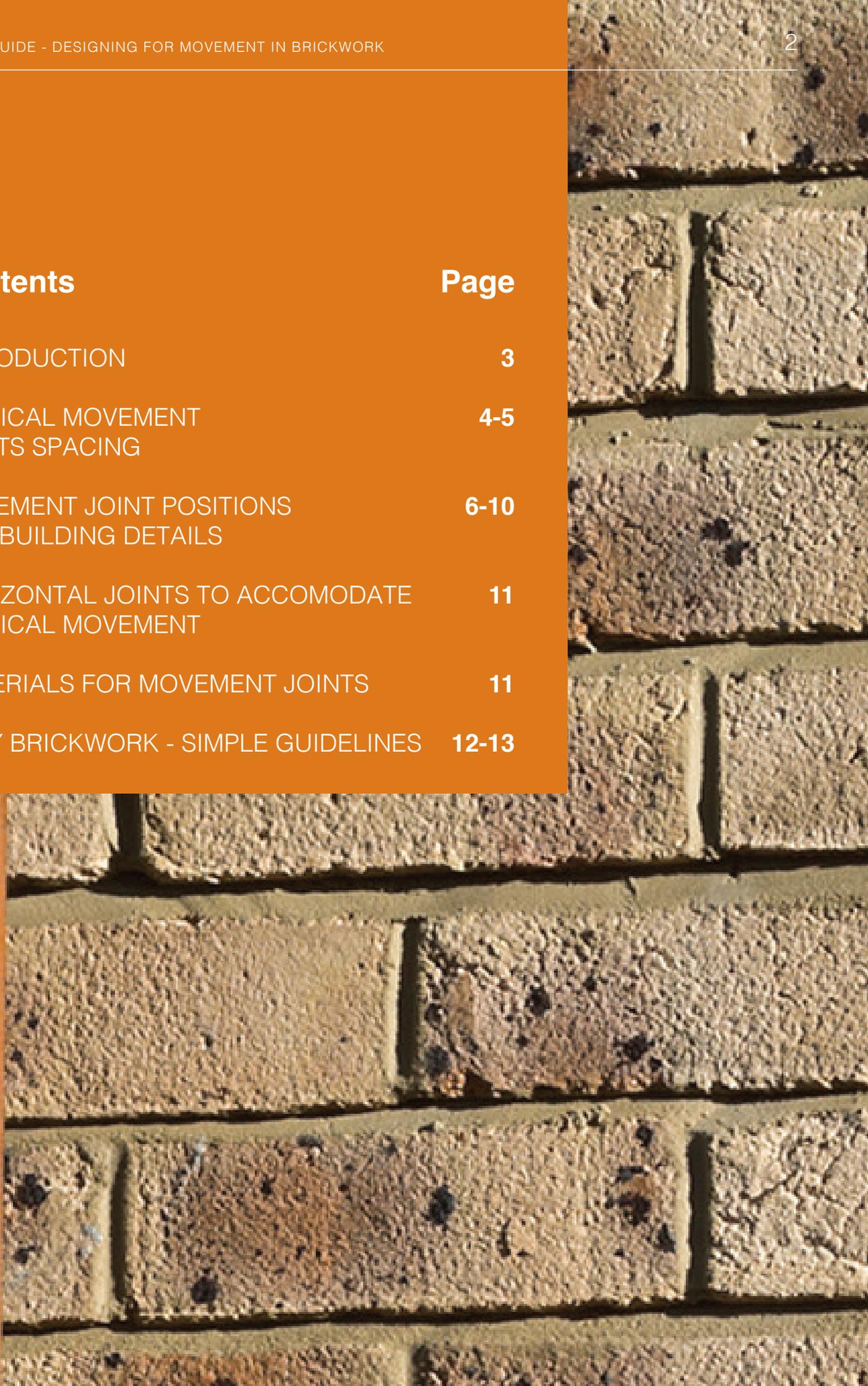


DESIGNING FOR MOVEMENT IN BRICKWORK



Contents	Page
INTRODUCTION	3
VERTICAL MOVEMENT JOINTS SPACING	4-5
MOVEMENT JOINT POSITIONS AND BUILDING DETAILS	6-10
HORIZONTAL JOINTS TO ACCOMODATE VERTICAL MOVEMENT	11
MATERIALS FOR MOVEMENT JOINTS	11
CLAY BRICKWORK - SIMPLE GUIDELINES	12-13



INTRODUCTION

All building materials are subject to movement. This movement is due to a number of reasons including:-

- Thermal expansion / contraction due to temperature changes
- Moisture movement
- Creep and structural loading
- The effects of chemical changes such as sulphate attack

It is the first two of these which are particularly influential on masonry movement. Clay brickwork will generally be subjected to long term expansion while concrete masonry, aggregate blocks, aircrete blocks will be prone to shrinkage.

