ACCOUNTING FOR MOVEMENT IN CONCRETE BRICKS

Introduction
This technical document provides additional guidance relating to how the Functional Requirements in the Technical Manual may be satisfied.

The increasing demand and availability of construction materials has resulted in concrete bricks becoming more popular.

All building materials move in one way or other, either from drying shrinkage, moisture movement (absorption and drying out), thermal effects or structural movement. Concrete bricks are not unique in this respect.

Types of movement
Movement in a structure can arise from the effects of:

- Thermal influences.
- Shrinkage and moisture movement characteristics of the external masonry.
- Changes in the orientation or shape of a building.
- Site practice.
- Type and grade of mortar.
- Incorrect storage and protection of materials.

The tendency for all concrete products is to shrink slightly over time and when drying out, although they may revert back to near their original size when subject to moisture. Like all materials they are also subject to thermal movement. Consequently the location of movement joints is to define the most appropriate position to accommodate this movement whilst considering the aesthetic, practical and structural factors.

Shrinkage
Concrete shrinkage is due primarily to the shrinkage of the hardened cement paste. The type and amount of aggregate can affect the amount of shrinkage in a concrete bricks performance.

Sandstone Aggregate: Typical 1 year shrinkage @ 0.116%
Granite Aggregate: Typical 1 year shrinkage @ 0.047%
Limestone Aggregate: Typical 1 year shrinkage @ 0.032%

With the high differential of movement between the various available raw materials used in concrete brick manufacture it is imperative that the design for movement in a wall panel is specific to the shrinkage capacity of the concrete brick used and the requirements of the manufacture should be followed. In all cases site specific advice should be obtained from the manufacture before work begins.

Materials
Concrete bricks must display a CE/UKCA marking. The use of non CE concrete bricks must be referred back to the technical services team for consideration.

From 1st January 2022 UKCA marking in accordance with UK Construction Product Regulation and design standards will be required.

For 'construction products', CE marked products will be accepted in UK until 30th June 2025. All construction products in circulation in the England, Wales and Scotland markets must change their marking to UKCA mark by 1st July 2025.

Concrete bricks must be adequately cured before delivery to site.

Excess moisture introduced into the brick will result in a higher shrinkage rate. Bricks must be kept dry whilst storing on site and stacking out. Bricks should not be wetted before laying and incomplete brickwork should be protected from the rain and snow as this will minimise the risk of shrinkage and efflorescence leaching from around the mortar joints.

Thermal movement Warranty position
South facing walls, particularly those built of dark coloured bricks, are more susceptible to thermal movement than other elevations. Whereas a simple contraction joint may suffice in more sheltered elevations, joints for southern facing elevations should have movement joints which are capable of responding to both expansion and contraction.

Mortar
The mortar should be suitable for use and the specific strength of the mortar used on site should be accounted for in the design. Stronger mortars have higher shrinkage values and care should be taken to ensure the correct grade of mortar is specified and used. Due to safety factors incorporated by mortar suppliers the onsite mix has the potential to have an increased strength. The mortar manufactures supply documents must verify that the mortar is the required specification and ensure the mortar mix is not a stronger mix due to safety factors.

Dissimilar materials
In certain instances different masonry materials may be combined within the same elevations. In the case of clay bricks, which have expansive properties, and concrete bricks, which may shrink slightly, it is important to make provision for this differential movement.

