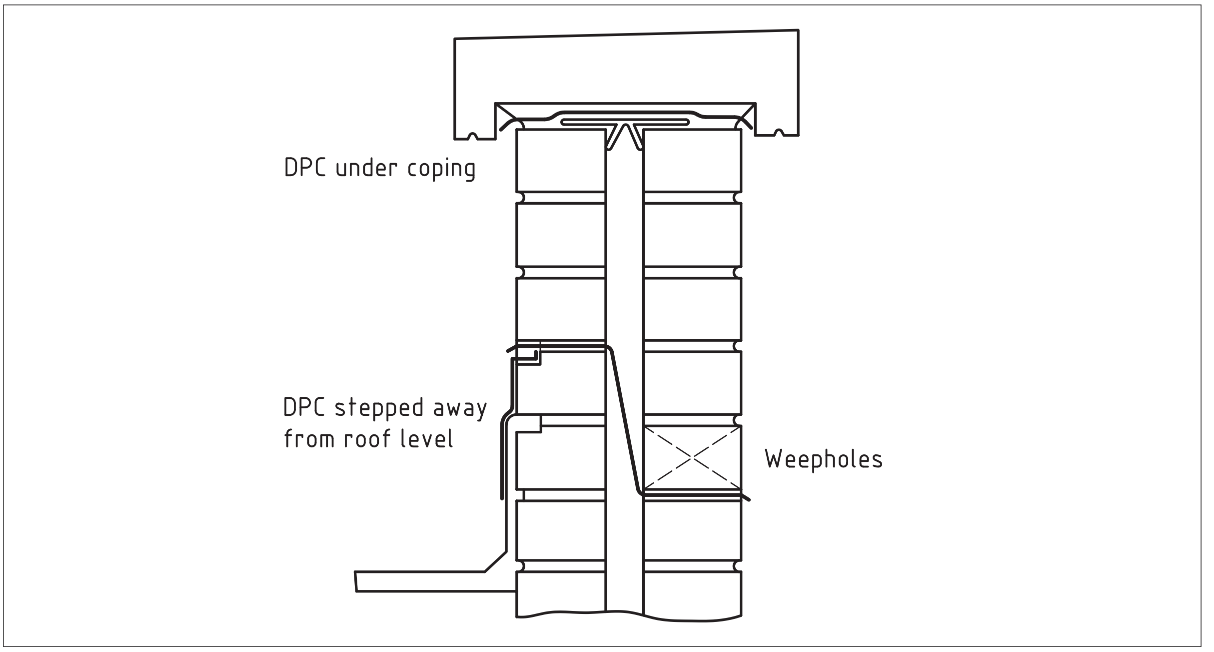
Figure 20 — *Cavity parapet walls*



6.2.8.7.9 Chimneys

Chimneys may be built in solid or cavity wall constructions.

A horizontal DPC should always be provided below a flaunched capping or coping at the top of the stack (See Figure 21). In exposure categories 2 to 4 (see Table 13), the chimney stack should be finished with a one piece overhanging throated coping with drip edge. In sheltered regions (category 1) where concrete flaunching is used, a minimum 25 mm up-stand should be maintained at the edge and deep flaunching should be used to withstand thermal fluctuation and to shed water effectively.

NOTE Brick on edge is not a suitable capping for chimneys.

In chimney stacks the mortar should be the strongest appropriate for the type of masonry unit. Mortar joints should not be recessed. A bucket handle profile should be used.

6.2.8.7.10 Flashings and weatherings

The material to be used for flashings and weatherings should be sufficiently malleable to permit dressing into shape, but sufficiently stiff to maintain its shape and to resist lifting by the wind. Metal flashings other than lead should, preferably, be pre-formed. They should be bedded into the masonry to a minimum 25 mm depth unless the flashings are supplied already bonded onto a DPC or cavity tray.

