THE BRICK INDUSTRY ASSOCIATION

TECHNICAL NOTES on Brick Construction

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November 2006

Accommodating Expansion of Brickwork

Abstract: Expansion joints are used in brickwork to accommodate movement and to avoid cracking. This *Technical Note* describes typical movement joints used in building construction and gives guidance regarding their placement. The theory and rationale for the guidelines are presented. Examples are given showing proper placement of expansion joints to avoid cracking of brickwork and methods to improve the aesthetic impact of expansion joints. Also included is information about bond breaks, bond beams and flexible anchorage.

Key Words: differential movement, expansion joints, flexible anchorage, movement, sealants.

SUMMARY OF RECOMMENDATIONS:

Vertical Expansion Joints in Brick Veneer:

- For brickwork without openings, space no more than 25 ft (7.6 m) o.c.
- For brickwork with multiple openings, consider symmetrical placement of expansion joints and reduced spacing of no more than 20 ft (6.1 m) o.c.
- When spacing between vertical expansion joints in parapets is more than 15 ft (4.6 m), make expansion joints wider or place additional expansion joints halfway between full-height expansion joints
- Place as follows:
  - at or near corners
  - at offsets and setbacks
  - at wall intersections
  - at changes in wall height
  - where wall backing system changes
  - where support of brick veneer changes
  - where wall function or climatic exposure changes
- Extend to top of brickwork, including parapets

Horizontal Expansion Joints in Brick Veneer:

- Locate immediately below shelf angles
- Minimum ¼ in. (6.4 mm) space or compressible material recommended below shelf angle
- For brick infill, place between the top of brickwork and structural frame

Brickwork Without Shelf Angles:

- Accommodate brickwork movement by:
  - placing expansion joints around elements that are rigidly attached to the frame and project into the veneer, such as windows and door frames
  - installing metal caps or copings that allow independent vertical movement of wythes
  - installing jamb receptors that allow independent movement between the brick and window frame
  - installing adjustable anchors or ties

Expansion Joint Sealants:

- Comply with ASTM C 920, Grade NS, Use M
- Class 50 minimum extensibility recommended; Class 25 alternate
- Consult sealant manufacturer's literature for guidance regarding use of primer and backing materials

Bond Breaks:

- Use building paper or flashing to separate brickwork from dissimilar materials, foundations and slabs

Loadbearing Masonry:

- Use reinforcement to accommodate stress concentrations, particularly in parapets, at applied loading points and around openings
- Consider effect of vertical expansion joints on brickwork stability

INTRODUCTION

A system of movement joints is necessary to accommodate the changes in volume that all building materials experience. Failure to permit the movements caused by these changes may result in cracks in brickwork, as discussed in *Technical Note* 18. The type, size and placement of movement joints are critical to the proper performance of a building. This *Technical Note* defines the types of movement joints and discusses the proper design of expansion joints within brickwork. Details of expansion joints are provided for loadbearing and nonloadbearing applications. While most examples are for commercial structures, movement joints, although rare, also must be considered for residential structures.

TYPES OF MOVEMENT JOINTS

The primary type of movement joint used in brick construction is the expansion joint. Other types of movement joints in buildings that may be needed include control joints, building expansion joints and construction joints. Each of these is designed to perform a specific task, and they should not be used interchangeably.

An *expansion joint* separates brick masonry into segments to prevent cracking caused by changes in temperature, moisture expansion, elastic deformation, settlement and creep. Expansion joints may be horizontal or vertical. The joints are formed by leaving a continuous unobstructed opening through the brick wythe that may be filled with a highly compressible material. This allows the joints to partially close as the brickwork expands. Expansion joints must be located so that the structural integrity of the brickwork is not compromised.

A *control joint* determines the location of cracks in concrete or concrete masonry construction due to volume changes resulting from shrinkage. It creates a plane of weakness that, in conjunction with reinforcement or joint reinforcement, causes cracks to occur at a predetermined location. A control joint is usually a vertical gap through the concrete or concrete masonry wythe and may be filled with inelastic materials. A control joint will tend to open rather than close. Control joints must be located so that the structural integrity of the concrete or concrete masonry is not affected.

A *building expansion joint* is used to separate a building into discrete sections so that stresses developed in one section will not affect the integrity of the entire structure. The building expansion joint is a through-the-building joint and is typically wider than an expansion or control joint.

A *construction joint (cold joint)* occurs primarily in concrete construction when construction work is interrupted. Construction joints should be located where they will least impair the strength of the structure.

EXPANSION JOINT CONSTRUCTION

Although the primary purpose of expansion joints is to accommodate expansive movement, the joint also must resist water penetration and air infiltration. A premolded foam or neoprene pad that extends through the full wythe thickness aids in keeping mortar or other debris from clogging the joint and increases water penetration resistance. Fiberboard and similar materials are not suitable for this purpose because they are not as compressible.

Mortar, ties or wire reinforcement should not extend into or bridge the expansion joint. If this occurs, movement will be restricted and the expansion joint will not perform as intended. Expansion joints should be formed as the wall is built, as shown in Photo 1. However, vertical expansion joints may be cut into existing brickwork as a remedial action.