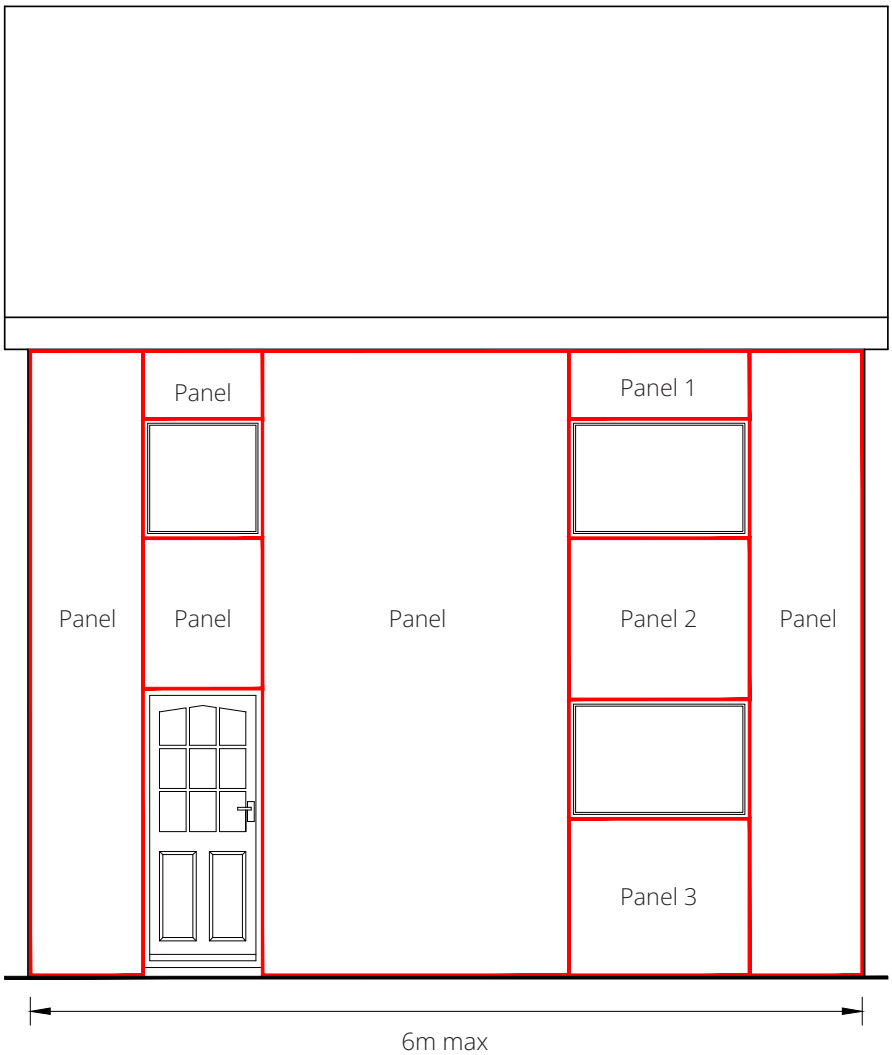
Where for example a clay brick is used up to DPC level and a concrete brick built as the superstructure, then the DPC itself may act as a slip plane and allow the differential movement to

occur. This can be dependent on the dead load on the DPC and a Structural Engineer's advice should be sought. In all cases provision should be made to ensure structural stability.

If two dissimilar materials are mixed on one elevation then slip planes should be introduced or bed joint reinforcement incorporated to dissipate the areas of tensile stress. Again, a Structural Engineer's advice should be sought and provision must be made to ensure that structural stability is not compromised.

Panel ratios

External wall leafs of concrete brickwork should be designed as a series of panels separated by movement joints to control contraction. The degree of movement is dependent upon unit type and, as a rule; vertical joints to accommodate horizontal movement should be provided at intervals of 6m. The ratio of length to height of the panels should generally not exceed 3:1 (BS 5628).



Masonry above and below openings over 1.5m in width will require additional measures

Figure 1: Front elevation of dwelling, divided into panels

Figure 1 above shows the superstructure viewed as a series of panels (the diagram does not demonstrate position of movement joints). For example in elevations where window openings are wide in comparison to their height leaving long low areas of masonry such as figure 1 panel 1, 2 and 3 or where those types of openings are stacked above each other, this may result in the brick panels in between the windows being less than 6m metres but exceeding the 3:1 ratio.

In these instances inclusion of additional vertical movement joints may need to be considered, or alternatively bed joint reinforcement introduced to dissipate the stresses within the panel (figure 2).