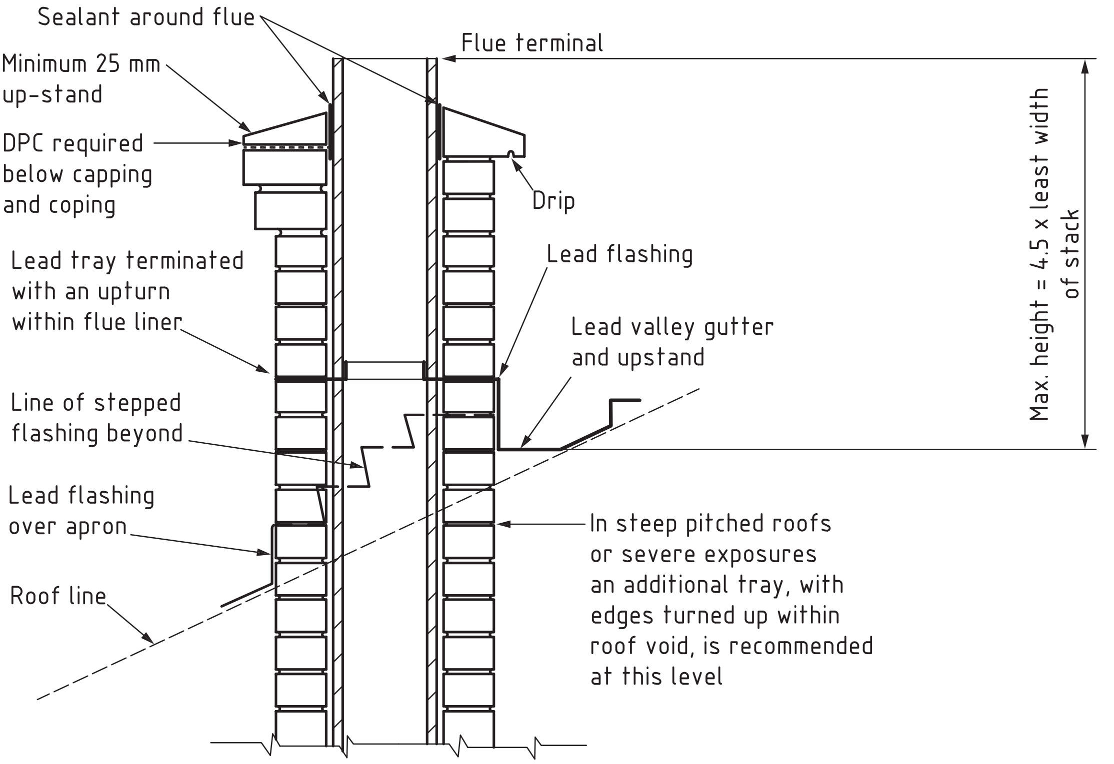
6.2.8.7.11 Cappings and copings

Chimney terminals, freestanding walls, parapet walls and retaining walls exposed to the weather, should preferably be provided with a coping. Drip edge(s) should be positioned a minimum of 30 mm from the face(s) of the wall. Where for aesthetic or other reasons a capping is used, special care is needed in the choice of materials, both for the capping and for the walling beneath (see also **6.2.8.4** and **Figure 15**).

Where the coping or capping is jointed, a continuous DPC should be provided. In cavity walls horizontal DPCs require support over the cavity.

Consideration should be given to copings being displaced by lateral loads, and to the possibility of vandalism. L-shaped copings and clip-over copings can be more satisfactory in some situations. Where necessary, copings should be suitably fixed down and can be doweled or joggle-jointed together.

