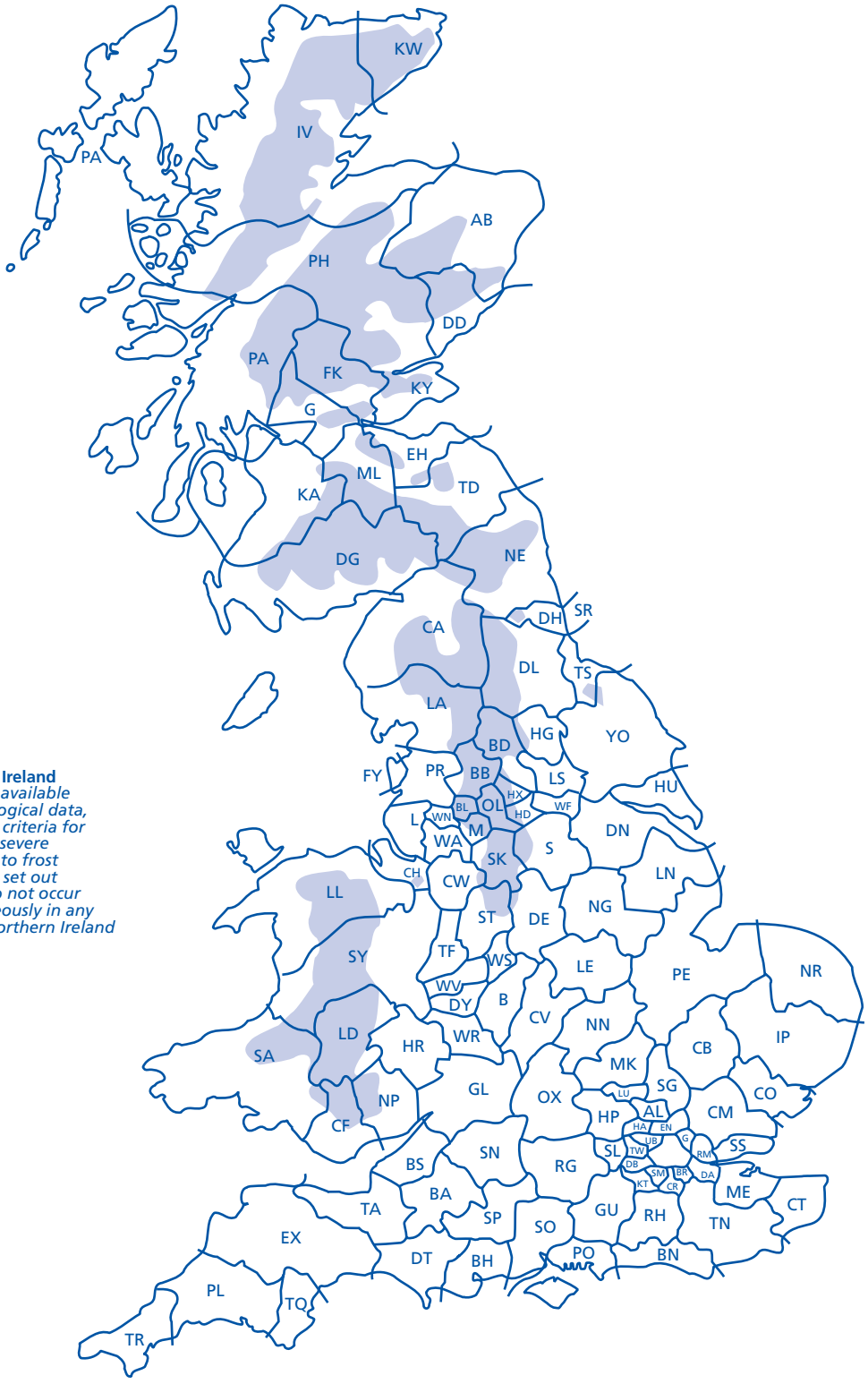
**Note:**
Variations to the exposure shown on the map can only be made by site-specific calculations using BS 8104 "Assessing exposure of walls to wind driven rain" and the table above.

Adapted from the map in the BRE report "Thermal Insulation: avoiding risks"

## APPENDIX 6.1-B

### Areas of *severe* exposure to frost attack

The tinted areas have a frost incidence over 60 days a year, rainfall over 1000mm per year and an elevation over 90m above sea level.