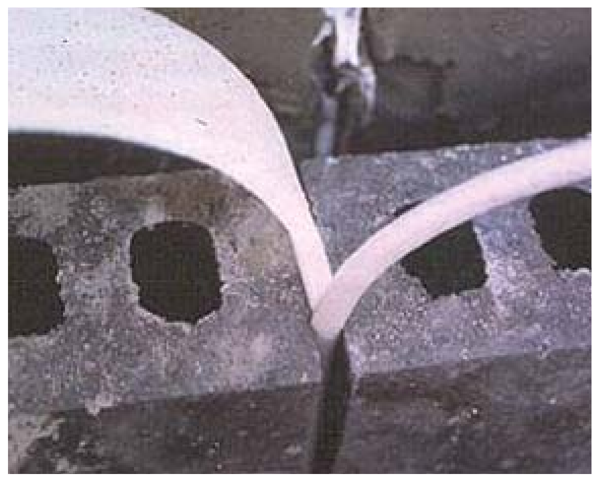


Photo 1
Vertical Expansion Joint Construction

Sealants

Sealants are used on the exterior side of expansion joints to prevent water and air penetration. Many different types of sealants are available, although those that exhibit the highest expansion and compression capabilities are best. Sealants should conform to ASTM C 920, *Standard Specification for Elastomeric Joint Sealants* [Ref. 1], Grade NS, Use M, and be sufficiently compressible, resistant to weathering (ultraviolet light) and bond well to adjacent materials. Sealant manufacturers should be consulted for the applicability of their sealants for expansion joint applications. Compatibility of sealants with adjacent materials such as brick, flashings, metals, etc., also must be taken into consideration. Manufacturers recommend three generic types of elastomeric sealants for use on brickwork: polyurethanes, silicones and polysulfides. Most sealants suitable for use in brickwork expansion joints meet an ASTM C 920 Class 25 or Class 50 rating that requires them to expand and contract by at least 25 percent or 50 percent of the initial joint width, respectively. Sealants meeting Class 50 are recommended to minimize the number of joints. Many sealants require a primer to be applied to the masonry surface to ensure adequate bond.

Use a circular foam backer rod behind sealants to keep the sealant at a constant depth and provide a surface to tool the sealant against. The sealant must not adhere to the backer rod. The depth of the sealant should be approximately one-half the width of the expansion joint, with a minimum sealant depth of $^1/_4$ in. (6.4 mm).

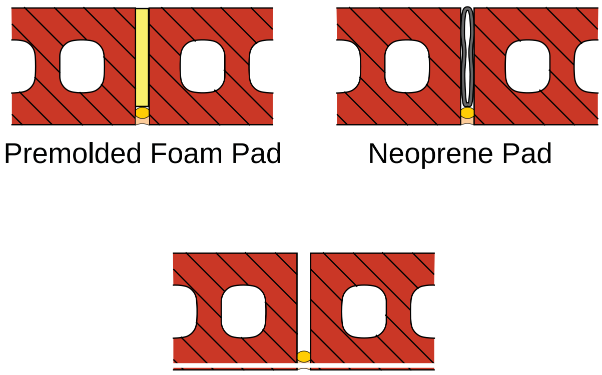


Figure 1

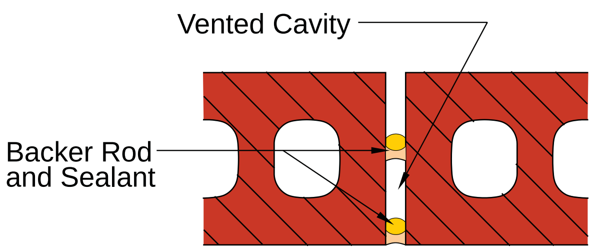


Figure 2

Two-Stage Vertical Expansion Joint

VERTICAL EXPANSION JOINTS

Figure 1 shows typical methods of forming vertical expansion joints with either a premolded foam pad, a neoprene pad or a backer rod.

While generally limited to rain screen walls, a two-stage joint as shown in Figure 2 can increase resistance to water and air infiltration. This type of joint provides a vented or pressure-equalized joint. The space between the sealants must be vented toward the exterior to allow drainage. This is typically achieved by leaving a hole or gap in the exterior sealant joint at the top and bottom of the joint.

Spacing

No single recommendation on the positioning and spacing of expansion joints can be applicable to all structures. Review each structure for the extent of movements expected. Accommodate these movements with a series of expansion joints. Determine the spacing of expansion joints by considering the amount of expected wall movement, the size of the expansion joint and the compressibility of the expansion joint materials. In addition to the amount of anticipated movement, other variables that also may affect the size and spacing of expansion joints include restraint conditions, elastic deformation due to loads, shrinkage and creep of mortar, construction tolerances and wall orientation.

The theory and equation for estimating the anticipated extent of unrestrained brick wythe movement are presented in *Technical Note* 18. Estimated movement is based on the theoretical movement of the brickwork attributed to each property and expressed as coefficients of moisture expansion (k_e), thermal expansion (k_t) and freezing expansion (k_f). As discussed in *Technical Note* 18, for most unrestrained brickwork, the total extent of movement can be estimated as the length of the brickwork multiplied by 0.0009. A derivative of this equation can be written to calculate the theoretical spacing between vertical expansion joints as follows:

$$S_e = \frac{w_j e_j}{0.09} \qquad \text{Eq. 1}$$

where:

S_e = spacing between expansion joints, in. (mm)

w_j = width of expansion joint, typically the mortar joint width, in. (mm)

e_j = percent extensibility of expansion joint material

The expansion joint is typically sized to resemble a mortar joint, usually 3/8 in. (10 mm) to 1/2 in. (13 mm). The width of an expansion joint may be limited by the sealant capabilities. Extensibility of sealants in the 25 percent to 50 percent range is typical for brickwork. Compressibility of filler materials may be up to 75 percent.

Example. Consider a typical brick veneer with a desired expansion joint size of 1/2 in. (13 mm) and a sealant with 50 percent extensibility. Eq. 1 gives the following theoretical expansion joint spacing:

$$S_e = \frac{(0.5\text{ in.})(50)}{0.09}$$

$$= 278\text{ in. or } 23\text{ ft - }2\text{ in. } (7.06\text{ m})$$

Therefore, the maximum theoretical spacing between vertical expansion joints in a straight wall would be 23 ft - 2 in. (7.1 m). This spacing does not take into account window openings, corners or properties of other materials that may require a reduction in expansion joint spacing. In most instances it is desirable to be conservative, but it may be economically desirable to exceed the theoretical maximum spacing as a calculated risk. For example, calculations may result in a theoretical spacing of expansion joints every 23 ft – 2 in. (7.06 m) but the actual expansion joint spacing is set at 24 ft (7.3 m) to match the structural column spacing or a specific modular dimension. Vertical expansion joint spacing should not exceed 25 ft (7.6 m) in brickwork without openings.