Figure 21 Detail of typical chimney stack

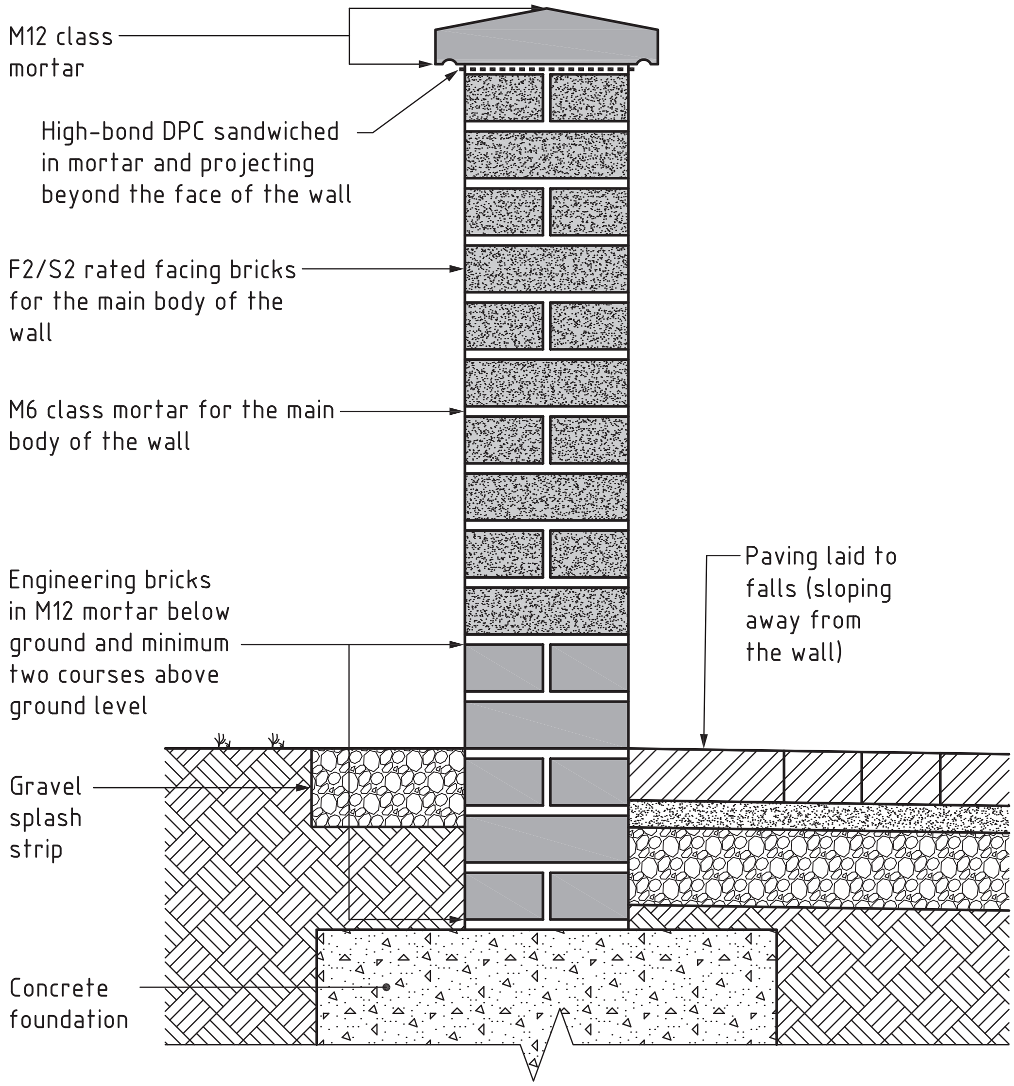


NOTE 1 Damp proof course to be included immediately under coping.

NOTE 2 For copings a minimum of 30 mm is required from the wall face to drip line of the throating.