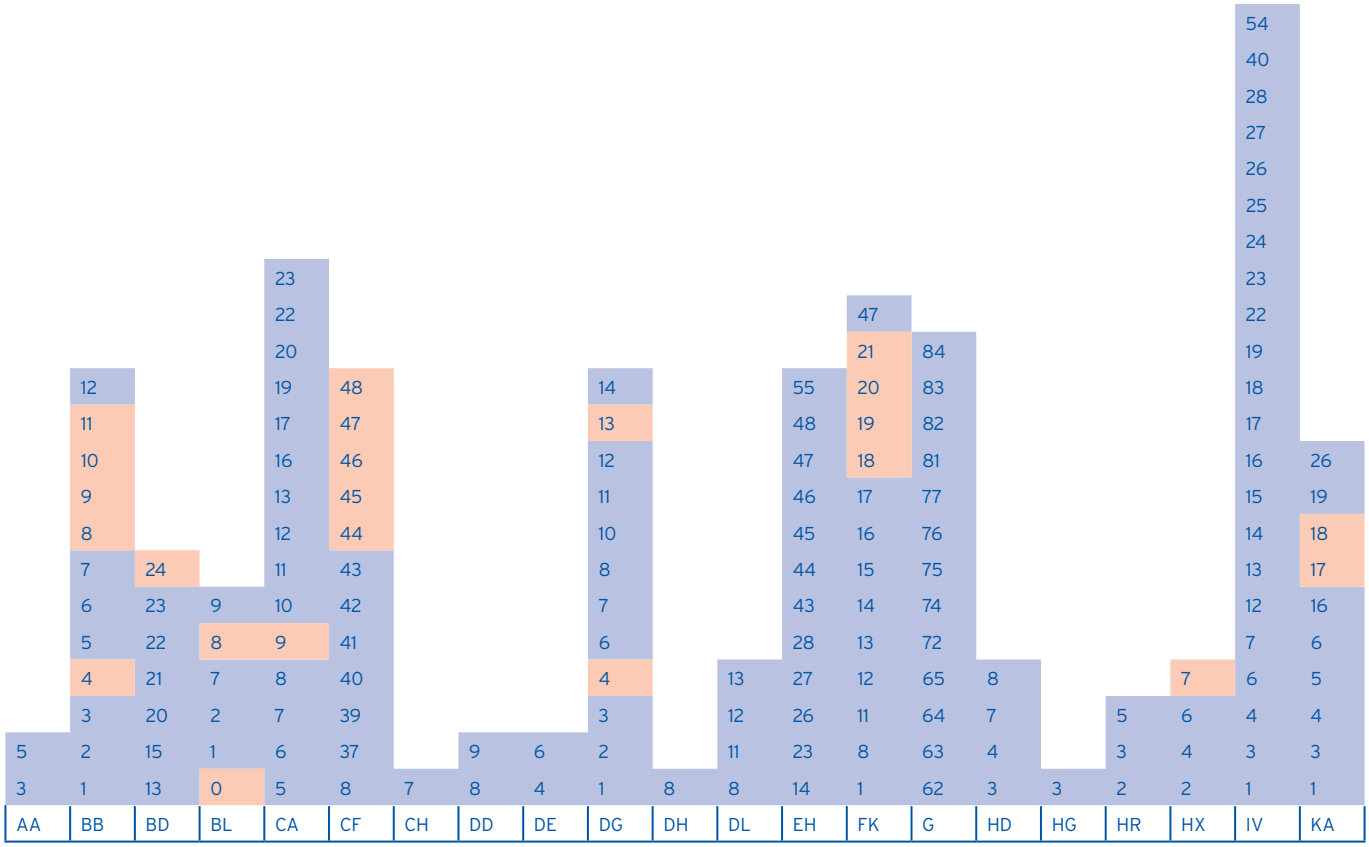


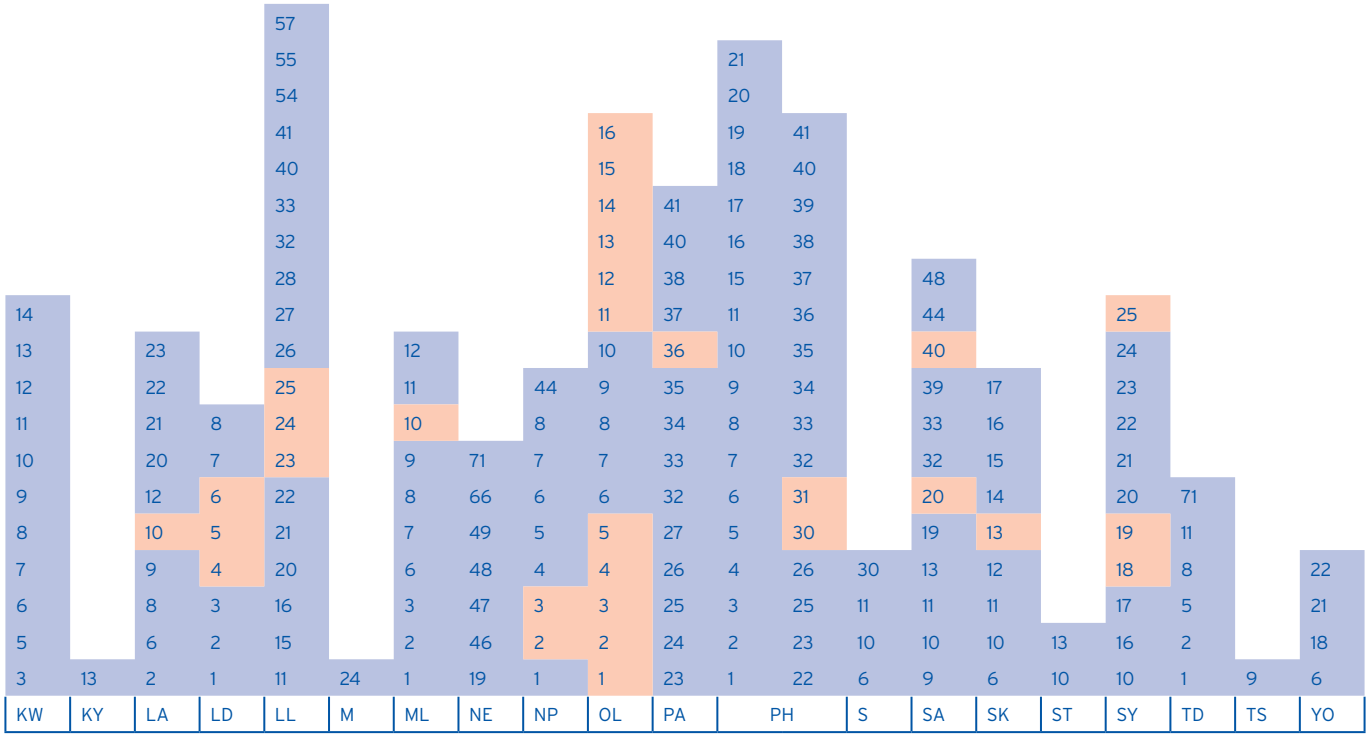

**Northern Ireland**
*From the available meteorological data, the three criteria for assessing severe exposure to frost attack, as set out above, do not occur simultaneously in any part of Northern Ireland*

Map reproduced by permission of Hanson.

The following list identifies the postal areas within which the three criteria for severe exposure to frost attack are met.

Only in a few instances is the whole of the post code district within the area of severe frost exposure.




partly within

wholly within

## APPENDIX 6.1-C

### Mortar mixes

Unless recommended otherwise by the brick manufacturer, the mixes in the table below should be used for clay bricks.

In the case of concrete or calcium silicate bricks, particular attention should be paid to manufacturers' recommendations.

**Mortar mixes using ordinary Portland or sulfate-resisting cements where required (see also Design clauses 6.1- D5(b) and (d)).**

| Location | | Recommended cement: lime: sand mix | Recommended cement: sand mix with air-entraining plasticiser | Recommended masonry cement: sand mix | Mortar designation to BS EN 1996-1-1 |
|---|---|---|---|---|---|
| General wall area above dpc | in areas of *Severe* or *Very Severe* exposure - high durability | 1 : ½ : 4½ | 1 : 3½ | 1 : 3 | (ii) |
| | other exposure categories - general use | 1 : 1 : 5½ | 1 : 5½ | 1 : 4½ | (iii) |
| Below dpc level and in chimney stacks | - high durability | 1 : ½ : 4½ | 1 : 3½ | 1 : 3 | (ii) |
| Cappings, copings and sills | - low permeability | 1 : 0 to ¼ : 3 | - | - | (i) |

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 pre-mixed mortars can be used over a longer period of time than site mixed, cement : lime : sand mortars. The timescale of use is defined by the manufacturer, whose advice should be followed:

- protect retarded mortar against freezing prior to use
- do not use retarded mortar beyond the time for which it is effective
- because of delayed setting, temporary bracing of larger walls, for example gable peaks and long walls, may be necessary.

