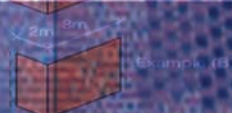
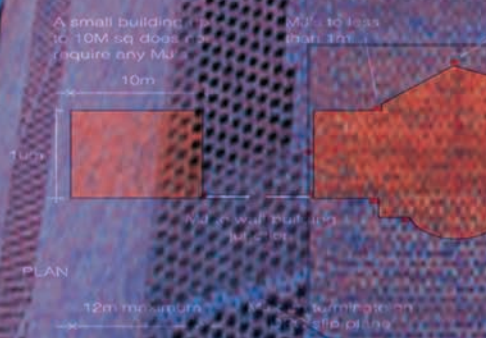


MOVEMENT JOINTS: PROVISION OF BRICKWORK EXPANSION JOINTS



Introduction To Movement Joints

There are two kinds of expansion in brickwork. Reversible Expansion which is the Movement Joint expanding and contracting and Irreversible Expansion, which is permanent. When constructing a building both Reversible and Irreversible movement needs to be accommodated for and controlled by the inclusion of Movement Joints which allow movement in both directions.

This guide is only concerned with clay brickwork and is only relevant for current climatic conditions in the UK. This guide will identify how to avoid stresses in brickwork and relieve potential issues by giving advice on how to correctly position Movement Joints.

As a general guide the width of a Movement Joint should be about 30% more than the value of the distance between joints in metres, and the maximum distance between Movement Joints, in a straight run of brickwork, is 12m. For example;

- Movement Joints at 12m centres should be about 16mm wide.
- Movement Joints at 7m centres should be about 10mm wide.

It should be within the knowledge of most architects and certainly all structural engineers to interpret the design provisions of PD 6697. In particular, they should select suitable positions for Movement Joints. It is one of the benefits of brickwork that there is no area that the designer cannot understand and therefore the designer does not require the advice of an outside expert, although, checking procedure with a second opinion is part of good practise.

Movement Joints if positioned badly on a building, can resemble scars, so there are ways in which you can incorporate the joints at the design stage:

- Hide the joints behind other elements or in corners.
- Joints can be disguised by considering the bonding; for example, designing a straight joint as part of the bond pattern.
- The joints may be emphasised and be part of the rhythm of a building with repeated elements.

It is worth mentioning that the North elevation of a building will have less thermal expansion than the South and West. An experienced practitioner may, after considering the geometry of the North facade, slightly stretch the distances between the Movement Joints and if so the advice given should be strictly observed for the South and West elevations.

If Movement Joints are placed at closer centres or at greater frequency no harm will occur.

Background

Buildings prior to the 1890s were built in Lime Mortar. Lime Mortar permitted the movement in brickwork thus allowing, without the need for Movement Joints, expansion to occur throughout the structure. Buildings were built at a much slower pace and mass masonry meant that load and compression restricted movement. Lambeth Palace is a great example of a heavy lime mortar structure which was slowly built in 1495 and still stands today. The building contains no Movement Joints. Lime mortar is still used today but the introduction of Cement based mortar in 1894 meant that a building became quicker and so inevitably easier to build. We would now not advise the use of Lime mortar without the provision of Movement Joints and if you are thinking along these lines we advise that you contact your Lime mortar manufacture.

Modern buildings tend to have cleaner lines and less overhang, thus, less shadowing which will cause more thermal expansion within the brickwork. It is also worthy to note that the UK is living in a time of potential climate change so the provision of Movement Joints is essential.