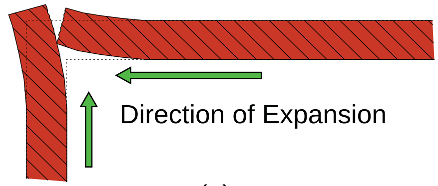
Placement

The actual location of vertical expansion joints in a structure is dependent upon the configuration of the structure as well as the expected amount of movement. In addition to placing an adequate number of expansion joints within long walls, consider placing expansion joints at corners, offsets, openings, wall intersections, changes in wall heights and parapets.

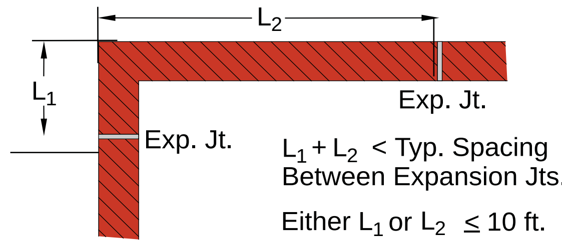
Corners. Walls that intersect will expand toward their juncture, typically causing distress on one or both sides of a corner, as shown in Figure 3a. Place expansion joints near corners to alleviate this stress. The best location is at the first head joint on either side of the corner; however, this may not be aesthetically pleasing. Masons can typically reach about 2 ft (600 mm) around the corner from the face where they are working. An expansion joint should be placed within approximately 10 ft (3 m) of the corner in either wall, but not necessarily both. The sum of the distance from a corner to the adjacent vertical expansion joints should not exceed the spacing of expansion joints in a straight wall, as shown in Figure 3b. For example, if the spacing between vertical expansion joints on a straight wall is 25 ft (7.6 m), then the spacing of expansion joints around a corner could be 10 ft (3.0 m) on one side of the corner and 15 ft (4.6 m) on the other side.

Offsets and Setbacks. Parallel walls will expand toward an offset, rotating the shorter masonry leg, or causing cracks within the offset, as shown in Figure 4a. Place expansion joints at the offset to allow the parallel walls to expand, as Figure 4b illustrates. Expansion joints placed at inside corners are less visible.

Openings. When the spacing between expansion joints is too large, cracks may develop at window and door openings. In structures containing punched windows and door openings, more movement occurs in the brickwork above and below the openings than in the brickwork between the openings. Less movement occurs along the line of openings since there is less masonry. This differential movement may cause cracks that emanate from the corners of the opening, as in Figure 5. This pattern of cracking does not exist in structures with continuous ribbon windows.

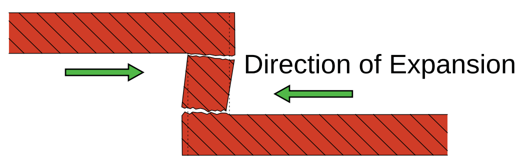


(a)
Movement at Corner Without Expansion Joints

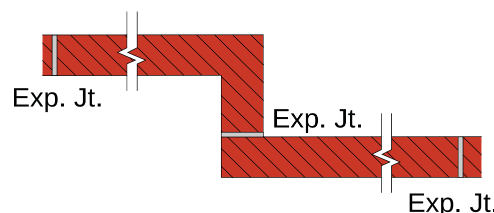


(b)
Proper Expansion Joint Locations at Corner

Figure 3
Vertical Expansion Joints at Corners



(a)
Movement at Offset Without Expansion Joints



(b)
Proper Expansion Joint Locations at Offset

Figure 4
Vertical Expansion Joints at Offsets

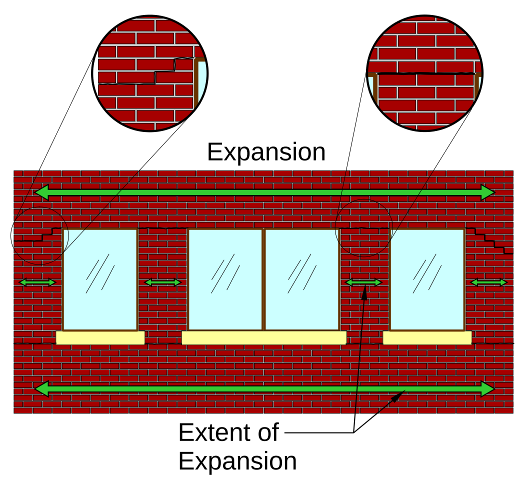


Figure 5
Cracking in Structure with "Punched" Windows, Without Proper Expansion Joints