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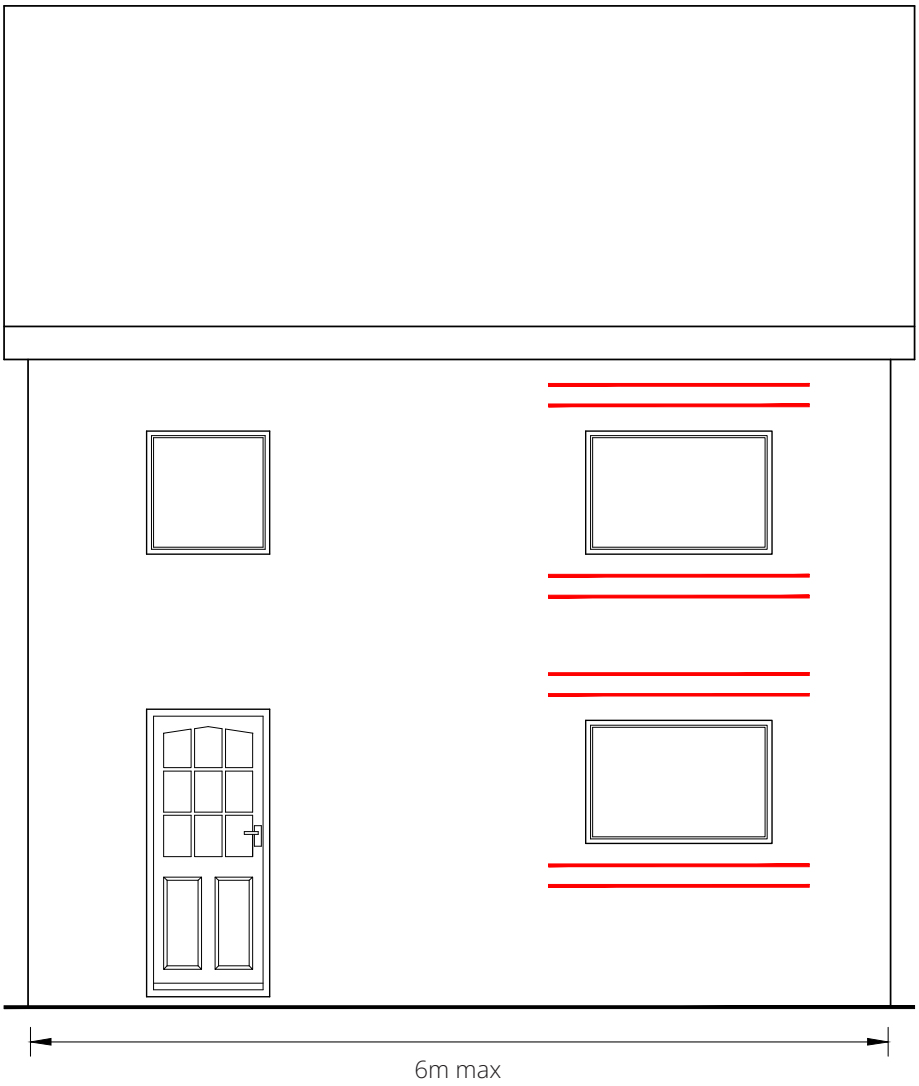

Figure 2: Example of reinforcement above and below openings exceeded 1.5m

Provision of reinforcement around openings

Particular care should be taken with openings greater than 1.5m in width especially where they are placed directly above each other. In this case the panel may not exceed 6m or the 3:1 ratio but can be subject to stresses from the larger areas of brickwork adjacent to the openings. In these cases bed joint reinforcing should be introduced above and below the openings (figure 2). The bed joint reinforcement should generally extend 600mm past the openings and must not extend through any movement joint. Care must be taken to ensure the bed reinforcement is installed in the correct brick courses as per the brick manufactures recommendations. The reinforcement should be of the ladder/lattice type as opposed to the expanded mesh version.

Whilst this bed joint reinforcement will assist in the prevention of potential cracking it is not a complete alternative to movement joints and these should still be provided at the appropriate locations.

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Positioning of movement joints

The position of movement joints should take into account the need to maintain the structural integrity of the wall.