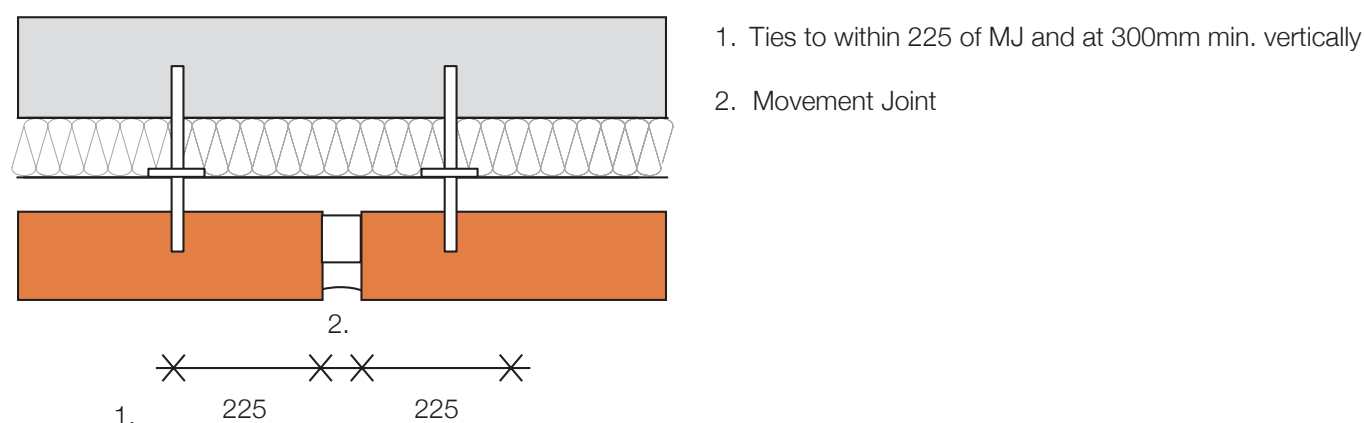


Wall Ties And Flexibility

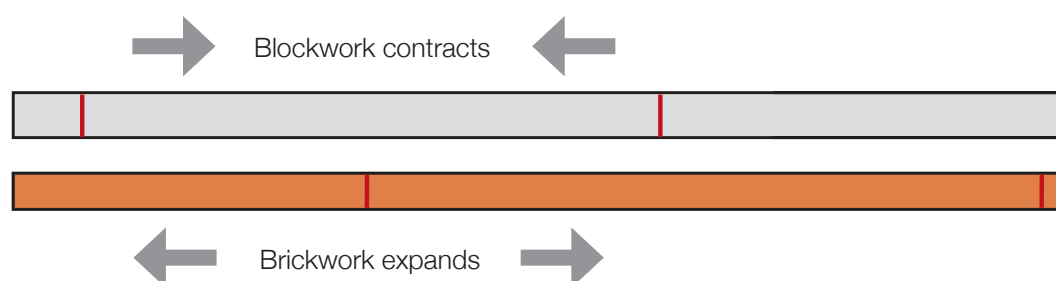
Movement and flexibility is required in all building elements and wall ties are crucial to the stability and safety of cavity walls. Wall Ties provide structural support for a thin weak outer skin. Spaced at regular intervals horizontally and vertically, a wall tie transfers the cavity wall's strength to the outer skin. Thus in effect the outer skin forms part of the overall thickness of the wall.

Wall ties also allow the flexible movement between dissimilar materials and allows for the fluctuations between internal and external temperatures. It is not advisable that wall ties be too stiff and also we would strongly advise that a brick panel should never be set into a rigid frame. This restricts movement.

Wall ties should be installed to the requirements of PD 6697 and should be evenly distributed except around openings, and should be staggered to avoid stress. At the vertical edges of openings and at vertical unreturned or unbounded edges (for example a Movement Joint), additional wall ties should be used at a minimum rate of one tie per 300mm height or equivalent, placed not more than 225mm from the edge.



