Getting the best from Wienerberger Bricks

A Guidance Note on Garden & Retaining Walls

Introduction

Correct construction and detailing of freestanding garden and retaining walls is important to ensure long term performance. These are especially at risk irrespective of geographical location, because they are often in exposed and unprotected areas and are subject to saturation, frost, sulfates and low temperatures. While all of these issues need to be considered, brick is an excellent choice of material and with the correct detailing will provide satisfactory performance for years to come.

Structural Considerations

This guide deals with the design for durability of domestic garden and retaining walls where forces and loadings are minimal. Professional guidance should be obtained for retaining walls above 1m in height and for freestanding walls above 1.2m.

Brick Selection

All of our bricks are manufactured in accordance with the European Standard BS EN771-1 : 2003. We recommend that for any garden or retaining wall a brick with a durability designation of F2 is selected. It is also worth noting that all of our products are within the lowest category (S2) of active soluble salts content. F2 rated bricks are frost resistant, confirming them as suitable for building details of severe exposure, where units may be saturated and subjected to repeated freezing and thawing. They can be used for walls at or below ground level, for external free standing walls including cappings, and for retaining walls. Therefore F2/S2 bricks must be specified. Detailing to minimise the water content of masonry will prolong its life.

We also recommend that copings and cappings be formed from smooth textured bricks or special shapes, to maximise water shedding. At the base of the wall, at least two courses of Engineering bricks or creasing tiles in M12 category mortar will provide an effective barrier to rising damp without compromising the wall's structural performance.

Coping and Capping of Brickwork

Correct finishing of the head of a wall adds visual appeal and has important benefits in terms of protecting the brickwork beneath from water ingress and staining. Copings and cappings can vary in appearance from a standard brick on edge to bullnoses, cants, angles and curves. A series of standard shapes are available under BS4729 (Specification for dimensions of bricks of special shapes & sizes) and if required units can be designed and manufactured specifically for a project. The definitions of a coping and capping are as follows:

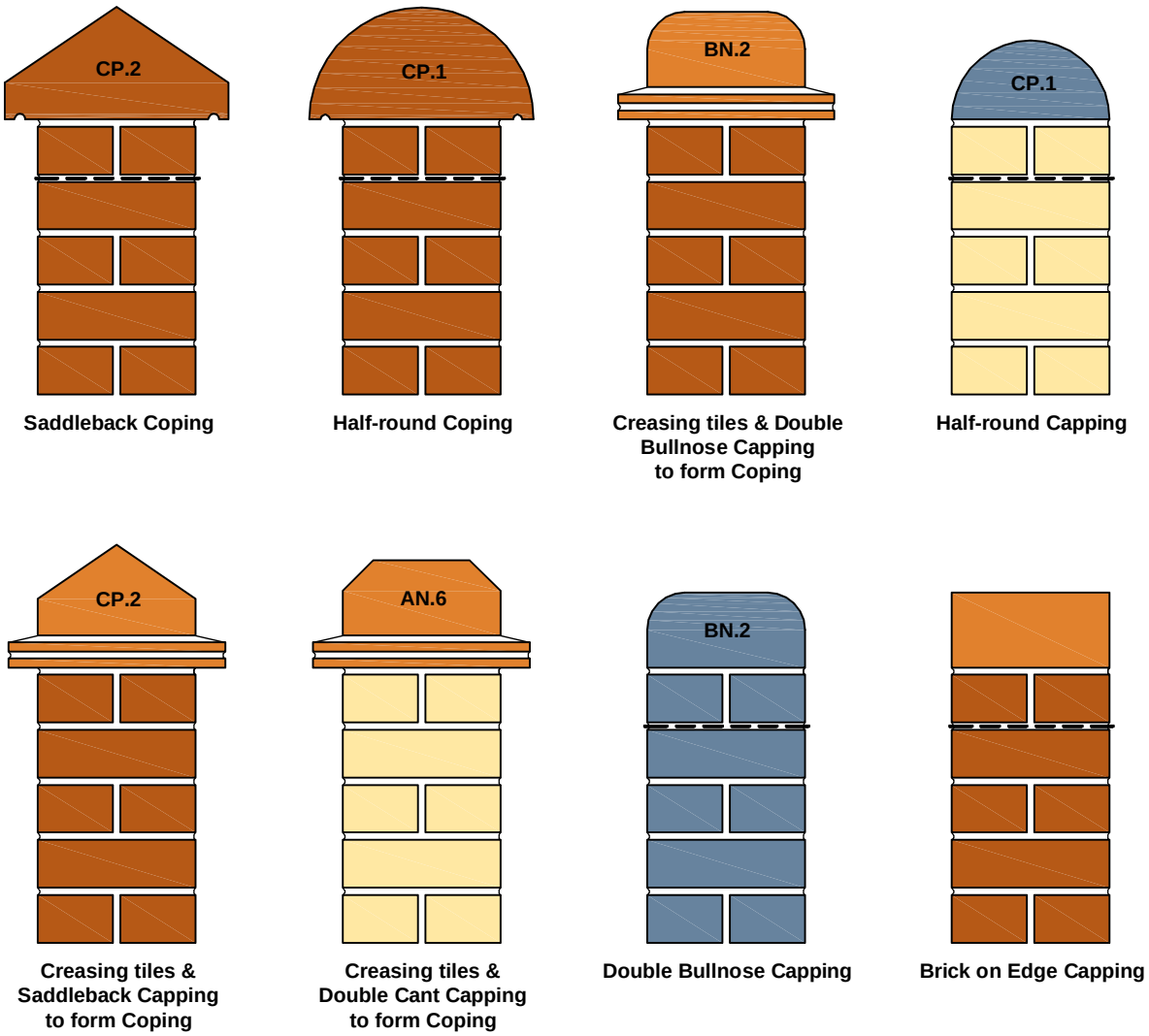
Capping – Sits flush with the vertical face of the wall.
Coping – Projects at least 40mm from both sides of the wall and incorporates a drip on the underside.

Copings provide better protection because they shed water clear of the vertical face of the wall. It is important that a brick with a durability designation of F2/S2 is selected, with a smooth texture being preferable.

Refer to figure 1

figure 1

Examples of Copings and Cappings



Damp Proof Courses & Waterproofing

We advocate good site practice of providing a suitable membrane to prevent percolation of water and the effect of longer term staining from ground salts and leaching of mortar. With this in mind it is important that a waterproofing membrane (DPM) or liquid applied coating should be applied to the rear face of any retaining wall. This DPM should be protected from damage by a suitable protective board.

It is also good practice to incorporate a damp proof course near the head of the wall. It is usual to place the DPC two courses down to increase stability, particularly with brick on edge cappings. DPC's should be sandwiched in fresh mortar. At the base of the wall sheet DPC's should be avoided. The use of two or more courses of engineering bricks or creasing tiles (with staggered joints) will provide good resistance to rising dampness without affecting structural performance.

Refer to figures 2 and 4

Creasing Tiles

Creasing tiles have been used for many centuries as a means of shedding water and preventing dampness in walls as well as for visual effect. Their resistance to moisture and their ability to form a strong bond with mortar make them an ideal damp-proofing medium for garden and retaining walls. By projecting them from both faces of the wall (minimum 40mm) they can also provide a protective drip feature to form a coping detail. At the base of the wall creasing tiles will also provide a resistance to dampness due to their low water absorption.

It is important to note that a minimum of two courses should be specified with staggered joints.

Refer to figure 3

Drainage

Water accumulating behind a retaining wall exerts pressure and needs to be released. This is critical to prevent structural damage. This can be achieved by incorporating a drainage layer, generally a granular material (gravel), with land drains and weepholes at regular intervals. A plastic pipe through the wall will normally suffice. Leaving open perpend joints to release water can lead to localised wall saturation and staining, with potential effects on long term durability.