The expansion and contraction of masonry needs to be accommodated and controlled by the inclusion of both vertical and horizontal joints within the building. If such movement is not allowed for there will be a build-up of internal stresses and a risk of cracking which is unsightly and costly to repair. The frequency, location and the width of the joints should be sufficient to accommodate both reversible and irreversible movements.

This document provides empirical recommendations for the specification and location of movement joints in clay brickwork and it is applicable to the majority of construction situations.

References:-

- PD6697 Recommendations for the design of masonry structures
- EC6 Eurocode 6 Design of Masonry Structures
- BS 8000-3 Workmanship on Building Sites



Jafar Gallery and Jafar Hall, Eton College

VERTICAL MOVEMENT JOINT SPACING

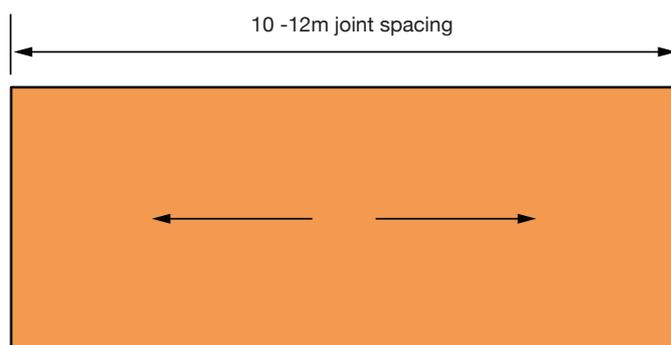
When designing for brickwork movement consideration must be given to the geometry of the building and its orientation. South, South West and South East facing elevations will be susceptible to more movement and an increase in joint frequency should be considered, particularly where darker coloured bricks are being used.

Unrestrained or lightly restrained unreinforced walls expand approximately 1mm/m during the life of a building due to combined thermal and moisture movement changes. Not all clay types expand at the same rate and in some cases an allowance of greater than 1mm/m may be necessary. It is advisable to check this information with the brick manufacturer when specifying movement joints.

As a general guide and to allow for the compressibility of the movement joint filler, the width of the joint in millimetres should be about 30% more than the distance between joints in metres. For example, movement joints at 12m centres should be 16mm wide.

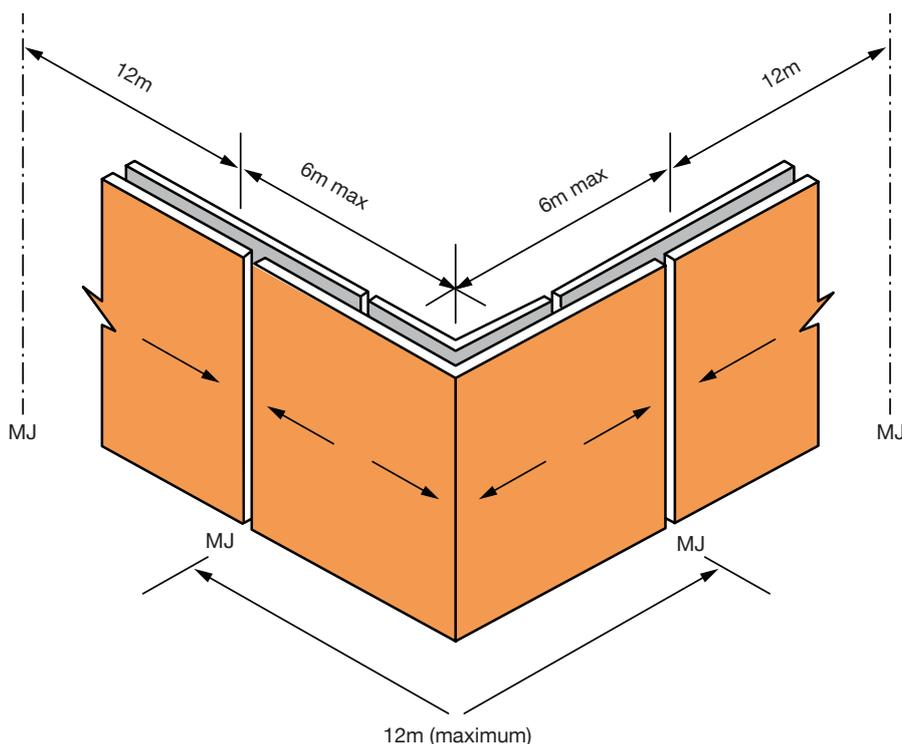
A vertical movement joint should be located at no greater than half the maximum spacing from a corner or return in a wall. Hence for joint spacing of 12m in a straight run of walling, a joint is required to be no more than 6m from the corner.