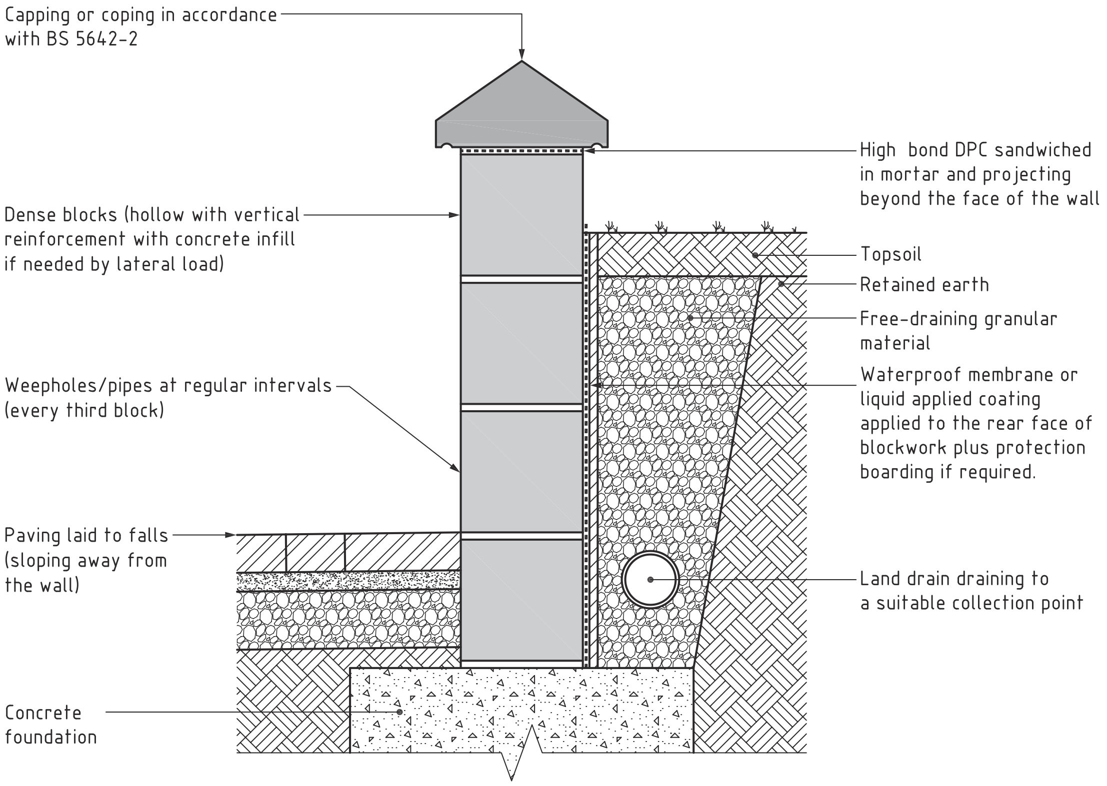
Figure 22 shows the key design aspects that should be taken into account for freestanding walls up to 1.2 m in height.

Figure 22 — *Freestanding and earth retaining wall*



a) Freestanding garden wall up to 1.2 m in height

Figure 22 — *Freestanding and earth retaining wall (continued)*



b) Block retaining wall

6.2.9 Durability

6.2.9.1 General

6.2.9.1.1 While the principles to be used in ensuring satisfactory performance for durability requirements are given in BS EN 1996-2:2006, **2.1**, further detailed considerations are given below.

6.2.9.1.2 A major factor influencing the durability of masonry is the degree to which it becomes saturated with water. It can become saturated in many ways.

6.2.9.1.3 External masonry is much less likely to become saturated where projecting features have been provided to shed run-off water clear of the walling below.

6.2.9.1.4 It should be noted that conventional weathering details do not always protect walls sufficiently in situations of severe or very severe categories of exposure (as defined in Table 13).

6.2.9.1.5 Recessed mortar joints place the surface of a wall at greater risk of frost attack and, therefore, recessed joints should not be used for external work using clay bricks of the moderate freeze/thaw resistance category F1 in all exposure situations.

6.2.9.1.6 Impervious finishes, e.g. masonry paint, tiling, or a dense render, can lead to the entrapment of moisture in the masonry if water is able to get behind the finish as a result of poor building detail or imperfections in the finish.