Gravel 'splash' strips adjacent to the wall faces, at ground level, reduce the risk of saturation near the base of the wall. Adjacent paving should be laid to falls, sloping away from the wall, to reduce the saturation risk.

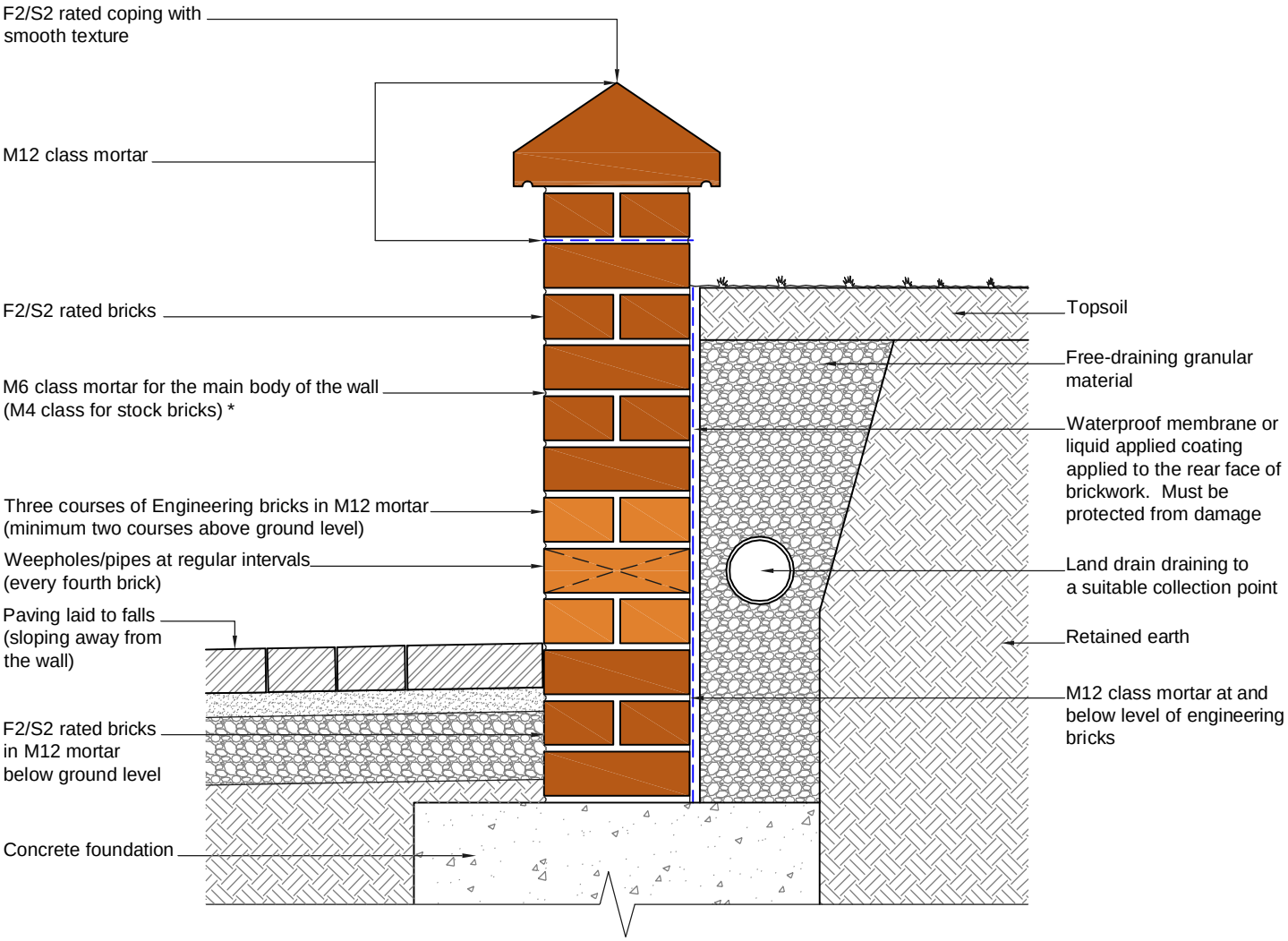


figure 2

Retaining Wall

Up to 1m in height

* NOTE: Where there is no DPM or there is a risk that it may not be effective sulfate resisting cement should be used.