Fig. 1 Typical vertical movement joint spacing



Joint spacing at external returns should be based on being continuous around the corner.

Fig. 2 Typical vertical movement joint spacing at an external return



VERTICAL MOVEMENT JOINT SPACING

In freestanding walls, parapet walls, unrestrained or lightly restrained brickwork and non load-bearing cladding or spandrel brickwork panels brickwork movement joints should be provided at twice the frequency recommended for full walls as described previously. For these walls the joint spacing should not exceed 6m.

Note:- Some manufacturers recommend reduced joint spacing for copings and cappings.

Fig. 3 Freestanding wall

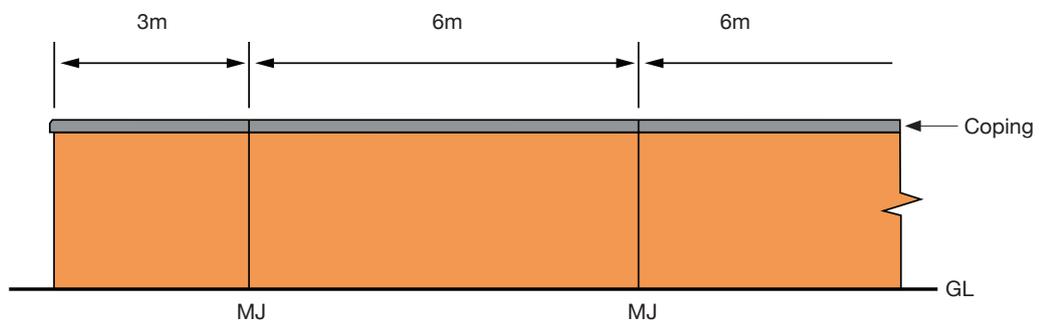
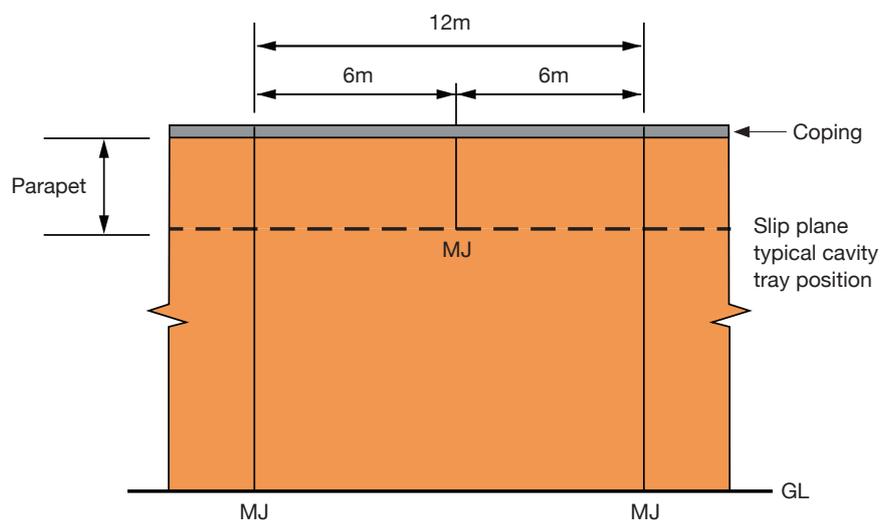


