CI/SfB Ff
August 2004

Design Guide

A member of the Anglo American plc group

Topblock

The causes of movement

All buildings undergo small movements and dimensional changes from various causes; those which most affect concrete masonry are:

- changes in moisture content of the blockwork (reversible);
- changes in temperature (reversible);
- carbonation of the concrete (non-reversible);
- movement of the adjoining structure (reversible or non-reversible).

There is a general tendency for concrete masonry to contract as it dries to equilibrium moisture content and the concrete carbonates. Clay masonry, by contrast, expands as the masonry matures and adsorbs water.

Unless proper provision is made to allow such movements to take place in a controlled manner, cracking may occur; such cracking presents little hazard, but can be unsightly. The advice given here is based upon the recommendations of BS 5628: Part 3 and long-term experience.

Provision for movement

The amount of movement to be expected is related to the moisture content of the materials, the ability of the masonry to carbonate after construction, and the ambient temperature during construction. Unless slip planes are provided, longitudinal movement in loadbearing masonry is likely to be less than that in non-loadbearing masonry because of the restraint provided by the structure.

Whilst it is possible to calculate the likely level of movement and then to design for it, the number of variables involved make calculation complex; it is more usual to:

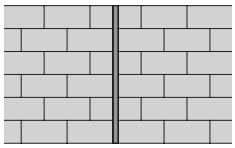
- divide masonry into a series of discrete panels, separated by joints which allow movement of the panels, and/or
- to restrict movement by using bed joint reinforcement.

Internal walls in single occupancy dwellings do not normally require movement joints; any small movement cracks are made good after the building has dried out. However, if the length of internal walls exceeds three times their height then provision for movement may need to be considered.

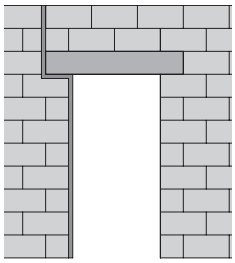
Joints to accommodate horizontal movement

Movement joints should be considered at the following locations:

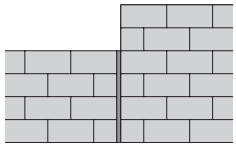
- at regular spacings in long runs of walling;



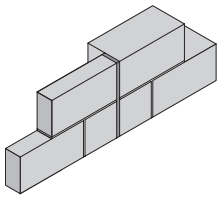
- above and below openings;



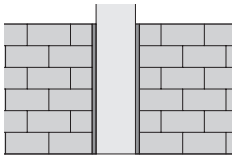
- at changes in wall height;



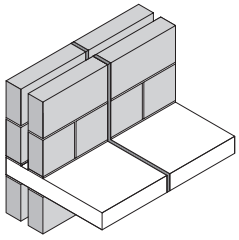
- at changes in wall thickness;



- at junctions with dissimilar materials;



- to coincide with movement joints in other parts of the construction.



Movement joints

Movement joint spacings for Topblock products in walling are given in the Table 36. Where end restraint is provided, such as at bonded corners, the recommended spacings should be halved. Long, low panels – those with length to height ratios greater than 3:1 – should have joints at reduced spacings. In such cases, bed reinforcement may be a better solution as this will avoid an excessive number of movement joints.

Table 36: Recommended movement joint spacings

Product	Joint spacing (m)
Hemelite	7.0 - 8.0
Topcrete	7.0 - 8.0
Toplite	6.0
Durox	6.0

Formation of movement joints

Typically movement joints to accommodate horizontal movement should be straight, 10mm wide butt joints built in as work proceeds. They should be filled with a suitable compressible material and sealed as required. Wider joints may be required where they pass through the whole structure.

In some situations, for example internal walls, a simple butt joint may be used without filler. Suitable joint fillers include flexible cellular polyethylene, cellular polyurethane or foam rubber. Internal joints which generally only need to allow for contraction, may be filled with fibreboard and carried through plasterwork.

Structural continuity across movement joints, and at junctions of masonry with the structural frame, is achieved by using flat metal ties with one end de-bonded (for example by a plastic sleeve) at 450mm maximum vertical centres (see Fig 18).

Movement joints must be continuous through applied rigid finishes such as plaster or render (see Fig 19). The use of a proprietary plaster/render stop bead will give the best results. Further construction details for movement joints are given in Figs 24 - 34.