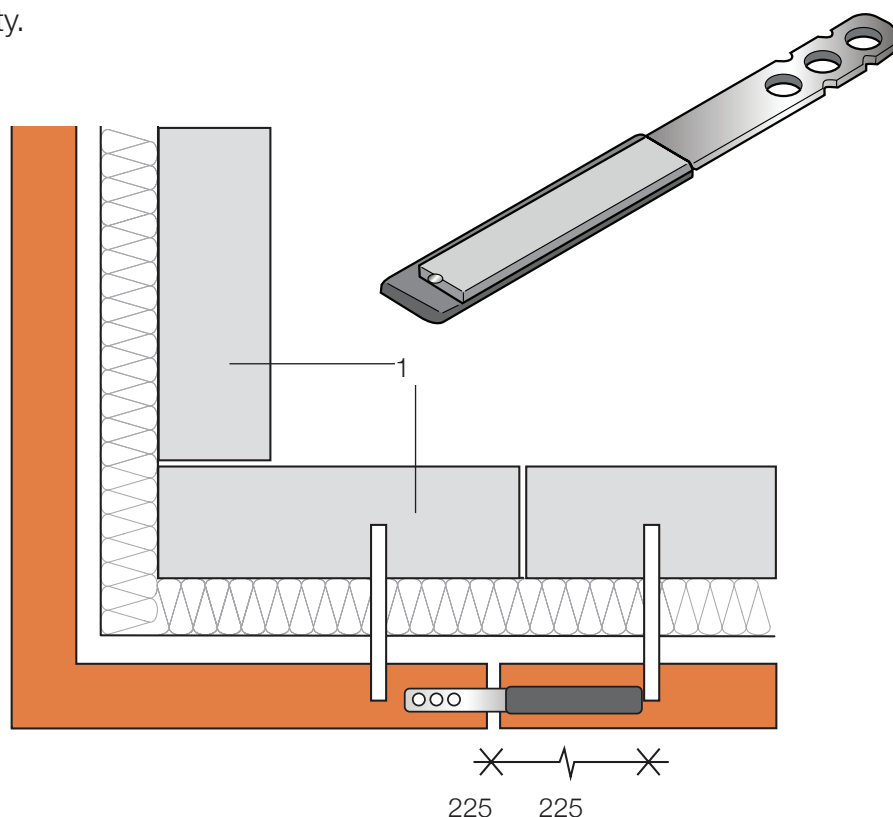
It is essential to use a staggered approach when using wall ties if brickwork is combined with concrete block work. Concrete will contract as it dries where as brickwork expands so to avoid obvious stressing of the wall ties staggering is necessary.



MJ's to brickwork and blockwork should alternate to avoid stressing wall ties

If a brickwork column or chimney is built with an adjoining panel wall, they must be separated by a Movement Joint to allow movement. Different thickness of a wall may move differently and require a joint between the elements.

If a particularly demanding Movement Joint occurs such as a joint being placed close to a building corner, a stronger de-bonded tie is available and can be used to cross the joint, but also provide additional security.



1. Debonded tie can move to accommodate changes in MJ dimensions

Mortar

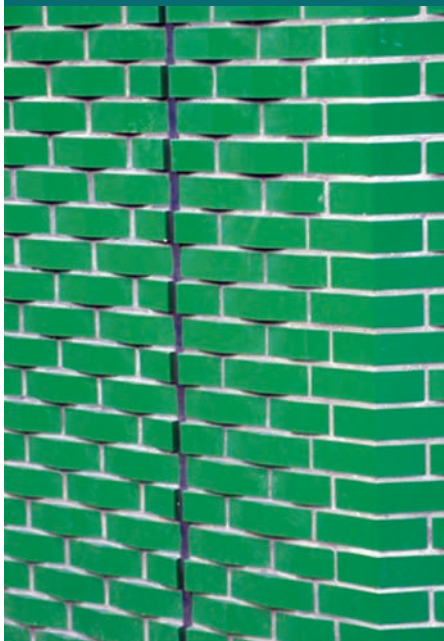
This advice assumes that the normal designation for external walls, an M4 mortar, is being used but if a stronger mortar is used (M6 Mortar), albeit for a parapet or a free standing wall the Movement Joints should be set closer than the recommended centres mentioned in this guide.

If traditional construction is being adopted, with a full brick wall (215mm wide) in conjunction with lime mortar, Movement Joints could be reduced but only with the advice of an expert in mortar who also understands the structure of the building.