Fig. 4 Parapet wall



MOVEMENT JOINT POSITIONS AND BUILDING DETAILS

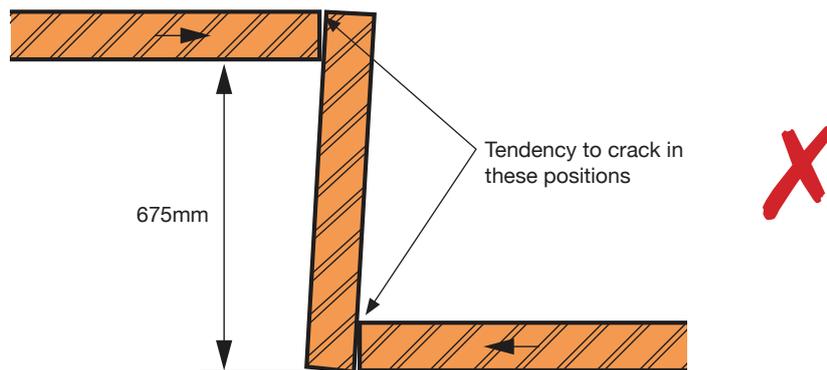
Features of the building which should be considered when determining joint positions in masonry are:-

1. Short returns in clay masonry
2. Changes in height or external materials
3. Window and door openings
4. Location of wall ties with respect to movement joints
5. Bed joint reinforcement

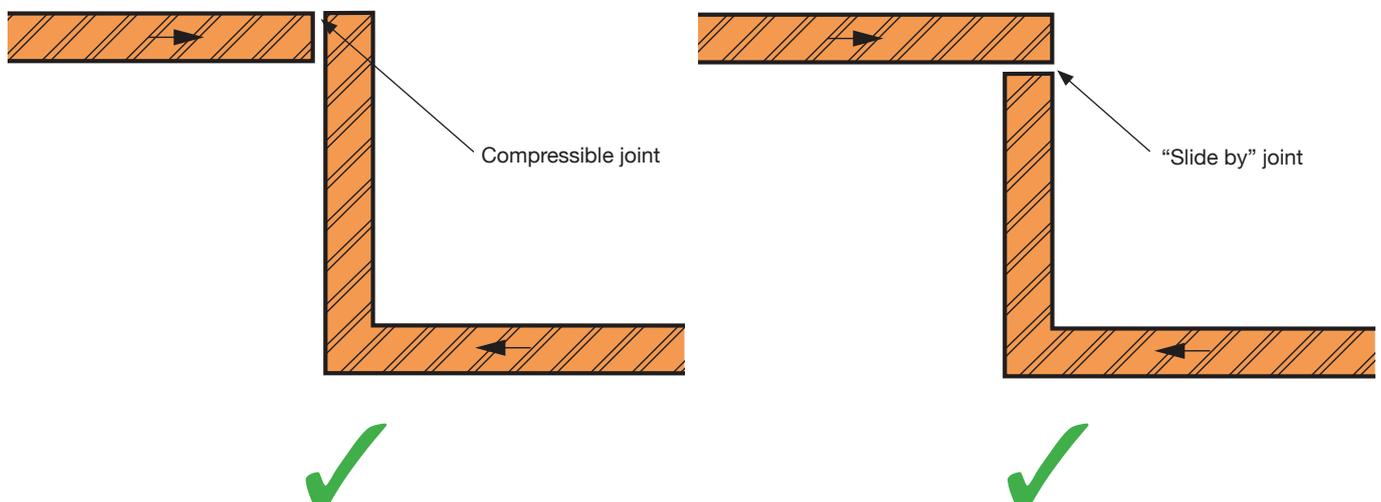
1. Short returns in clay masonry

If a return in the length of brickwork is less than 675mm, movement joints should be included to avoid the risk of cracking. This can be achieved by the introduction of a vertical, compressible joint or a “slide-by” detail (see below).

Fig. 5 Mechanical couple in short return of clay masonry



Figs. 6 and 7 Preferable positions for movement joints



MOVEMENT JOINT POSITIONS AND BUILDING DETAILS

Returns of 1m or more should be flexible enough to allow brickwork to move without cracking. (See below).