Movement joints should not pass through structural members e.g. lintels. Where possible it is recommended that movement joints should not coincide with door or window openings due to the difficulty in continuing the movement joint between the frames and masonry and around the ends of the lintels (figure 4).

Vertical movement joints should therefore be located in sections of full height masonry between the openings (figure 3).

Vertical movement joints should not pass through bed joint reinforcement and should not be located in close proximity to the openings that may impair the structural integrity of the wall.

Where a full height masonry panel does not exist the location and detailing of the movement joint should be designed by an Engineer to avoid it passing around window and door frames.

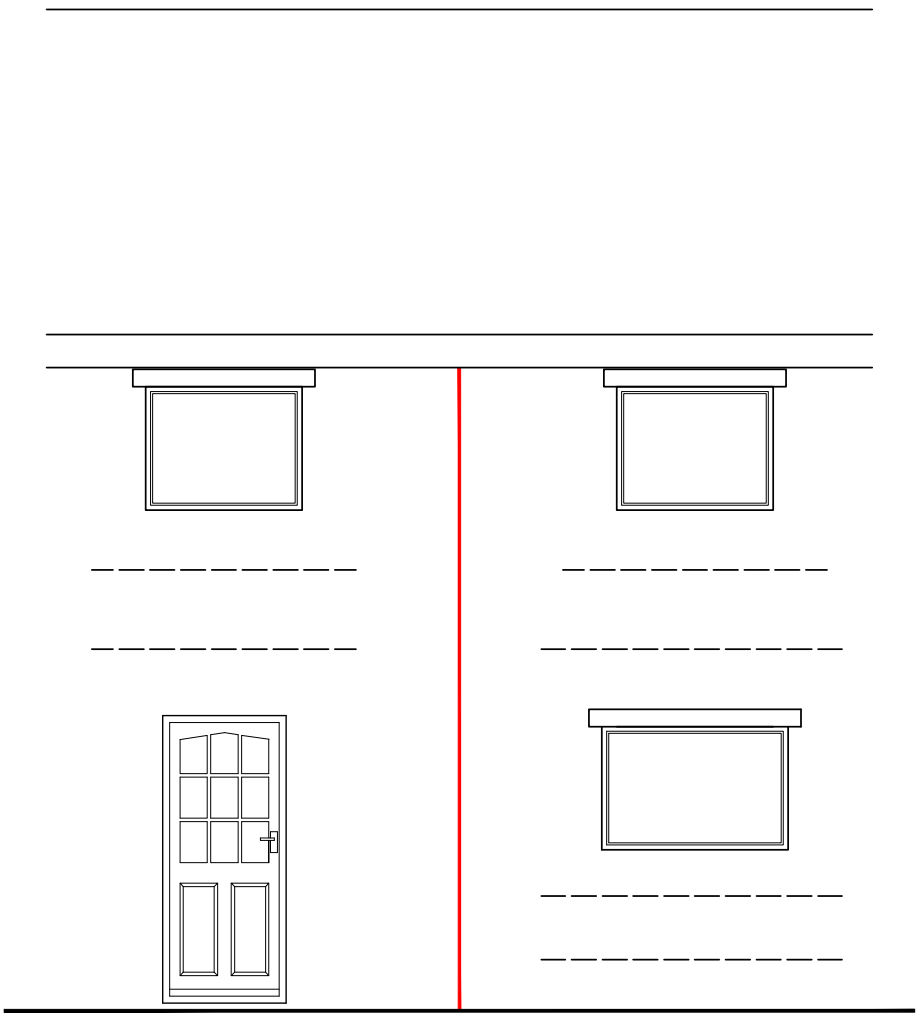

Figure 3: Correct placement of movement joint and reinforcement

Note: The movement joint should be in full height masonry between the window and door openings