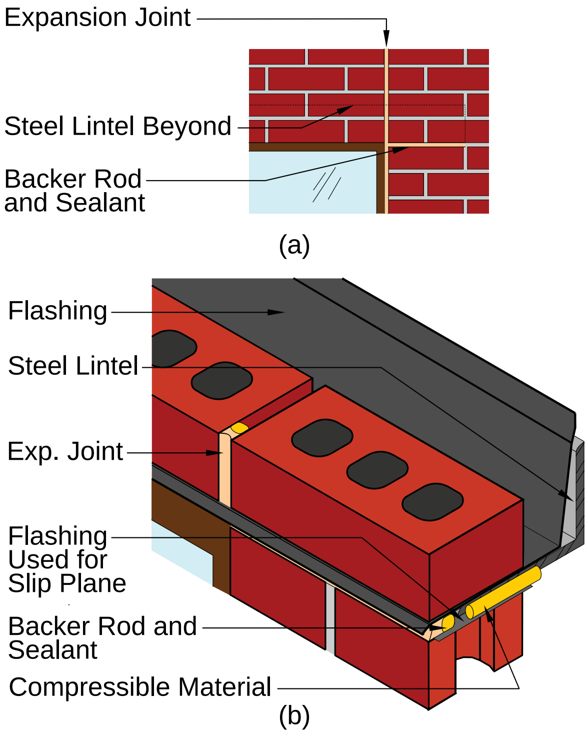


Figure 6
Expansion Joint at Loose Lintel

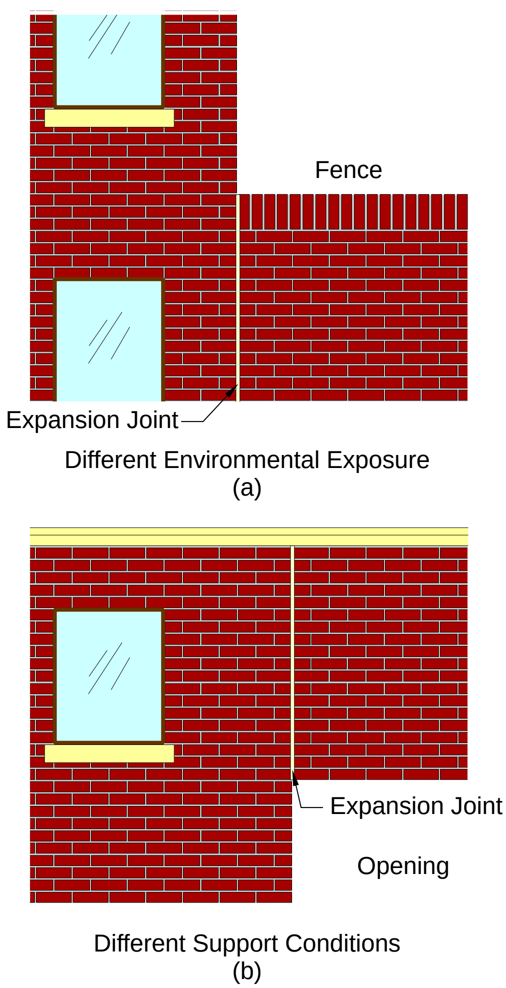


Figure 7
Expansion Joints at Junctions

Window and door openings weaken the wall and act as "natural" expansion joints. One alternative is to place expansion joints halfway between the windows. This requires a sufficiently wide section of masonry between the openings, typically 4 ft (1.2 m). It is often desirable to locate vertical expansion joints along the edge or jamb of the opening. In cases where the masonry above an opening is supported by shelf angles attached to the structure, a vertical expansion joint can be placed alongside the opening, continuing through the horizontal support.

If a vertical expansion joint runs alongside an opening spanned by a loose lintel as shown in Figure 6a, the loose steel lintel must be allowed to expand independently of the masonry. A slip plane should be formed by placing flashing above and below the angle. Mortar placed in front of the lintel is subject to cracking; thus, a backer rod and sealant should be used, as shown in Figure 6b. Because steel expands more than masonry, a $1/8$ to $1/4$ in. (3.2 to 6.4 mm) space should be left at each end of the lintel. These measures form a pocket that allows movement of the steel angle within the brickwork. Locating the expansion joint adjacent to the window will influence the dead weight of the masonry bearing on the lintel. Instead of the usual triangular loading, the full weight of the masonry above the angle should be assumed to bear on the lintel. See *Technical Note* 31B for more information about steel lintel design. If a vertical expansion joint cannot be built in this manner, do not place it alongside the opening.

Junctions. Expansion joints should be located at junctions of walls with different environmental exposures or support conditions. Separate portions of brickwork exposed to different climatic conditions should be separated with expansion joints since each area will move differently. An exterior wall containing brickwork that extends through glazing into a building's interior should have an expansion joint separating the exterior brickwork from the interior brickwork. You may need to use expansion joints to separate adjacent walls of different heights to avoid cracking caused by differential movement, particularly when the height difference is very large. Examples are shown in Figure 7.

Parapets. Parapets with masonry exposed on the back side are exposed on three sides to extremes of moisture and temperature and may experience substantially different movement from that of the wall below. Parapets also lack the dead load of masonry above to help resist movement. Therefore, extend all vertical expansion joints through parapets. Since parapets are subject to more movement than the wall below, they must be treated differently. When vertical expansion joints are spaced more than 15 ft (4.6 m) apart, the placement and design of expansion joints through parapets need to accommodate this additional movement. In this situation, make expansion joints in the parapet wider or add expansion joints placed halfway between those running full height. These additional expansion joints must continue down to a horizontal expansion joint. As a third alternative, install joint reinforcement at 8 in. (203 mm) on center vertically in the parapet.

Aesthetic Effects

Photo 2
Accentuated Expansion Joint

Although expansion joints are usually noticeable on flat walls of masonry buildings, there are ways to reduce their visual impact. Architectural features such as quoins, recessed panels of brickwork or a change in bond pattern reduce the visual impact of vertical expansion joints. In some cases, it may be desirable to accentuate the location of the expansion joint as a design detail. This is possible by recessing the brickwork at the expansion joint, or by using special-shaped brick units as shown in Photo 2.

Colored sealants that match the brick in running bond, or the mortar in stack bond, help to hide vertical expansion joints. Mason's sand also can be rubbed into new sealant to remove the sheen, making the joint blend in more. Expansion joints also are less noticeable when located at inside corners. Hiding expansion joints behind downspouts or other building elements can inhibit maintenance access and is not advised. Toothing of expansion joints to follow the masonry bond pattern is not recommended. It is more difficult to keep debris out of the joint during construction; such debris could interfere with movement. Further, most sealants do not perform well when subjected to both shear and tension.