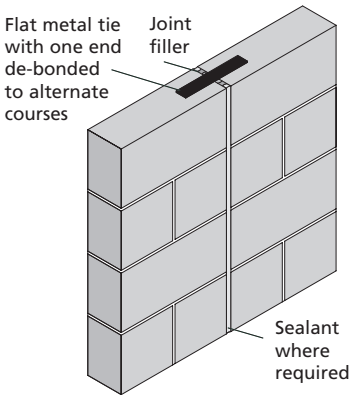


Fig 18.
Movement joint with flat-strip metal ties

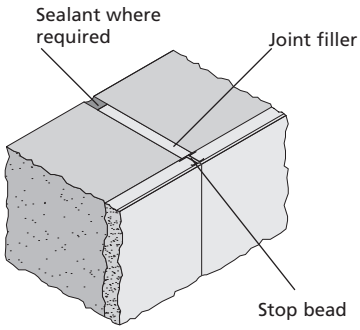


Fig 19.
Movement joint continued through rigid finishes

Vertical and lateral movement

In non-loadbearing walls a gap, usually packed with soft filler, is left at the soffit to allow for vertical movement of the structure above. Lateral restraint can be provided by lengths of steel angle fixed to the soffit on either side of the masonry after the wall has been constructed (see Fig 20). Alternatively, sliding ties may be built into masonry perpend joints and fixed to the soffit; the use of ties which do not permit movement may cause dislodgement of the top course of masonry.

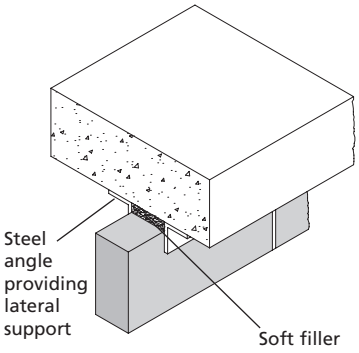


Fig 20. Lateral restraint of non-loadbearing walls

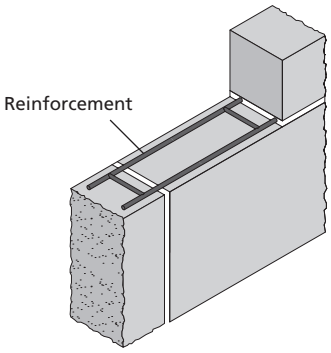


Fig 21.
Bed joint reinforcement

Bed joint reinforcement

Movement may also be controlled using prefabricated wire reinforcement in mortar bed joints to distribute stresses throughout the immediate area of the wall (see Fig 21). This will prevent major cracking.

For use in conjunction with Durox System, thin joint block work, polymer movement control fabric, eg 'Clanmesh', can be considered as an alternative to steel composition reinforcement. Tests conducted by John Moores University have shown this material to be effective when incorporated in the bed joints to reduce the occurrence of shrinkage cracks and minimise crack width. Further details on application are given in the Durox System thin joint guide.

Bed joint reinforcement may be used:

- at stress concentrations around door and window openings (see Fig 22)
- in long panels where movement joints are impractical (see Fig 23)
- to increase the spacing of movement joints beyond that recommended for unreinforced masonry.

Fig 22. Bed joint reinforcement at openings

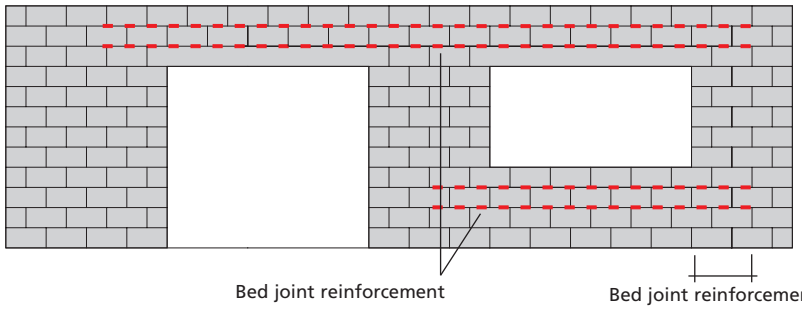
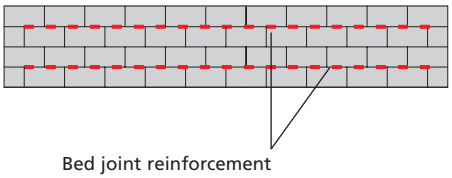


Fig 23. Bed joint reinforcement in low height



Mortar

A significant proportion of the overall shrinkage of masonry is owing to the mortar. The effect of the shrinkage can be reduced by ensuring mortar joints are weaker than the masonry units; this reduces the stresses by allowing redistribution of forces within the wall. However, the mortar must still be compatible with the strength and durability requirements of the masonry.