**Admixtures and additives**

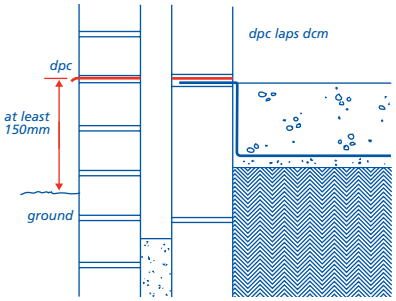
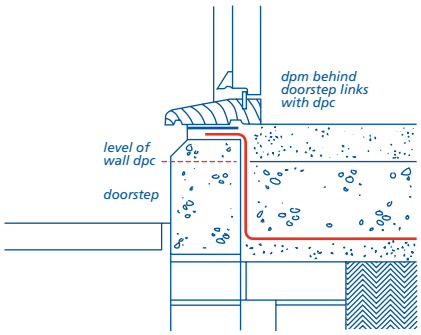
Where air-entraining plasticisers or other additives are to be used, follow manufacturers' instructions:

- do not overdose, 'more is not better'
- an air entraining agent can help reduce frost damage but it is not an anti-freeze
- do not use unauthorised additives.

## APPENDIX 6.1-D

### Dpcs and cavity trays

Some positions where dpcs and cavity trays should be provided:

| 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.<br>  |
| Base of partitions built off oversite where there is no integral dpm | Dpc should be full width of partition. |
| Base of wall built off beam, slab, etc | Detail to prevent entry of damp by driving rain. |
| Parapet | (1) Beneath coping, and<br>(2) 150mm above adjoining roof surface to link with the roof upstand. |
| In cavity walls over openings, air bricks and the like | A cavity tray should be provided to direct to the outside any water that enters the cavity. 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 the 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 | A stepped cavity tray should be provided above the roof surface and linked to any 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.<br>  |
| 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.<br><br>For *Severe* and *Very Severe* exposure conditions: rebated reveal construction, with or without closed cavity and dpc. |

## APPENDIX 6.1-E

### Durability classification of bricks

BS EN 771-1 classifies clay bricks according to their freeze/thaw resistance and active soluble salts content as follows:

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

Calcium silicate and concrete bricks contain no significant active soluble salts. Information on their durability is given in Materials clause 6.1 - M2(b).

## APPENDIX 6.1-F

### Protection of ancilliary components

| Selection of ancilliary components in relation to material/coating specification for use in buildings up to three storeys in a non-aggressive environment (For the full range of product types, materials and details refer to Table 2 of PD 6697:2010) | | |
|---|---|---|
| Product type | EN 845 Ref * | Material/Coating specification (The zinc coating masses are for one surface) |
| Wall ties 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 (940 g/m$^2$) steel wire or component |
| 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 (940 g/m$^2$) steel wire or component |
| Tension straps and hangers conforming to BS EN 845-1 (internal uses **) | 10 | Zinc coated (710 g/m$^2$) steel component |
| | 11 | Zinc coated (460 g/m$^2$) steel component |
| | 12.1 or 12.2 | Zinc coated (300 g/m$^2$) steel strip or sheet with organic coating over all outer surfaces of finished component |
| | 13 | Zinc coated (265 g/m$^2$) steel wire |
| | 14 | Zinc coated (300 g/m$^2$) steel strip or sheet with all cut edges organic coated |
| | 15 | Zinc pre-coated (300 g/m$^2$) steel strip or sheet |
| | 16.1 or 16.2 | Zinc coated (137 g/m$^2$) steel strip or sheet with organic coating over all outer surfaces of finished component |
| | 17 | Zinc pre-coated (137 g/m$^2$) steel strip with zinc coated edges |

| | | |
|---|---|---|
| Lintels conforming to BS EN 845-2 | L3 | Austenitic stainless steel (chrome and nickel alloys) |
| | L10 | Zinc coated (710 g/m$^2$) steel component |
| | L11.1 or L11.2 | Zinc coated (460 g/m$^2$) steel component with organic coating over all outer surfaces of finished component |
| | L12.1 or L12.2 | Zinc coated (300 g/m$^2$) steel strip or sheet with organic coating over all outer surfaces of finished component |
| | L16.2 | Zinc coated (137 g/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 (460 g/m$^2$) steel component |
| | L14 | Zinc coated (300 g/m$^2$) steel strip or sheet with all cut edges organic coated |
| | L16.1 | Zinc coated (137 g/m$^2$) steel strip or sheet with allorganic 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) |

* Material /coating reference in accordance with the relevant part of BS EN 845.
** These products are not suitable for use in contact with the outer leaf of an external cavity wall or a single leaf cavity wall.

It is an NHBC recommendation that components in contact with, or embedded in, an inner leaf which is damp or exposed to periodic wettings (eg below dpc) should be protected in the same way as components in contact with, or embedded in, an outer leaf.

## INDEX