Symmetrical placement of expansion joints on the elevation of buildings is usually most aesthetically pleasing. Further, placing the expansion joints in a pattern such that wall areas and openings are symmetrical between expansion joints will reduce the likelihood of cracking.

Other Considerations

Location of vertical expansion joints will be influenced by additional factors. Spandrel sections of brickwork supported by a beam or floor may crack because of deflection of the support. Reduced spacing of expansion joints will permit deflection to occur without cracking the brickwork.

Building Code Requirements for Masonry Structures (ACI 530/ASCE 5/TMS 402) [Ref. 4] and most building codes allow anchored masonry veneer with an installed weight not exceeding 40 lb/ft^2 (1,915 Pa) and a maximum height of 12 ft (3.66 m) to be supported on wood construction, provided that a vertical expansion joint is used to isolate the veneer supported by wood from the veneer supported by the foundation.

HORIZONTAL EXPANSION JOINTS

Horizontal expansion joints are typically needed if the brick wythe is supported on a shelf angle attached to the frame or used as infill within the frame. Placing horizontal expansion joints below shelf angles provides space for vertical expansion of the brickwork below and deformation of the shelf angle and the structure to which it is attached. Structures that support the brick wythe on shelf angles, usually done for each floor, must have horizontal expansion joints under each shelf angle. Figure 8 shows a typical detail of a horizontal expansion joint beneath a shelf angle. If the shelf angle is not attached to the structure when the brick below it are laid, any temporary shims that support the angle must be removed after the shelf angle is connected. The joint is formed by a clear space or highly compressible material placed beneath the angle, and a backer rod and

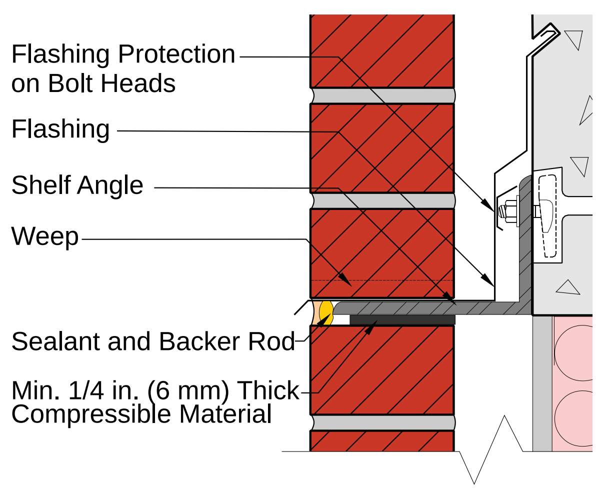


Figure 8
Expansion Joint at Shelf Angle

sealant at the toe of the angle to seal the joint. It is not necessary to interrupt shelf angles at vertical expansion joint locations. However, shelf angles must be discontinuous to provide for their own thermal expansion. A space of ¼ in. in 20 ft (6 mm in 6 m) of shelf angle length is typically sufficient. Bolt heads anchoring a shelf angle to the structure should be covered to decrease the possibility of flashing puncture.

The size of the horizontal expansion joint should take into account movements of the brickwork and movements of the frame. Frame movements include both material and load-induced movements, such as deflections of the shelf angle, rotation of the horizontal leg of the shelf angle, and movement of the support from deflection, temperature change, shrinkage, creep or other factors.

When a large horizontal expansion joint is necessary, a lipped brick course may be used to allow movement while minimizing the aesthetic impact of the joint. To avoid problems with breakage, the height and depth of the lipped portion of the brick should be at least ½ in. (13 mm). Lipped brick should be made by the brick manufacturer for quality assurance purposes.

Construction using lipped brick requires careful consideration of the frame movements noted previously. Allowance for adjacent material tolerances including the building frame should also be considered. Adequate space should be provided between the lipped portion of the brick and the shelf angle to ensure no contact. Contact should not occur between the lipped brick and the brickwork below the shelf angle or between the lip of the brick and the shelf angle, not only during construction, but also throughout the life of the building.

Lipped brick may be installed as the first course above a shelf angle, as shown in Figure 9a. Flashing should be placed between the shelf angle and the lipped brick course. Proper installation of flashing is made more difficult because the flashing must conform to the shape of the lip. This shape may be achieved with stiffer flashing materials such as sheet metal. If the specified flashing materials are made of composite, plastic or rubber, a sheet metal drip edge should be used. The practice of placing flashing one course above the shelf angle is not recommended, as this can increase the potential for movement and moisture entry.

Lipped brick also may be inverted and placed on the last course of brickwork below a shelf angle, as shown in Figure 9b. While installing an inverted lipped brick course allows the flashing of the brickwork above to maintain a straight profile through the brickwork, it also allows the lipped brick course to move independent of the shelf angle. Thus, there is an increased possibility of the shelf angle coming in contact with the lipped brick course, resulting in cracking at the lip. It is difficult, if not impossible, to install compressible material below the shelf angle. Further, it is likely that temporary shims may be left in place between the lipped brick and the shelf angle.