Differential movement

Differential movement may occur when designs combine materials with differing physical characteristics. This is not usually a problem when various types of concrete masonry are combined; for example only a small amount of differential movement will be produced between a Topcrete dense aggregate outer leaf and a Durox or Toplite inner leaf.

However, allowance must be made for differential movement when concrete and clay masonry are used in adjoining leaves and the use of rigid wall ties should be avoided where possible. When concrete and clay units are built into the same panels, slip planes and/or more closely spaced movement joints may be necessary to allow for the differential movement.

Site practice

Protecting blocks from rain and snow will help minimise excessive movement caused as the blockwork dries out.

Packs of blocks should be covered with weatherproof sheeting. Blocks can be supplied shrink-wrapped but these should also be covered once the wrapping has been opened. It is equally important to provide weather protection to blockwork under construction. Loaded out blocks should be covered with a spot board and partially completed walls should be covered with a scaffold board or waterproof sheeting.

During periods of very hot weather, blockwork should not be allowed to dry out too quickly.

Summary

- Internal walls in single occupancy dwellings do not normally require movement joints.
- Movement joints in unreinforced masonry should normally be 6.0 - 8.0m apart, depending on block type, for normal storey height walls.
- A movement joint should be provided at half the normal spacing where there is end restraint such as at bonded corners.
- Unrestrained or lightly loaded walls with length/height ratios greater than 3:1, such as low horizontal panels or parapet walls, require more frequent movement joints or the introduction of bed joint reinforcement.
- Bed joint reinforcement should be used to control movement at stress concentrations such as window and door openings, or to extend the spacing of movement joints.
- Where appropriate, suitable provision for movement should be allowed at the tops of walls.
- Over strong mortars should be avoided.
- Suitable precautions should be taken when mixing materials of different compositions, such as clay or concrete, in the same wall. Movement joints and slip planes should be introduced as appropriate.

Design *Movement control*

The following design details are the most common movement joint details likely to be encountered in the design of concrete blockwork. They are generally applicable to all Topblock products but the designer is also referred to the Durox System guide for details of movement joints and bed joint reinforcement when designing with Durox thin joint blocks.