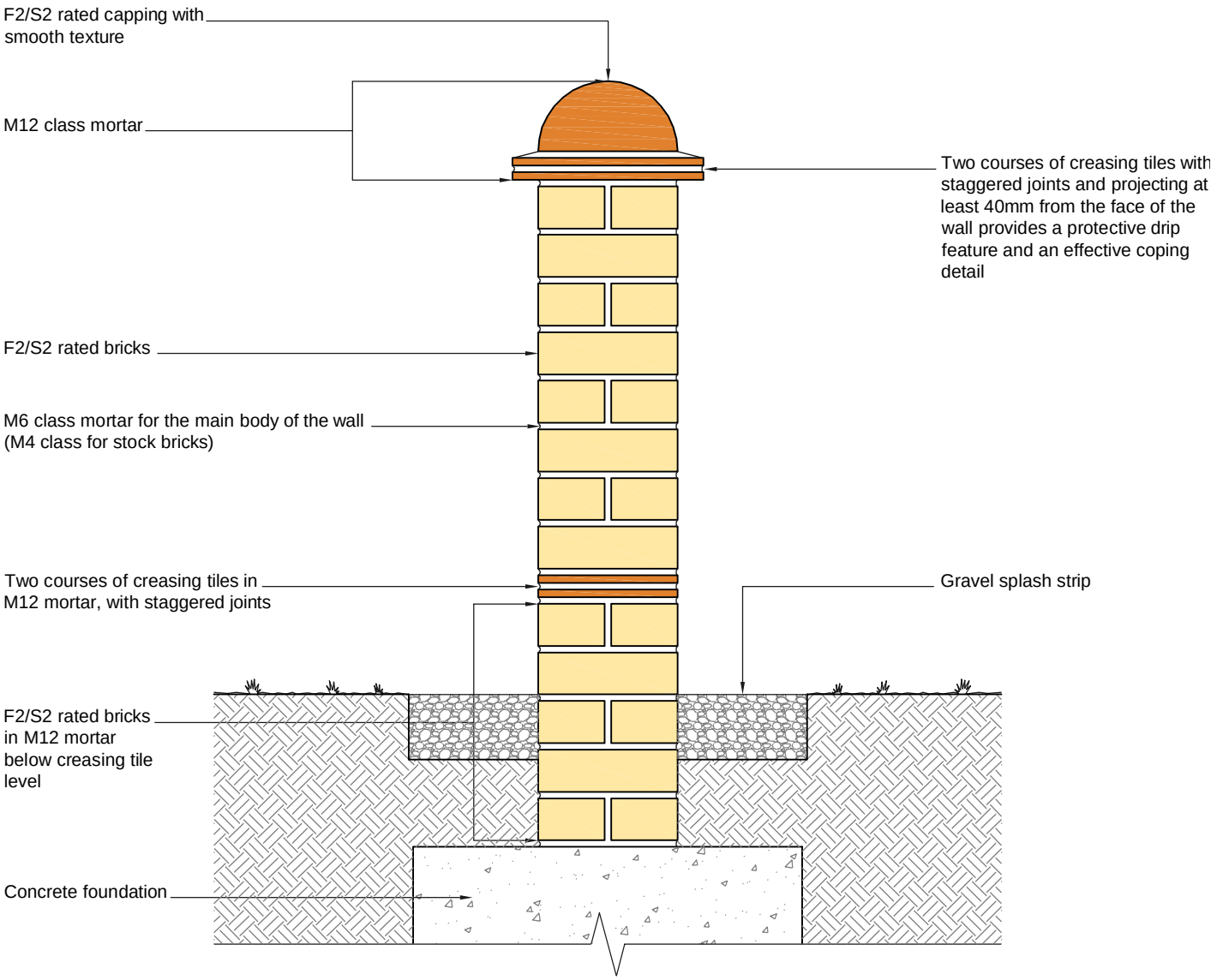


figure 3

Freestanding Garden Wall (up to 1.2m in height)
With creasing tiles and capping

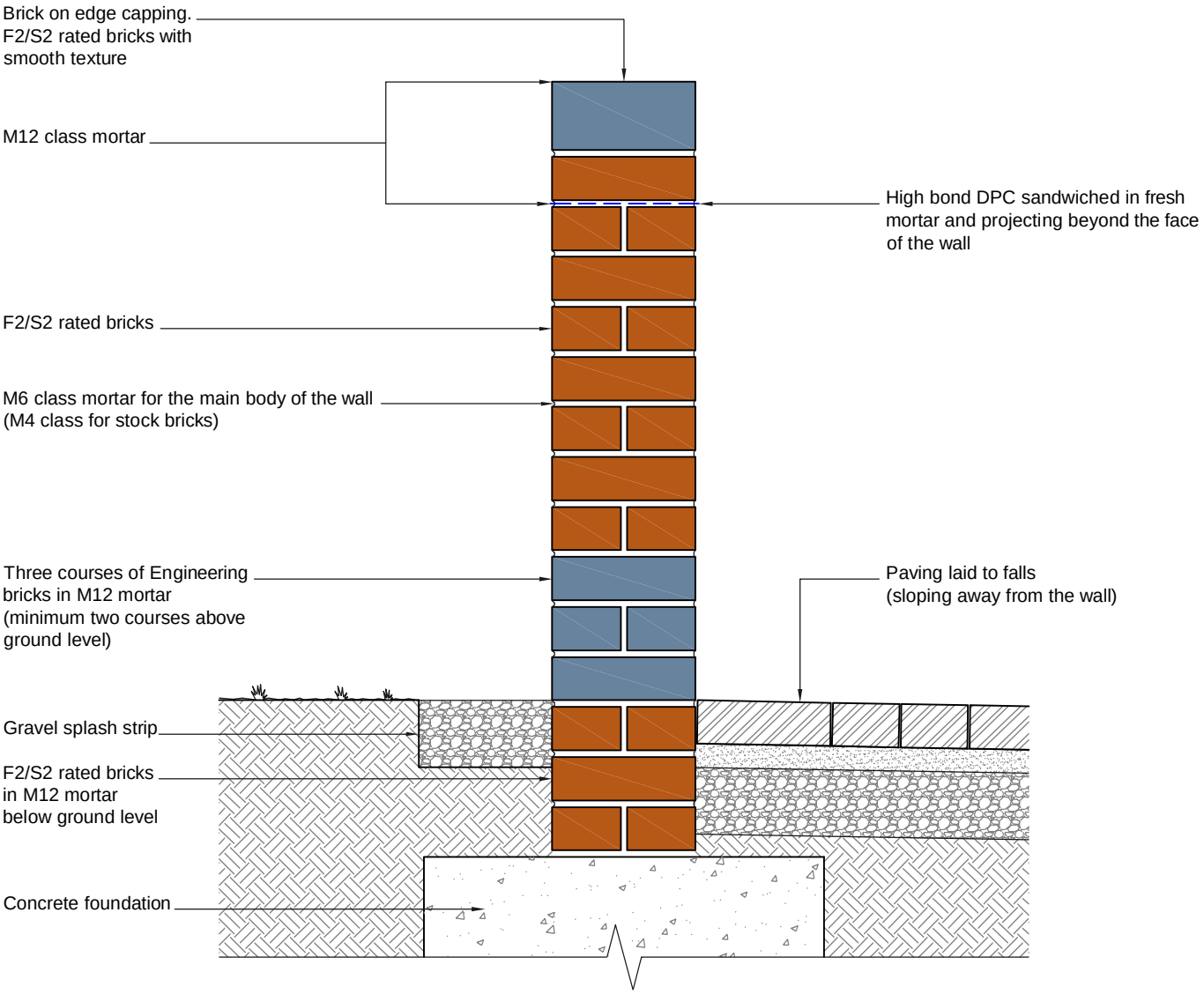


figure 4

Freestanding Garden Wall (up to 1.2m in height)
With brick on edge capping

Mortar

Consideration should be given to the appropriate mortar specification for different applications.