Mortar should never be stronger than necessary. A weak mortar will tolerate more movement than a stronger mortar and an over strong mortar has an adverse effect on the provision of Movement Joints, which may have to be at closer centres than advised within this guide.

Successful Joint Design

West Hampstead Railway Station



Sugar Mills, Edinburgh



University of London, Bloomsbury



University of London, Bloomsbury

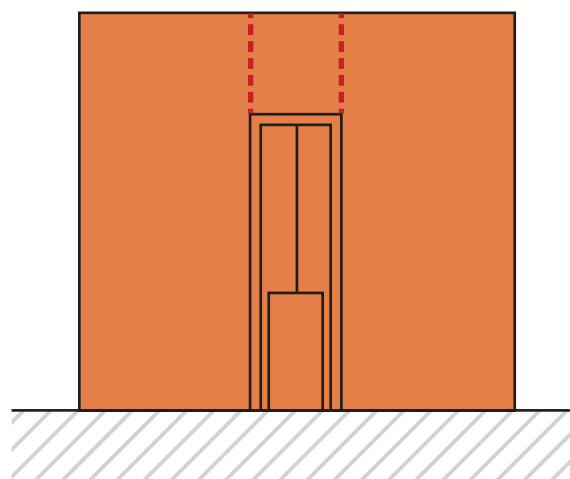


Movement Joint Positioning

The general principles outlined apply to both horizontal and vertical Movement Joints, and in general terms they can be considered broadly similar.

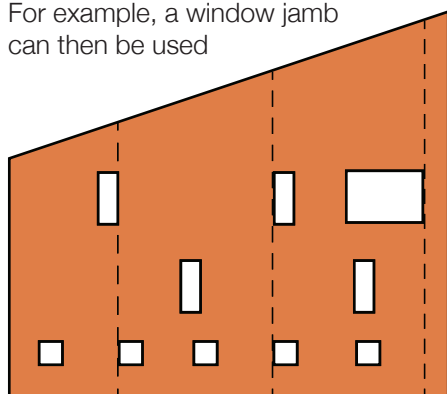
When placing Movement Joints in a building, there are a few rules that must be understood:

- Movement Joints should be considered at the design stage.
- Break the elevation into rectilinear areas. Or in other words lines that can run from the bottom to the top of the building. Irregular or L shaped brickwork is to be avoided.