Fig 24. Movement joints to walls incorporating solid blocks

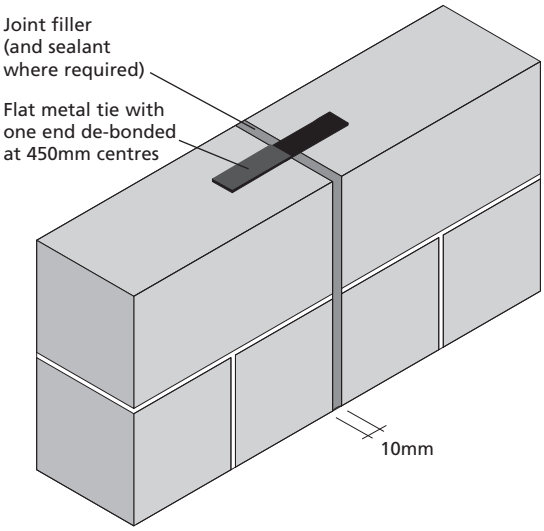


Fig 25. Movement joints to walls incorporating hollow blocks

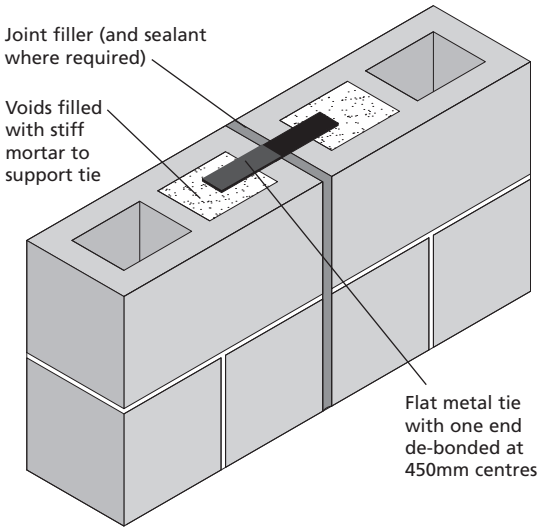


Fig 26. Movement joints at an intersecting wall

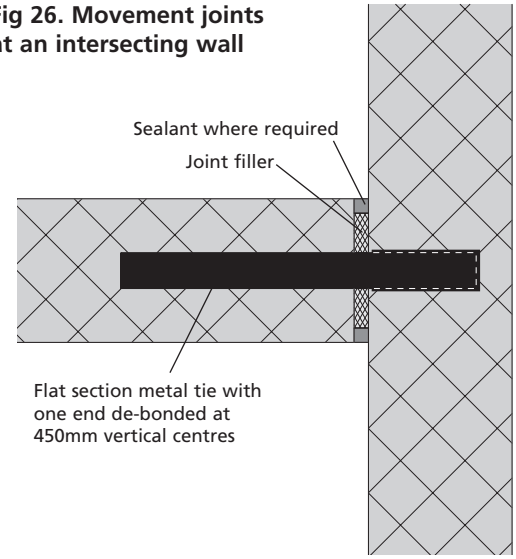


Fig 27. Movement joint to the inner leaf of a cavity wall

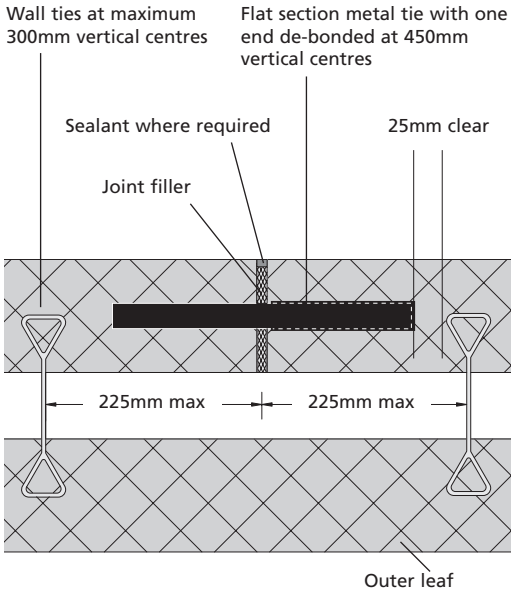


Fig 28. Movement joint at external wall junction to separating wall

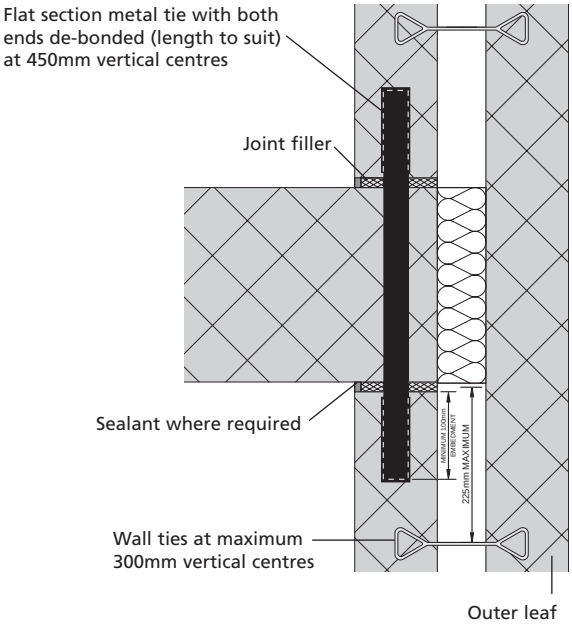


Fig 29. Movement joint to a rendered outer leaf