M12 For cappings, copings and work at and below the base DPC.

M6 For the main body of the wall in all exposure zones.

M4 For the main body of the wall when using stock type bricks or in sheltered zones, with the correct detailing.

British Standard Categorisation of Mortars

Table NA2 in the National Annex to BS EN 1996-1-1 (Eurocode 6)

Mortar Designation	Compressive Strength Class	Prescribed Mortars (proportion of materials by volume)				Compressive Strength at 28 days (N/mm²)
		Cement : Lime : Sand with or without air entrainment	Cement : Sand with or without air entrainment	Masonry Cement [a] : Sand	Masonry Cement [b] : Sand	
(i)	M12	1 : 0 to ¼ : 3	-	-	-	12
(ii)	M6	1 : ½ : 4 to 4½	1 : 3 to 4	1 : 2½ to 3½	1 : 3	6
(iii)	M4	1 : 1 : 5 to 6	1 : 5 to 6	1 : 4 to 5	1 : 3½to 4	4

[a] Masonry cement (inorganic filler other than lime)
[b] Masonry cement (lime)

Notes: Proportioning by mass will give more accurate batching than proportioning by volume, providing that the bulk densities of the materials are checked on site.

When the sand proportion is given as, for example, 4 to 5, the lower figure should be used with sands containing a higher proportion of fines whilst the higher figure should be used with sands containing a lower proportion of fines.

Sulfate Attack

If there are sufficient soluble salts or sulfates presents in a mortar containing tri calcium aluminate (C3A) and there is enough water present (for long enough) expansion of the mortar can be caused, eventually causing total disruption of the mortar joints. This rare problem is called sulphate attack.

The salts/sulfates usually come from the earth behind a retaining wall, from salts used for de-icing purposes or very rarely from the bricks themselves. To reduce the risk of sulphate attack, S2 designation bricks should be specified. Design and construction measures should minimise the ingress of water into the brickwork for example DPC's, copings, DPM's behind retaining walls and paving laid to fall away from the wall.

A further precautionary measure would be to use sulphate resisting types of cement (SR grades) where there is a risk of contamination.

Movement Joints

Clay bricks, like all materials, expand and contract as temperature rises and falls. Whilst thermal expansion of the brick will occur due to the range of temperatures experienced, the orientation of walls and the colour of the brick, a greater influence on the overall movement of clay bricks is the long term effect of moisture. The location and size of movement joints must therefore take into account the overall thermal and moisture movement characteristics of the product, the design and the dimensions of brickwork panels, and their relationship in plan form.

For simplicity in garden and retaining walls a movement joint spacing of maximum 6m is advised.

Vertical joints should commence from foundation level and extend through any coping or capping feature. It is important that an easily compressible joint filler material is specified. Cellular polyethylene and cellular polyurethane are ideal materials. The face sealant should offer long term protection of the joint filler and various sealant colours are available to complement mortar colours.

Refer to figure 5

Mortar Joint Profiles

To maximise the water shedding properties of the brickwork it is advised that mortar joint profiles have a bucket handle (preferred), weather struck or flush finish. It is also important that any joint is well tooled. Recessed joints are not recommended because they hold water, encourage longer term staining and are less resistant to rain penetration.