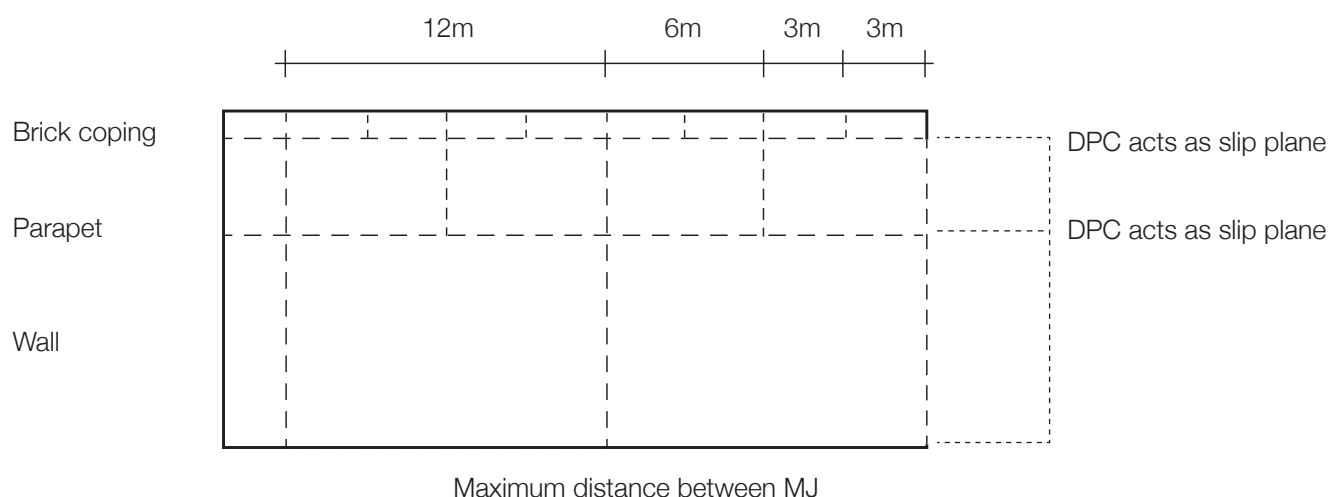
Break elevations into rectilinear areas

MJ's cannot pass through structural members. If shelf angles are used they can be stopped to allow an MJ. For example, a window jamb can then be used