6.2.9.1.7 External masonry will generally be maintained in a drier condition by a moderately porous render free from significant cracks conforming to BS EN 13914-1, or by a ventilated cladding such as slate or tile hanging, by weather boarding, and by panels of various materials, e.g. of plastics, timber or metal.

6.2.9.1.8 Frost can damage both masonry units and mortar, depending on their susceptibility to such damage when frozen in a saturated, or near saturated, condition.

6.2.9.1.9 When masonry remains wet for long periods and soluble sulfates are present in sufficient quantities, sulfate attack on mortar joints and other materials containing Portland cement can arise. Soluble sulfates can originate from various sources including some clay bricks, see **6.2.8.4**.

6.2.9.1.10 The durability of masonry with regard to frost action and sulfate attack depends on the characteristics of both the masonry units and the mortar in relation to service conditions.

6.2.9.1.11 The degree to which masonry becomes saturated, when used below DPCs at or near ground level, will vary according to the site. Masonry materials are less prone to problems on a site that is well drained and dry. Where a site is wet, and/or the masonry at or near ground level is subject to saturation, the choice of materials should take this into account.

6.2.9.1.12 Paved surfaces adjacent to masonry should be laid to falls so that water is not directed to the masonry.

6.2.9.1.13 Where there is greater than 150 mm of masonry exposed between a DPC and the finished ground level, e.g. on sloping sites, the inner leaf of such masonry may act as an earth retaining wall. In some circumstances, water can be transferred into the walling thereby inducing a risk of frost action and sulfate attack, efflorescence, lime leaching and staining of the outer leaf. The application of waterproofing treatments to the rear face of the masonry in contact with the retained ground will avoid such problems.

NOTE Retaining walls supporting earth are particularly susceptible to saturation from retained ground in wet weather conditions [see Table 15(K)].

6.2.9.2 Exposure to the weather

A good indication of the general exposure of the site to wind-driven rain may be obtained as described in **6.2.7**. However, it should be appreciated that different elements in the same building can be subject to different degrees of exposure. This can affect the choice of materials including insulation (see **6.2.7.4.2.7**).

In locations subject to severe or very severe categories of exposure, the benefits of protection by overhangs and other projecting features are particularly valuable. If such protective features are omitted for aesthetic or other reasons, the effects of the increased exposure of the masonry to wetting should be considered (see **6.2.8.5**).

6.2.9.3 Frost action

6.2.9.3.1 General

Horizontal surfaces can become saturated or nearly saturated and are readily frozen by night frosts which are common in all parts of the UK.

Extra care should be given to the choice of masonry units and mortar if the masonry is liable to be splashed with de-icing salts from roadways or if the building is to be located in conditions of extreme exposure to weather.

6.2.9.3.2 Clay masonry units

For clay masonry units, neither strength nor water absorption are reliable guides for assessing the resistance to freezing and there is no substitute for experience of performance in a particular situation.

Where clay brick masonry is used in situations in which it can become saturated and exposed to cyclic frost action, the freeze/thaw resistance category F2 should be used and the manufacturer consulted regarding suitability.

6.2.9.3.3 Calcium silicate masonry units

For calcium silicate bricks, durability and compressive strength are related, and experience shows that repeated freezing and thawing has little effect on them. Bricks of compressive strength class 20 conforming to BS EN 771-2 possess good frost resistance in most applications, but higher strength classes are recommended for very severe categories of exposure. Calcium silicate bricks can suffer deterioration if they are impregnated with strong salt solution and then subjected to intense freezing. Therefore, they should not be used in situations where the masonry can be directly wetted by seawater or subjected to contamination by repeated application of road de-icing salts.

6.2.9.3.4 Concrete masonry units

For precast concrete masonry units durability and compressive strength are related. They should be selected following the recommendations in Table 15.

6.2.9.4 Sulfate attack

See also **6.2.8.1.9**.