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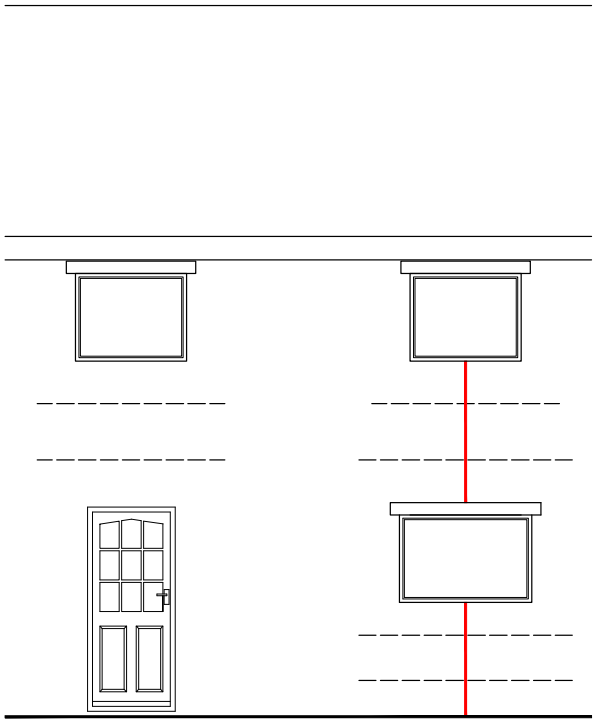
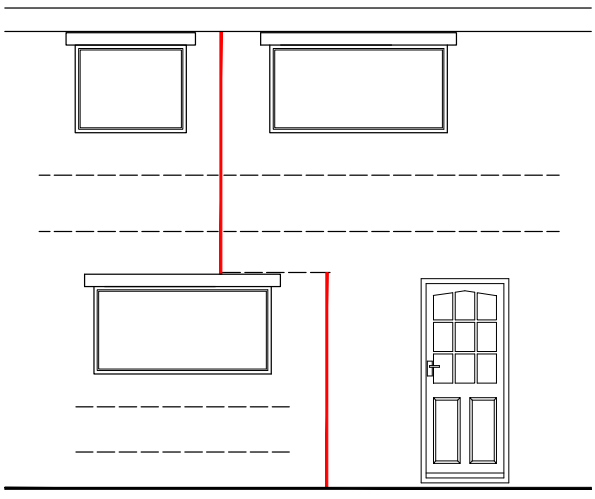


Figure 4: Incorrect positioning of movement joints

Note: It is recommended that Movement joints should not pass through openings due to the difficulty in continuing the joint between the frame and masonry and around the end of lintels



Note: Small piers created by the placement of movement joints should be justified by a Structural Engineer

Figure 5: Avoiding openings

Note: Where there is no full height path within the masonry the movement joint should be Engineer designed to avoid any door or window openings. The design may involve the introduction of a slip plane to link the staggered joint.

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Formation of joints

Contraction joints in external walls should be formed with a compressible material such as a polyurethane foam should be used to form the joint and a sealant to prevent water penetration. The width of these joints should be in accordance with the manufactures recommendations.

Recommendations

- Only concrete bricks displaying a CE/UKCA marking should be used and must be adequately cured before use on site.
- The design for movement should be specific to the shrinkage capacity of the brick used and the requirements of the brick manufacture should be followed. In all cases site specific advice should be obtained from the manufacturer before work begins.
- The bricks must be kept dry whilst storing and stacking out. Bricks should not be wetted before laying and incomplete brickwork should be protected from the rain and snow.
- Ensure that the correct grade of mortar is specified and used.
- Movement joints should be located at 6m centres. The length to height ratio of the panels should not exceed the 3:1 ratio.
- Accommodation for movement should be provided in long/low areas above or below large openings.
- Where possible movement joints should not pass through openings due to the difficulty in continuing the joint between the frame and masonry and around the end of lintels.
- Bed joint reinforcement or additional provision for movement should be used where openings exceed 1.5m.

References

1. Technical Manual Section 6 External Walls.
2. Edenhall Brick technical bulletin 5 movement control.
3. BS 5628 – 3:2001 codes of practice for design of masonry — Part 3: Materials and components, design and workmanship.
4. Aggregated concrete blocks a guide to movement control.
5. National Concrete Masonry Association an information series from the national authority on concrete masonry technology CRACK CONTROL FOR CONCRETE BRICK AND OTHER CONCRETE MASONRY VENEERS.