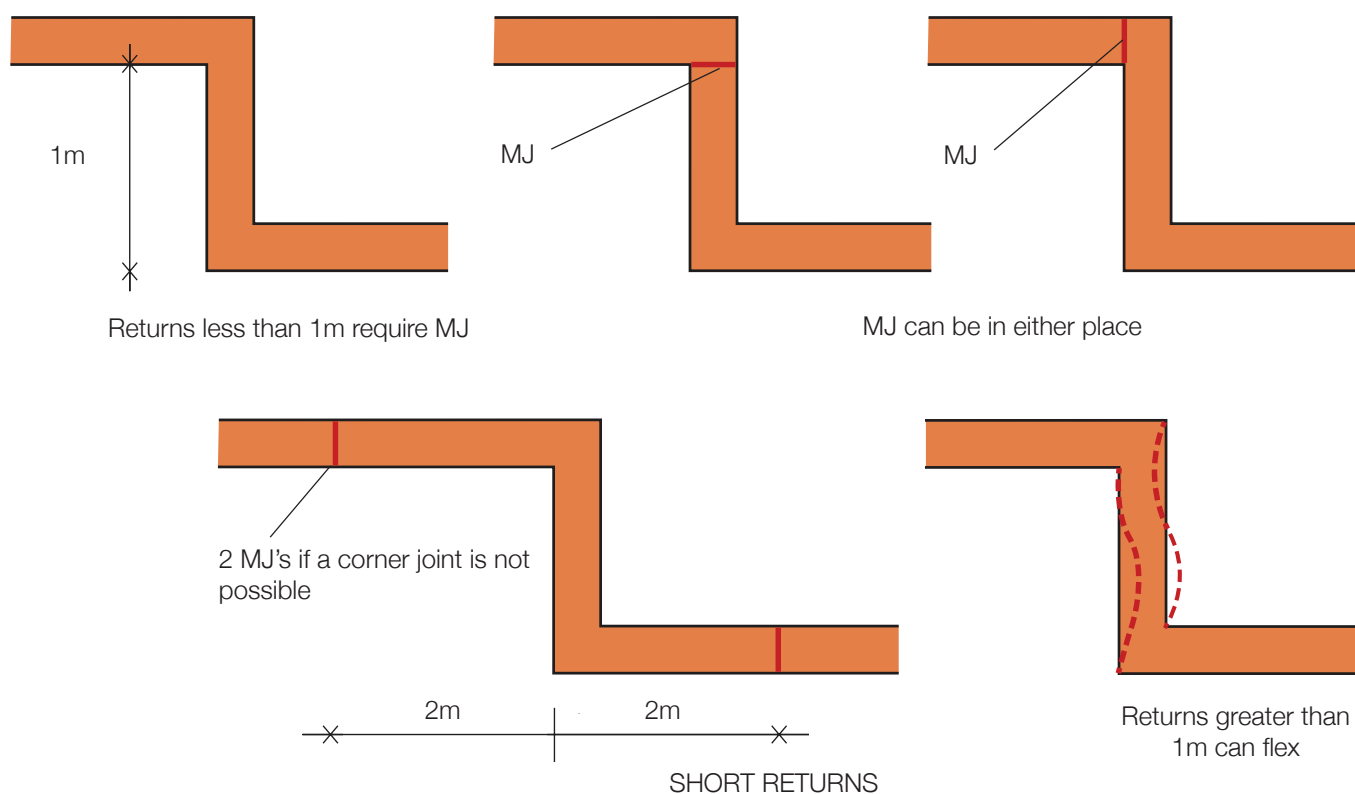


- Open the building plan out and discount corners.
- Place Movement Joints from one area on the wall and follow the building round until it arrives back at the original point.
- Movement Joints can not pass through structural members such as beams and lintels. This is not to say that the joint can not be routed around the end of the lintel.

- Movement Joints must be continuous unless terminating in a slip plane such as a DPC.
- Movement Joints can pass through Shelf Angles only by creating gaps for the movement joint to travel through (about 20mm).
- Maximum distance between Movement Joints in a straight run of brickwork is 12m.
- If there is a DPC at parapet level, Movement Joints can be installed at a maximum of 6m centres. The DPC will act as a slip plane allowing the wall to accommodate two separate areas of movement.
- In the event of a solidier course of bricks, Movement Joints should be placed at 3m centres. Again to allow this a DPC has to be added in order to work as a slip plane.



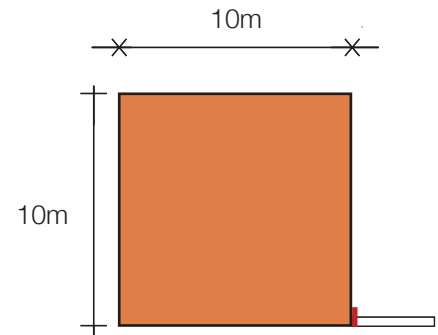
- Movement Joints should be placed under walls which are dissimilar in height as the walls will move differently.
- Movement Joints should be positioned in the return angle of a short return. According to PD 6697 Movement Joints should be placed in any return which is less than 675mm. The Industry advice is that Movement Joints must be placed in short returns of less than 1m. It is in these areas where the differing movement of foundations and cracking to masonry is likely. The provision of Movement Joints in short returns is a very good place to hide Movement Joints. For returns greater than 1m the wall has enough flexibility to allow flexing in the connecting wall.



Movement Joint Exceptions

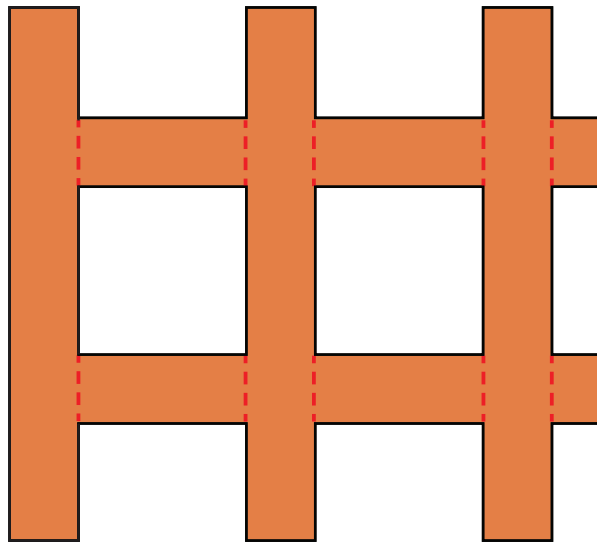
There are some exceptions to the general requirement of always having to provide Movement Joints. Internal walls do not generally require the provision of Movement Joints. Buildings of a square or nearly square nature of less than 10m in either direction or plan form do not generally require the provision of Movement Joints as the forces are opposite and equal.