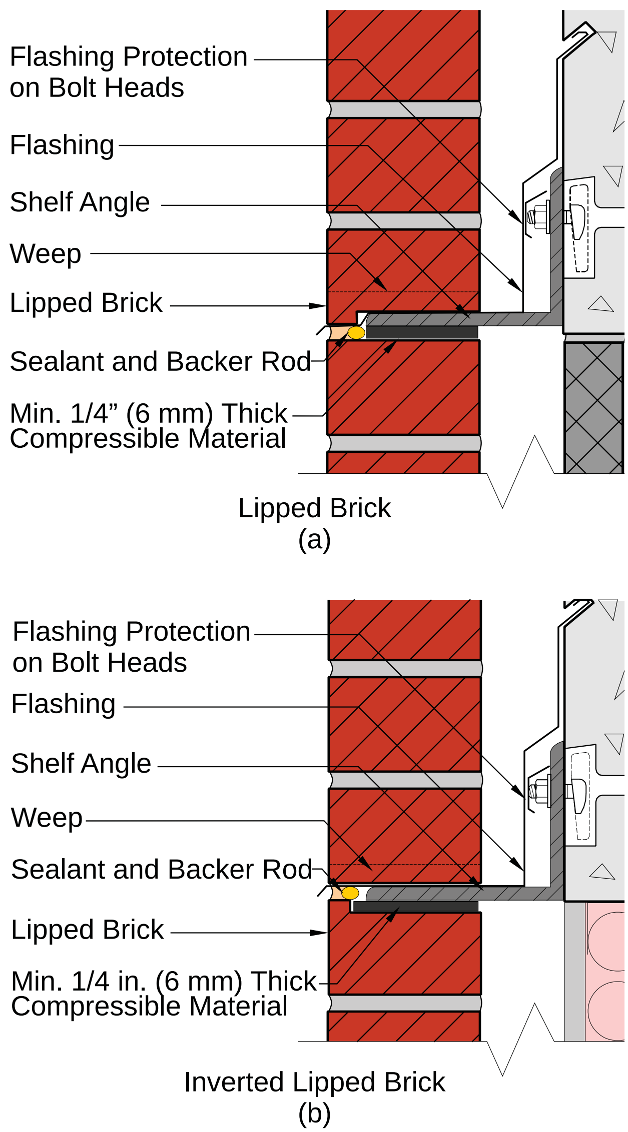


Figure 9
Alternate Expansion Joint Detail

Horizontal expansion joints are also recommended when brick is used as an infill material within the frame of the structure. Expansion joints must be provided between the top course of brickwork and the member above. Deflections of the frame should be considered when sizing the expansion joint to avoid inadvertently loading the brickwork.

STRUCTURES WITHOUT SHELF ANGLES

Some buildings with brick veneer construction do not support the brickwork on shelf angles. These typically include low-rise buildings constructed with wood and steel stud framing and buildings with shear walls. *Building Code Requirements for Masonry Structures* limits brick veneer with wood or steel stud backing to a height of 30 ft (9 m) to the top plate and 38 ft (12 m) to the top of a gable. Brick veneer with a rigid backing of concrete or concrete masonry has no such limitation in the code. Brick veneer with this rigid backing may be supported by the foundation without intermediate shelf angles to a recommended maximum height of about 50 ft (15 m), provided the building is