Sulfates can be derived from ground waters, from the ground, including made-up fill adjacent to masonry, from flue gases, or from clay masonry units and aggregates. The degree to which soluble salts are extracted depends on the quantity of water available and the permeability of the masonry. For this reason, the design should contain provisions for effective DPCs and the exclusion of water.

Where masonry is likely to remain wet for long periods of time, e.g. in free-standing walls, in earth retaining walls, below DPCs, at or near ground level and in elevations exposed to exceptionally severe wind-driven rain, sulfate attack of mortar can occur if soluble sulfates are also present. In these situations consideration should be given to the use of strong mortar mixes using Portland cement or a cement with sulfate resisting properties. Mixes based on CEM II B as specified in BS EN 197-1, which include blastfurnace slag or fly ash, show enhanced resistance to sulfate attack.

Calcium silicate and concrete masonry do not contain soluble sulfates. However, masonry built of these units can be vulnerable to sulfates from other sources.

6.2.9.5 Architectural features

6.2.9.5.1 General

For aesthetic reasons, designers may sometimes include features which lead to increased local exposure of the masonry. As a result, the masonry will be more likely to become very wet or saturated, so increasing the risk of frost damage or disfiguration. In such cases more durable masonry units and mortar should be selected, and this can in turn govern the choice for the whole building. Examples of architectural features leading to increased local exposure are:

a) recessed windows with sloping masonry below;

b) flush sills;

c) inadequate or non-existent overhangs at verges;

d) large expanses of glazing or impermeable cladding with no effective form of construction at the base designed to shed run-off rainwater clear of the masonry beneath;

e) areas of rendering adjoining the masonry and recessed from it without an efficient seal at the junction, or other detail, to prevent the entry of water to the back of the render;

f) vertical tile hanging, the lower edge of which has little or no projection over the walling below.

6.2.9.5.2 Cappings

Cappings can be brick-on-edge, bonded brick masonry or a purpose-made capping unit. Such cappings give relatively little protection to the masonry beneath, which can become saturated for up to 1 m below the capping level, depending on the water absorption of the masonry units used. It is strongly recommended that parapets and chimneys should be protected by copings and DPCs.

Cappings of brick masonry and tile creasing, even though flaunched with mortar, cannot be relied upon to keep out moisture and require an effective DPC beneath them. Where possible, a one-piece coping, with weathered top and ample overhang, properly throated, is preferred.

6.2.9.5.3 Chimney stacks

Because chimney stacks are normally exposed on all four faces and the top, they may be more liable to saturation and frost attack than other parts of a building, especially where an effective coping has not been provided at the terminal. The effect of clay decorative detailing should be taken into account to ensure that water is not allowed to settle on projecting ledges but can be shed away from brickwork.

6.2.9.6 Selection of masonry units and mortar for durability

6.2.9.6.1 General

Table 15 gives guidance on the choice of masonry units and mortar classes most appropriate for particular situations with regard to durability for finished work. Reference to experience of durability in service of masonry units and mortar produced from local constituent materials in the geographical area concerned can provide valuable guidance.

6.2.9.6.2 Recommendations for the use of natural stone

Natural stone is usually selected for aesthetic reasons. Nevertheless, it should be durable enough for use in the intended location.

Few natural stones will not give adequate service between eaves and DPC in buildings of domestic scale. Durability will need to be assessed for the more exposed elements of a building, e.g. string courses, sills, copings and cappings, and for harsh climates, e.g. coastal regions, or areas in severe or very severe categories of exposure as defined in Table 13.

Particular care should be exercised when selecting a stone for which there is no previous local experience of its satisfactory use.

Petrographical examination, good geological interpretation and the quarrymaster’s and/or mason’s experience can all contribute to a final assessment of suitability.

Water run-off from limestone and magnesian limestone can attack sandstone, and some bricks. Masonry material combinations should be chosen that are not vulnerable to such attack. Alternatively, building detail should prevent the flow of water from limestone to other masonry materials.