Fig. 8 Long return - more than 1m

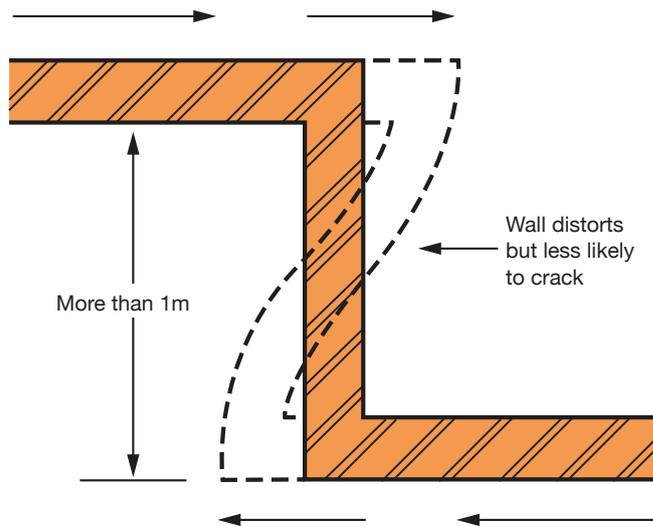
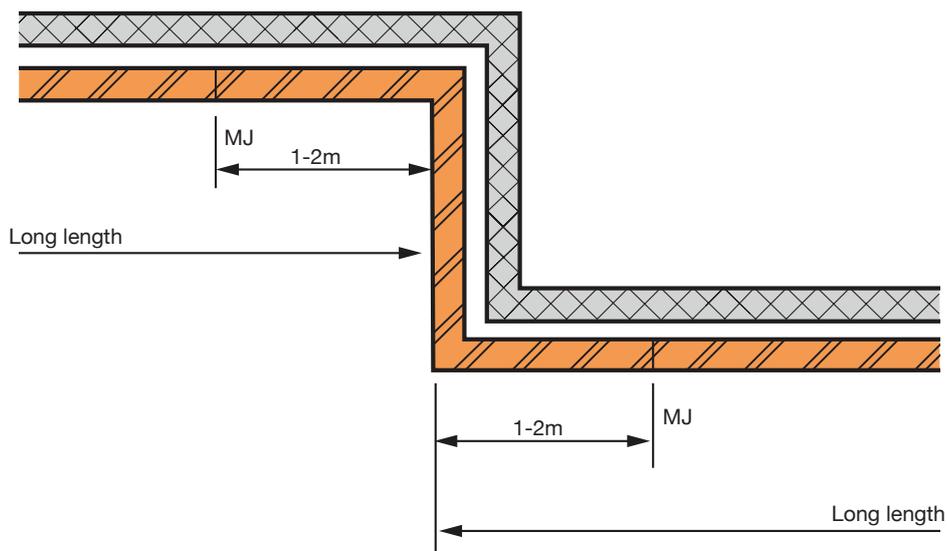


Fig. 9 Alternative arrangement using compression joints at some distance from the corner