A small building up to 10m sq does not require any MJ's



Design Advice

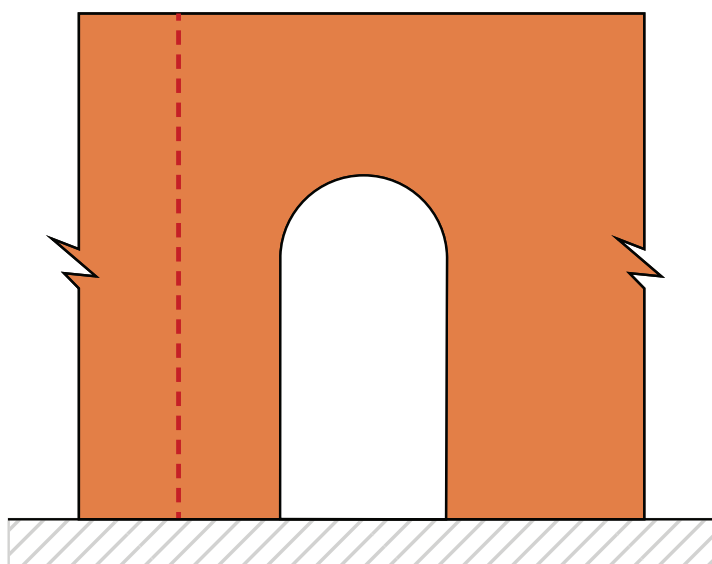
Movement Joints can be hidden behind features, for example, behind rainwater downpipes, or at a junction with other materials such as timber. A typical way of disguising the provision of Movement Joints in larger commercial buildings is to place them in the jamb of the window. The Movement Joint can then carry on down, minimising the visual effect.



The Jambs of windows can be used for expansion, if no oversailing lintel is used

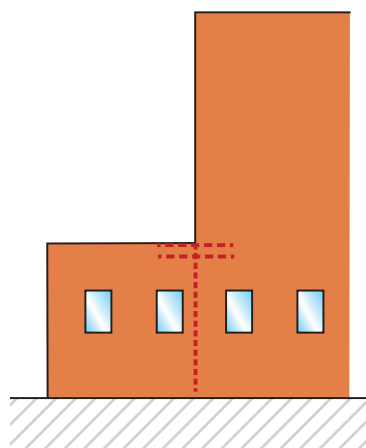
This advice is concerned only with movement provision for brickwork expansion. Additional creep in reinforced concrete, compression or shrinkage in other materials is in addition to this advice. For example, brickwork supported by a long span steel beam may have a horizontal brickwork expansion joint of 10mm for brickwork expansion. The beam has a potential deflection of 15mm from the designed loading. The total Movement Joint will be 25mm. This may well cause visual problems which have to be considered by the designer.

Movement Joints have to be placed to take stress off the facade of the building. If a building has narrow vertical columns joining a junction of horizontal brickwork, Movement Joints have to be considered to reduce considerable stress. Cracking may occur in the corners unless there is a provision for expansion provided. Similarly, if one has a large opening with a smaller opening above, stress imposed on the facade could lead to cracking. The general principle here is to break up the facade into rectilinear lines and not L-shaped areas of masonry, which can lead to problems.



Large openings require MJ's to release pressure

Bed Joint Reinforcement



MJ or BJR to junction

One of the most beneficial effects of Bed Joint Reinforcement is that, if installed at 225mm centres in the bed joint, Movement Joints may be increased to 17m centres from 12m centres. While this is not included in any standard this has been industry advice for over 20 years and has had no apparent failures. Apart from a slight increase in cost reinforcement has no drawbacks in use in masonry and its use is generally recommended to avoid problems which might otherwise occur.