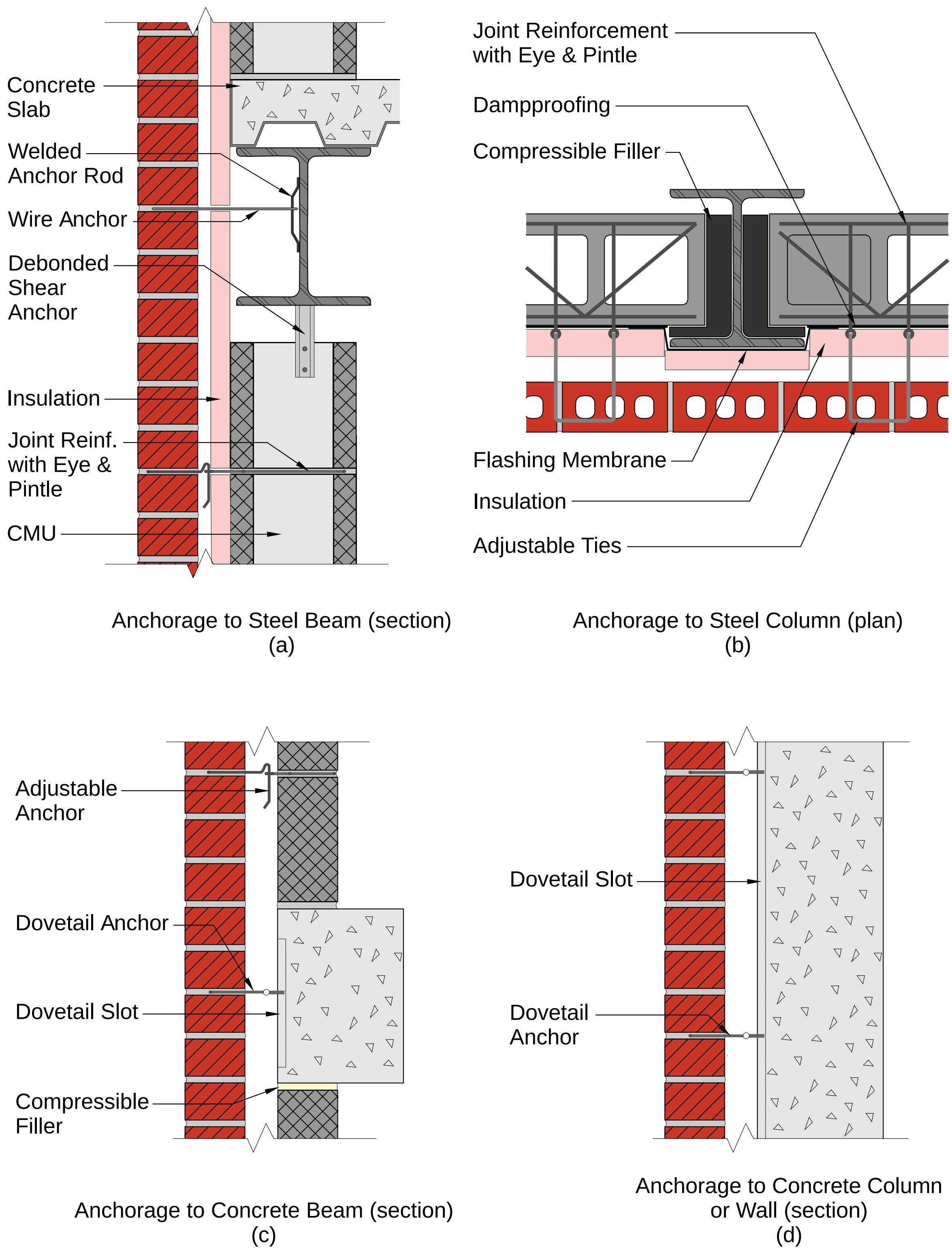


Figure 10

Flexible Anchorage to Beams and Columns

detailed appropriately for the differential movement and the moisture drainage system is designed and constructed properly. In these buildings, differential movement is accommodated by the anchor or tie system, window details, detailing at top of the wall and where other building components pass through the brickwork. These details must provide independent vertical movement between the brickwork and the backing. Building components that extend into or through the brick veneer (e.g., windows, doors, vents, etc.) also must be detailed to allow independent vertical movement of the brick veneer and the component. The structural frame or backing provides the brick veneer with lateral support and carries all other vertical loads. The veneer is anchored by flexible connectors or adjustable anchors that permit differential movement. Allowance for differential movement between the exterior brickwork and the adjacent components should be provided at all openings and at the tops of walls. Vertical expansion joints also must be incorporated, as discussed in previous sections of this *Technical Note*.

Connectors, anchors or ties that transfer load from the brick wythe to a structural frame or backing that provides lateral support should resist movement perpendicular to the plane of the wall (tension and compression) but allow movement parallel to the wall without becoming disengaged. This flexible anchorage permits differential movements between the structure and the brickwork. Figure 10 shows typical methods for anchoring masonry walls to columns and beams. *Technical Note* 44B provides detailed information about masonry ties and anchors.

The size and spacing of anchors and ties are based on tensile and compressive loads induced by lateral loads on the walls or on prescriptive anchor and tie spacing requirements in building codes. *Technical Note* 44B lists recommended tie spacing based on application.

There must be sufficient clearance among the masonry elements and the beams and columns of the structural frame to permit the expected differential movement. The masonry walls may be more rigid than the structural frame. This clearance provides isolation between the brickwork and frame, allowing independent movement.

COMBINING MATERIALS

Movement joints must be provided in multi-wythe brick and concrete masonry walls. Expansion joints are placed in the brick wythe, and control joints are placed in the concrete masonry, although they do not necessarily have to be aligned through the wall.

Bond Breaks

Concrete and concrete masonry have moisture and thermal movements that are considerably different from those of brick masonry. Floor slabs and foundations also experience different states of stress due to their loading and support conditions. Therefore, it may be necessary to separate brickwork from these elements using a bond break such as building paper or flashing. Such bond breaks should be provided between foundations and walls; between slabs and walls; and between concrete and clay masonry, to allow independent movement while still providing gravity support. Typical methods of breaking bond between walls and slabs, and between walls and foundations are shown in Figure 11.

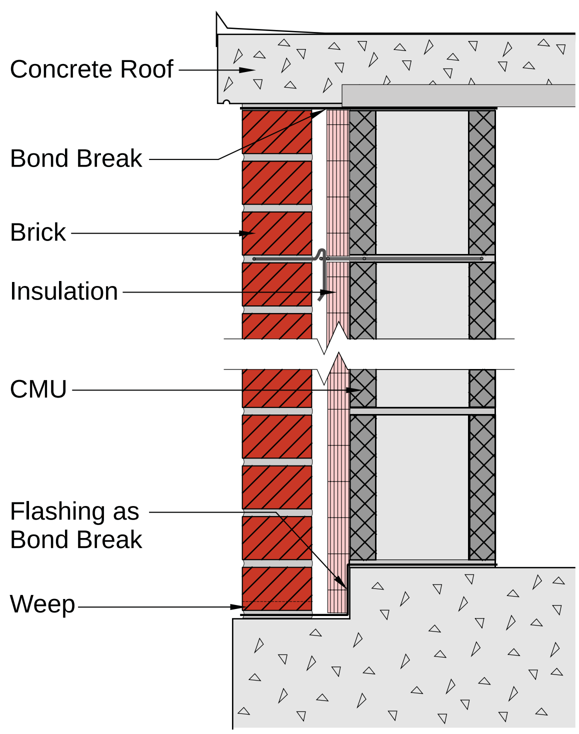


Figure 11
Bond Breaks in Loadbearing Cavity Wall

When bands of clay brick are used in concrete masonry walls, or when bands of concrete masonry or cast stone are used in clay brick walls, differences in material properties may cause mortar joints or masonry units to crack. Such problems can be easily avoided by using bands of brickwork featuring brick of a different color, size or texture or a different bond pattern. If, however, a different material is used for the band, it may be prudent to install a bond break between the two materials, provide additional movement joints in the wall, or place joint reinforcement in the bed joints of the concrete masonry to reduce the potential for cracking.