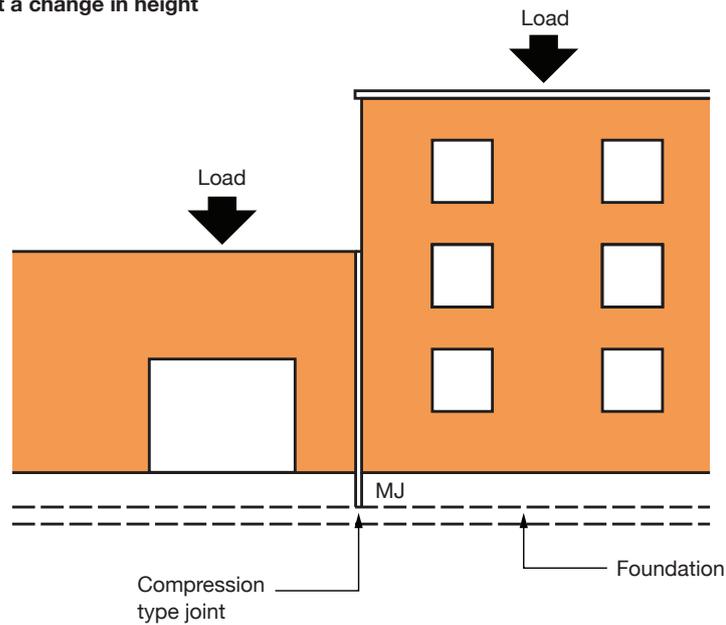


MOVEMENT JOINT POSITIONS AND BUILDING DETAILS

2. Changes in height or external materials

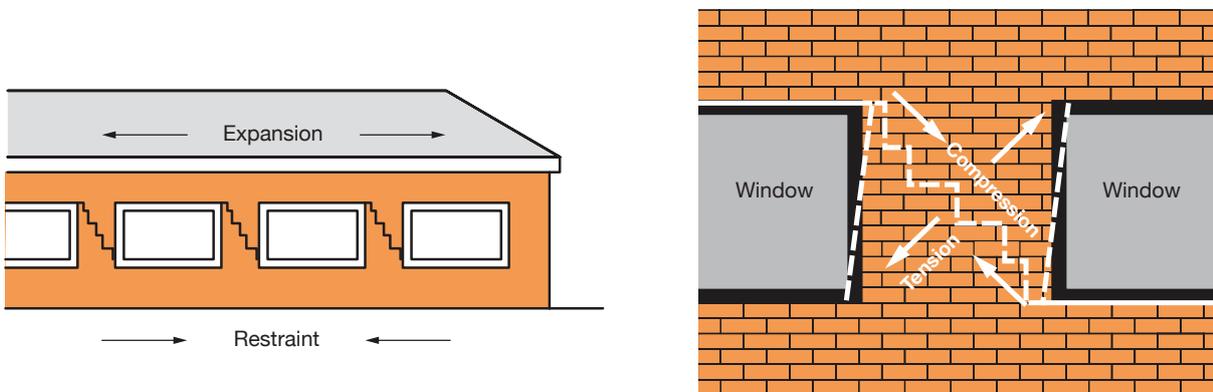
It is advisable to consider locating vertical expansion joints where there is a significant change in height within the building elevation or wherever there is a change in material such as rendered blockwork or stone. This can be achieved by the introduction of a vertical, compressible joint or a “slide-by” detail (see below).

Fig. 10 Movement joint position at a change in height



3. Window and door openings

Fig. 11 Cracking due to differential horizontal movement



MOVEMENT JOINT POSITIONS AND BUILDING DETAILS

4. Location of wall ties adjacent to movement joints

Fig. 12 Typical movement joint

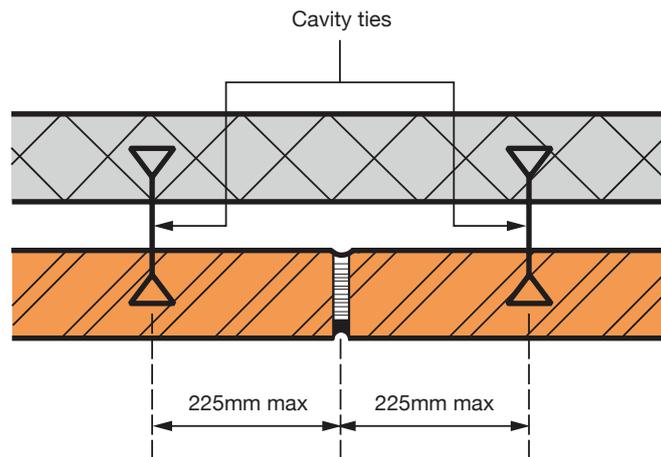
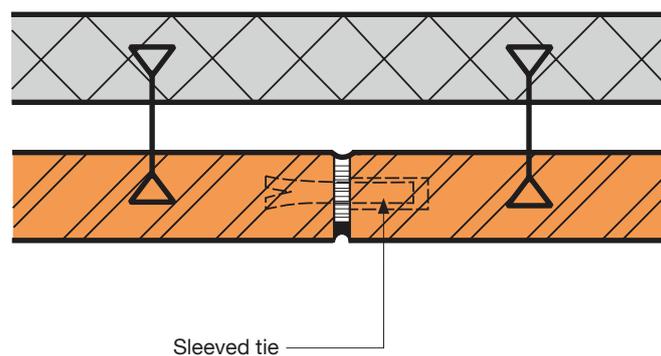


Fig. 13 Movement joint with sleeve debonding tie



MOVEMENT JOINT POSITIONS AND BUILDING DETAILS

5. Bed joint reinforcement

Bed joint reinforcement may be used to extend the centres of vertical movement joints and to minimise the risk of cracking. Areas above doors and above or below windows may benefit from the inclusion of bed joint reinforcement to distribute tensile stresses and avoid localised cracking. Proprietary bed joint reinforcements with parallel bars of at least 3mm diameter can be used to increase joint spacing. Light “chicken wire” meshes can be used for crack control only.