NOTE This British Standard introduces the following principal changes to Table 15 including:

a) LD amended to P; HD amended to U in column, Masonry condition or situation;

b) compressive strength amended to Mean compressive strength in column, Aggregate concrete blocks;

c) column title, Aggregate concrete and autoclaved aerated concrete blocks, amended to, Aggregate concrete, autoclaved aerated concrete and manufactured stone units;

d) compressive strength amended to mean net compressive strength; block amended to unit; and list point e) added in column, Aggregate concrete, autoclaved aerated concrete and manufactured stone units.

Table 15 — Durability of masonry in finished construction

Masonry condition or situation [A)]	Quality of masonry units and appropriate mortar designations				Remarks
	Clay units	**Calcium silicate units**	**Aggregate concrete bricks**	**Aggregate concrete, autoclaved aerated concrete blocks and manufactured stone units**	
(A) Work below or near external ground level					
A1 Low risk of saturation without freezing MX2.1		Without or with freezing	Without or with freezing	Without or with freezing	Some types of autoclaved aerated unit may not be suitable. The manufacturer should be consulted.
	P – F0 and S0 or U – F0, F1 or F2 and S0, S1 or S2 in M12, M6 or M4	Compressive strength class 20 or above in M4 or M2 (see remarks)	Mean compressive strength 16.5 N/mm^2 or above in M4	a) of net density ≥ 1500 kg/m^3; or b) made with dense aggregate conforming to BS EN 12620; or c) having a mean net compressive strength ≥ 7.3 N/mm^2; or d) most types of autoclaved aerated unit (see remarks) or e) all types of manufactured stone unit All in M4 or M2 (see remarks)	In sulfate bearing ground conditions, the recommendations in 6.2.9.4 should be followed. Where designation M2 mortar is used it is essential to ensure that all masonry units, mortar and masonry under construction are protected fully from saturation and freezing. Some manufacturers of clay units do not recommend the use of their U – F1 units for work below or near external ground level.

Table 15 *(continued)*

Masonry condition or situation A)		Quality of masonry units and appropriate mortar designations				Remarks
		Clay units	**Calcium silicate units**	**Aggregate concrete bricks**	**Aggregate concrete, autoclaved aerated concrete blocks and manufactured stone units**	
A2	High risk of saturation without freezing MX2.2	U – F1 or F2, and S1 or S2 in M12, M6 or M4 unless a manufacturer advises against the use of F1	Compressive strength class 20 or above in M6 or M4	Mean compressive strength 16.5 N/mm² or above in M6 or M4	As for A1 in M6 or M4	Masonry most vulnerable in situations A2 and A3 is located between 150 mm above and 150 mm below finished ground level. In this zone masonry will become wet and can remain wet for long periods, particularly in winter. Where S1 clay units in designation M6 mortar are used in A2 or A3 locations, the recommendations in 6.2.9.4 should be followed.
A3	High or low risk of saturation with freezing MX3.1, MX3.2	U – F2 and S2 in M12 or M6 (see remarks)	Compressive strength class 20 or above in M6 or M4	Mean compressive strength 22 N/mm² or above in M6 or M4	As for A1 in M6	In conditions of highly mobile groundwater, consult the manufacturer on the selection of materials (see **6.2.8.1.10** to **6.2.8.1.14**).
(B) Masonry DPCs						
B1	In buildings MX3.1, MX3.2, MX4	Max. water absorption 4.5 % in M12 (in line with historic DPC and engineering brick categories)	Not suitable	Not suitable	Not suitable	Masonry DPCs can resist rising damp, but will not resist water percolating downwards.
B2	In external works MX3.1, MX3.2, MX4, MX5	Max. water absorption 7 % in M12 (in line with historic DPC and engineering brick categories)	Not suitable	Not suitable	Not suitable	If sulfate ground conditions exist, the recommendations in **6.2.9.4** should be followed. DPCs of clay units are unlikely to be suitable for walls of other masonry units, as differential movement can occur (see **5.2**).