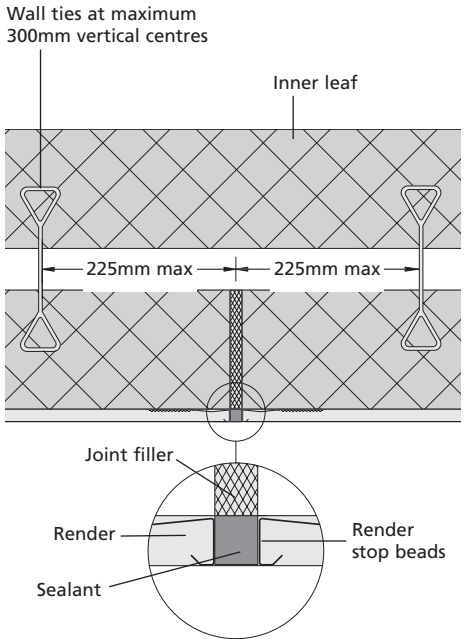


Fig 30. Movement joint and slip plane to the side of door openings

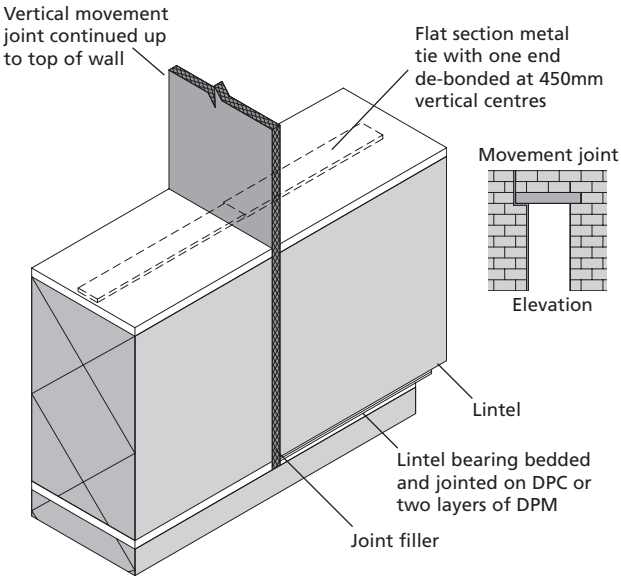


Fig 31. Movement joint to blockwork at internal steel column

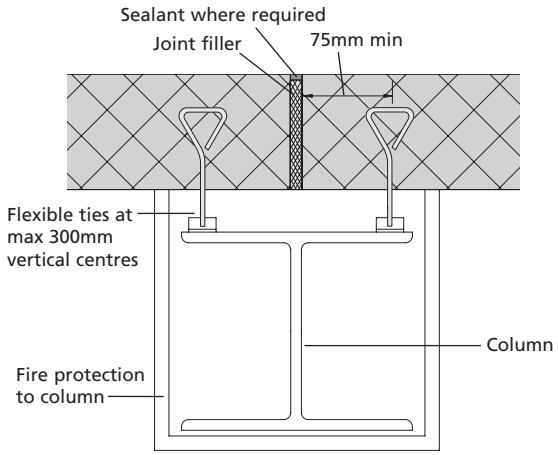


Fig 32. Movement joint to blockwork supported by a steel frame

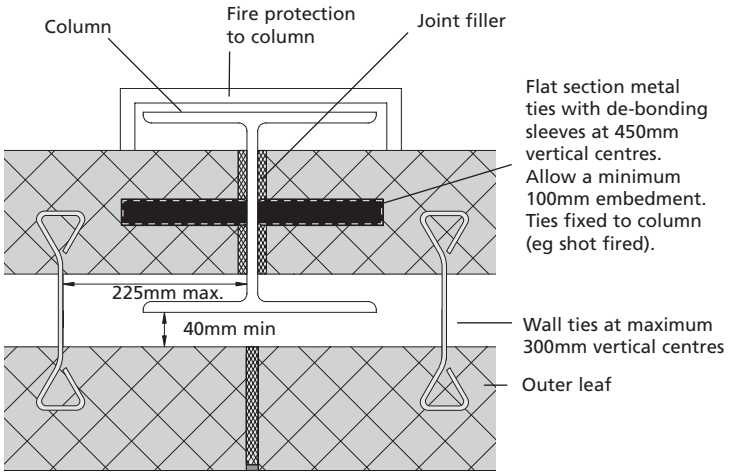


Fig 33. Movement joint to blockwork supported on a steel frame with internal pier

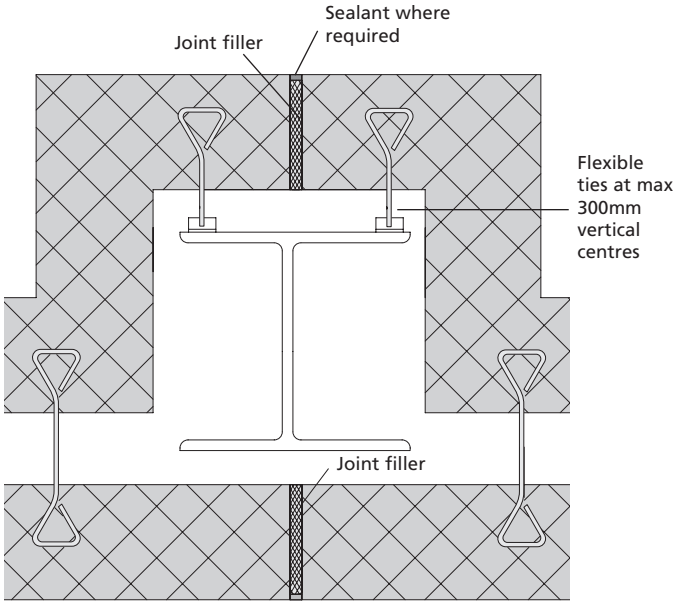


Fig 34. Movement joint at reinforced concrete column