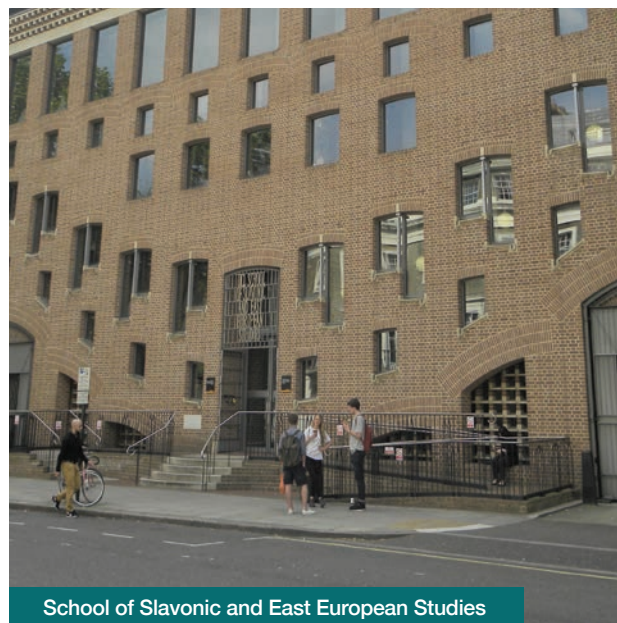
Bed Joint Reinforcement consists of two strips of stainless steel wire joined at intervals by cross wires. It has a similar look to a model railway track. The wire is often oval in shape and compressed down to around 3mm and 60mm wide. Bed Joint Reinforcement is therefore hidden within the depths of the bed joint and should be there for the lifetime of the building. It should not be confused with lightweight mesh which serves no purpose. Bed Joint Reinforcement is not expensive but does add a cost to the wall for both labour and materials. Bed Joint Reinforcement gives a simple masonry wall a tensile strength adding to its compressive characteristics. Movement Joints have to be placed under walls which are dissimilar in height as the walls will move differently. If a Movement Joint is not possible for design reasons, 3 rows of bed joint reinforcement can be installed in the bed joints to give tensile strength to the brick work carrying variable loads. This principle should be generally adopted to also spread point loads.



Ancon: Bed Joint Reinforcement

Bed joint reinforcement is used to build a stack bonded wall which would otherwise be unstable. Normally installed at 225 centres in the bedjoint or every 3rd course in standard brickwork it enables brickwork to achieve unusual designs effectively.

Apart from a slight increase in cost reinforcement has no drawbacks in use in masonry and its use is generally recommended to avoid problems which might otherwise occur.



School of Slavonic and East European Studies



Glyndebourne

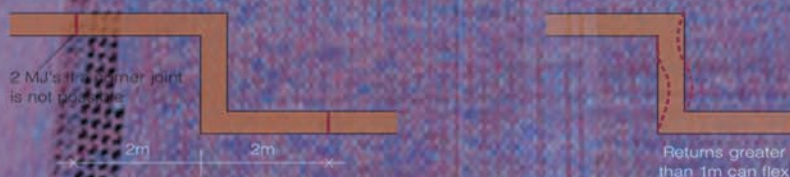
Most designers will have noticed that many buildings break the rules listed above. Ignoring the rules may lead to failure and whilst brickwork is forgiving the advice for Movement Joints provision should generally be followed. The designer is therefore advised to follow the advice contained within PD 6697 or this set of advice which in most if not all circumstances will guarantee there will be no issue with the provision of Movement Joints.

Glyndebourne and School of Slavonic and East European Studies shows heavyweight masonry and lime mortar. Both buildings achieved a masonry elevation with no Movement Joints, this required particular structural engineering expertise.



1m require MJ

MJ can be in either plane



2 MJ's if a corner joint is not possible

Returns greater than 1m can flex

SHORT RETURNS



A small building to 10M sq does not require any MJ's

MJ's to less than 1m

MJ's can be to changes of angle

While MJ's cannot pass through structural members if that structural member can be stopped to allow MJ. The window jamb can then be used



Can be twinned for symmetry

10m max in 10m

PLAN

12m maximum

12m maximum

12m maximum

12m maximum

12m maximum

12m maximum

12m maximum

12m maximum

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12m maximum



1. Shell angle
2. Movement joint
3. Weep hole (2 per tray or every 1m)
4. Cavity tray
5. Floor slab
6. Cavity insulation
7. Blockwork
8. Brick

Vertical movement joint

Supported by



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