Refer to figure 6

figure 5

Typical Movement Joint Detail

Plan

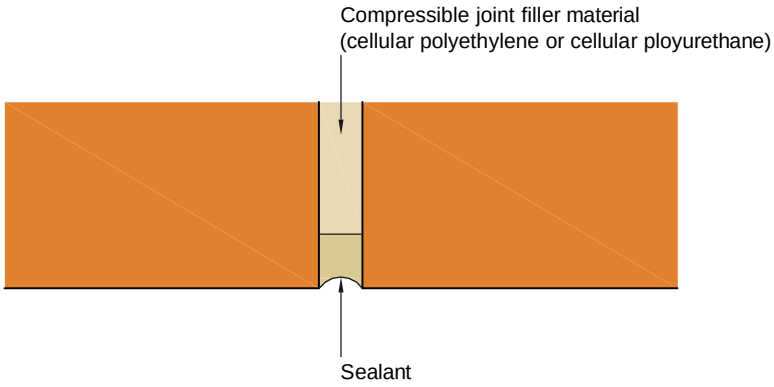
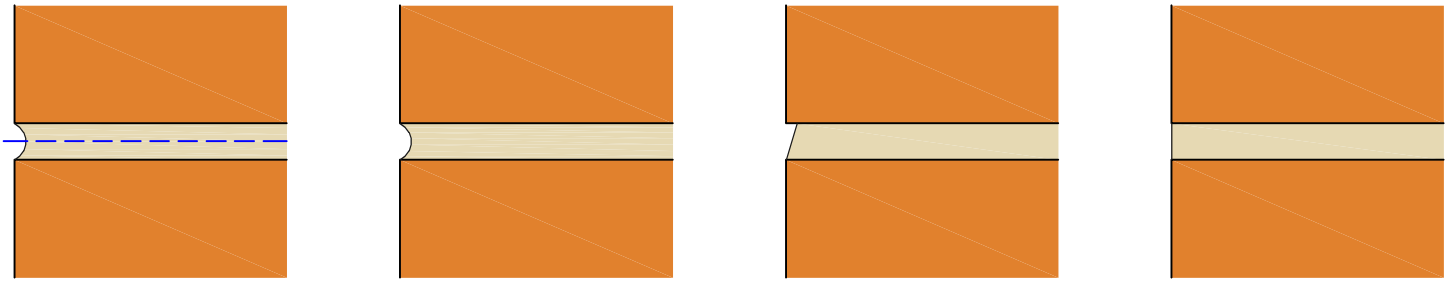


figure 6

Damp Proof Course (DPC) and Mortar Joint Profiles

Section



High bond DPC
sandwiched in fresh mortar and projecting beyond the face of the wall (min 5mm)

Bucket handle mortar joint
(preferred profile)

Weather struck mortar joint

Flush mortar joint

Checklist of Essential Points	✓
• A brick with a durability designation of F2 and an active soluble salt content of S2 must be selected (F2/S2).	
• Correct mortar specification and joint profile selected (bucket handle joint preferred). All mortar joints well tooled.	
• Consider the risk of sulphate attack and specify correct the materials and details needed to prevent it from occurring.	
• The DPC at the base of a wall must be constructed from engineering bricks or creasing tiles and should comprise at least two courses as shown.	
• A high bond DPC sandwiched in fresh mortar should be included near the head of the wall.	
• Suitable coping or capping to be selected. Copings are preferred.	
• A waterproofing membrane (DPM) or liquid applied coating should be applied to the rear face of a retaining wall. This needs to be protected from damage.	
• Suitable drainage to prevent water retention must be provided behind a retaining wall. With weepholes/pipes at regular intervals.	
• Movement joints should be included at maximum 6m centres (including copings and cappings).	
• Gravel 'splash' strips adjacent to the wall faces, at ground level. Paving laid to falls, sloping away from the wall.	

Further Information & Resources
This document has been developed to provide general guidance. For more detailed advice on specific applications please contact our Technical Design Services Department.

Wienerberger Technical Design Services Department
0161 491 8200

Please note that this guidance is considered to be an enhancement of the previous BS5628 Part 3 information which was withdrawn in 2010.