Brickwork, like concrete, is good in compression but poor in tension and the addition of reinforcement to the mortar bed joints will:

- Give more freedom in spacing of movement joints
- Reduce cracking due to the following causes:
 - Movement due to fluctuating temperatures
 - Flexural or tensile stresses resulting from loading
 - Stress concentrations around openings (windows and doors)
 - Differential movement between bonded materials
 - Differential settlement
 - Irregular elevations
 - Changes in wall thickness

Reinforcement is supplied in various widths and shapes to suit the application, but for external walling suitable grades of austenitic stainless steel should always be specified.

Design guides, and technical and structural advice are available from manufacturers and suppliers, together with guidance on correct application and installation of the material.

Fig. 14

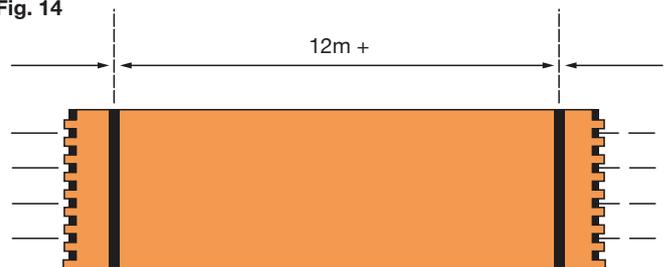


Fig. 15

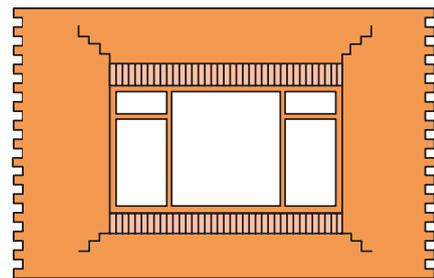


Fig. 16

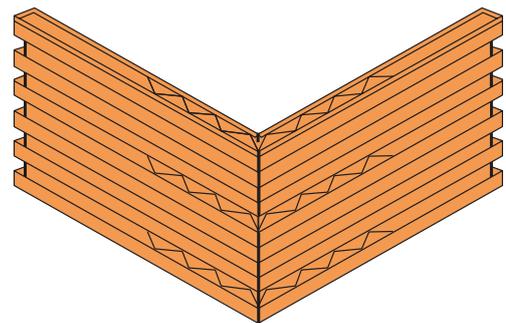


Fig. 17

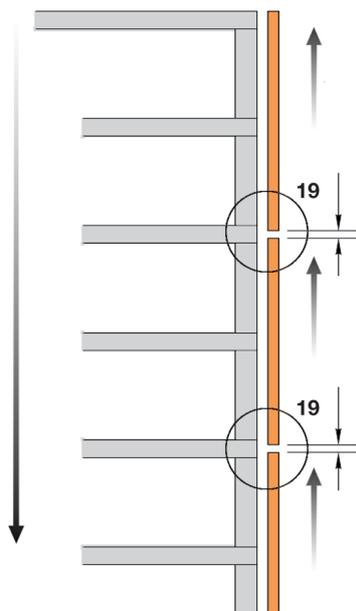


HORIZONTAL JOINTS TO ACCOMMODATE VERTICAL MOVEMENT

Present evidence suggests that vertical movement of unrestrained walls is of the same order as horizontal movement.

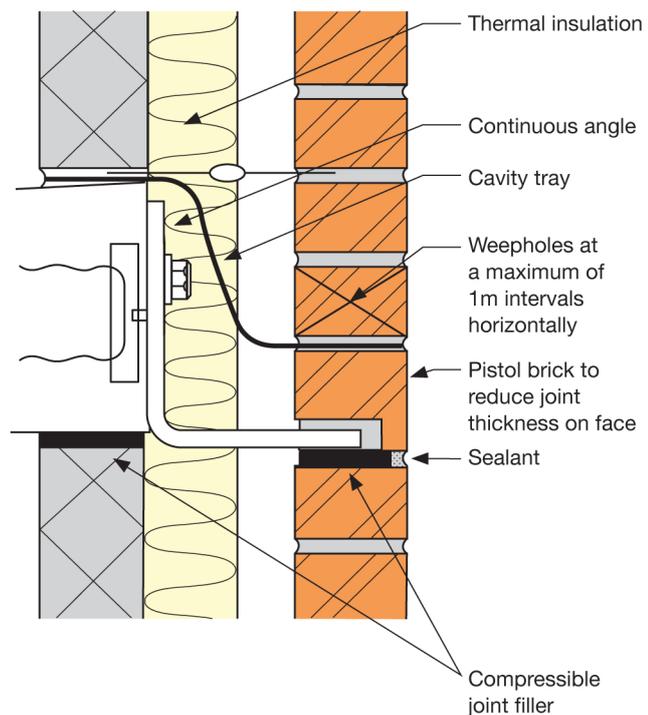
In order to avoid the detrimental effects of differential vertical movement between the inner and outer leaves of a wall a horizontal movement joint should be provided at no more than every third storey or 9m, whichever is the less. For buildings not exceeding 4 storeys or 12m height, whichever is the less, the outer leaf may be uninterrupted for its full height.

Fig. 18



It is common practice to incorporate support at every second storey so providing the opportunity to locate movement joints of reduced thickness.

Fig. 19



An example of a support system showing provision for movement

MATERIALS FOR MOVEMENT JOINTS

The material for filling movement joints to accommodate expansion should be easily compressible to approximately 50% of its original thickness. Flexible cellular polyurethane, cellular polyethylene or foam rubbers are satisfactory materials.

Movement joints should be sealed with a polysulfide or low modulus silicon which has sufficient flexibility to accommodate movement and be resistant to water penetration.

CLAY BRICKWORK - SIMPLE GUIDELINES FOR SPECIFICATION OF MOVEMENT JOINTS

1. In general, experience suggests that movement joints in clay brickwork should be spaced at approximately 10 - 12 metres. PD 6697 states that in no case should joints exceed 15 metres and the spacing of the first joint from an internal or external angle should not exceed half of the general spacing. In long narrow runs of walling or panels, which have certain unrestrained edges, a spacing of half the general recommendations should again be incorporated. Movement joints should be continuous for the full height of brickwork.
2. For unrestrained masonry such as parapets and free standing walls vertical joint spacing should be reduced to 5 - 6m centres. For copings and cappings which may be prone to greater movement further provision of joints should be considered.
3. With respect to horizontal expansion joints for vertical movement the outer leaf should be supported at intervals of not more than every third storey or every 9 metres whichever is less. However, for buildings not exceeding four storeys or 12 metres in height, whichever is less, the outer leaf may be uninterrupted for its full height.
4. Cracking due to movement can often be induced from the corner of openings, i.e. windows and doors, but the prediction of such cracking is extremely difficult with many parameters to consider, including the interaction of various materials such as concrete and brickwork, and the structural behaviour of the building. The use of bed joint reinforcement can provide some control over such cracking.
5. Where the superstructure comprises a reinforced concrete frame, allowance must be made for the full potential differential movement between the frame and the clay masonry. This may necessitate provision of horizontal expansion joints typically at every two storeys. If formed using a pistol brick (see page 11 Fig. 19) the joint must be of sufficient width to allow for full differential movement.
6. Brick cladding to timber framed buildings should be designed to prevent cracking as a result of stresses generated by vertical differential movement between the brickwork and the timber frame. Ref. PD6697 cl. 6.2.6.8.
7. When movement joints are positioned behind rain water pipes (rwp`s) the fixings for the rwp`s must allow for sufficient movement of the brickwork.
8. The location of vertical movement joints should take into consideration:-
 - short returns and changes in direction on plan
 - changes in height on elevation
 - different materials within the external leaf
 - southerly elevations which are more susceptible to temperature changes

9. Wherever movement joints are positioned it is important that the Structural Engineers are aware of their location to ensure that assumptions in brickwork design including the form of panel edge restraint, are fully considered.
10. Joints should be weather sealed on the external face and be filled with an easily compressible material. Materials, which cannot be readily compressed by hand, will not normally allow free masonry movement. PD6697 cl. 6.2.6.3.2 states that “the width of a joint in millimetres should be about 30% more than the distance between joints in metres”.



The Whitworth Gallery



Telephone: 020 7323 7030

Fax: 020 7580 3795

Email: brick@brick.org.uk

www.brick.org.uk

 [twitter: @BricksUK](https://twitter.com/BricksUK)

The Building Centre,

26 Store Street,

London,

WC1E 7BT

Brick Development Association

www.brick.org.uk