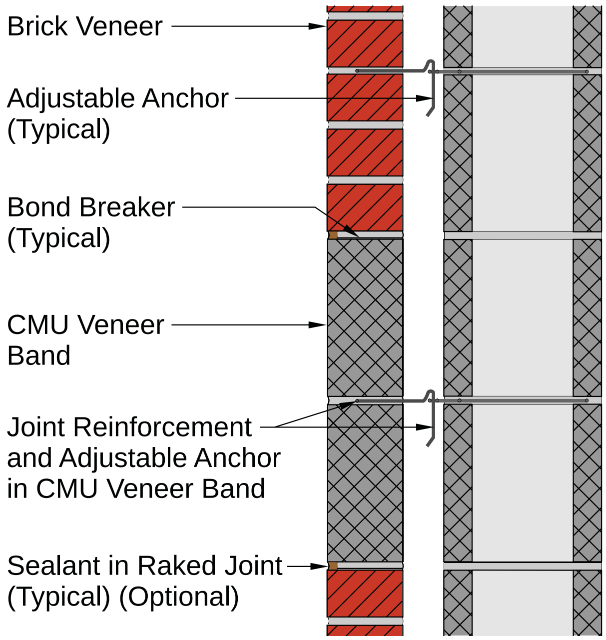


Figure 12
Multi-Course Concrete Masonry Band in Brick Veneer

Breaking the bond in this way does not affect the compressive strength of the wall and should not affect the stability of the veneer wythe when anchored properly. The weight of the masonry, additional anchorage and the frictional properties at the interface provide stability. Sealant at the face of the joints between the different materials will reduce possible water entry. If the band is concrete masonry or cast stone, additional control joints are recommended in the band. If the band is a single course, there is a likelihood of vertical cracks at all head joints. These can be closed with a sealant. Bands of two or more courses should include horizontal joint reinforcement in the intervening bed joints, as shown in Figure 12.

LOADBEARING MASONRY

The potential for cracking in loadbearing masonry members is less than in nonloadbearing masonry members because compressive stresses from dead and

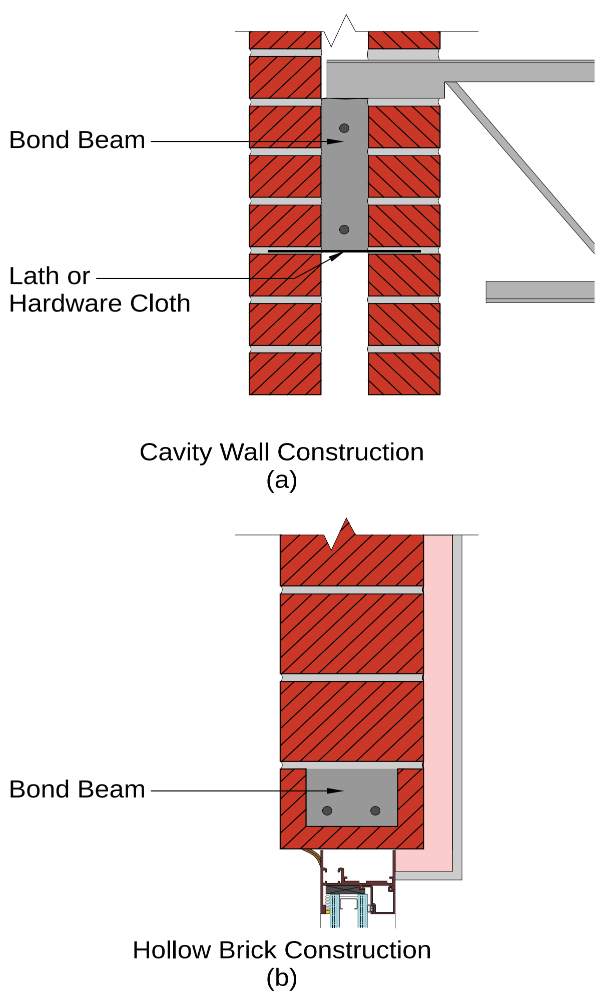


Figure 13
Bond Beams

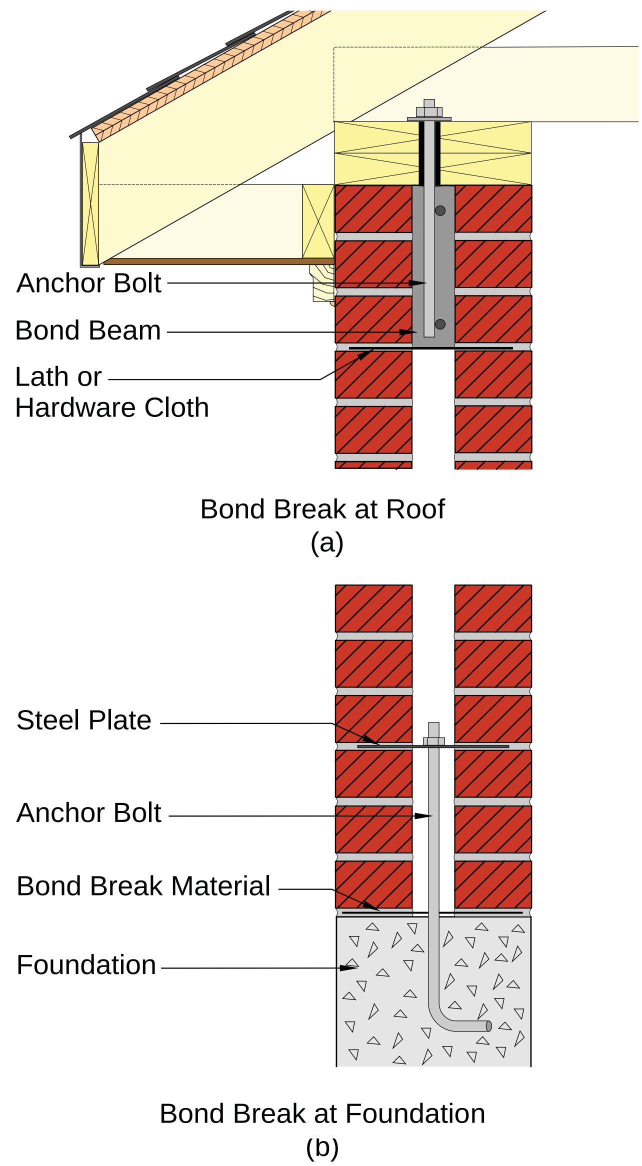


Figure 14
Bond Breaks

live loads help offset the effects of any movement. Adding reinforcement at critical sections such as parapets, points of load application and around openings to accommodate or distribute high stresses will also help control the effects of movement. Reinforcement may be placed in bed joints or in bond beams, as shown in Figure 13. Historic loadbearing structures were not constructed with expansion joints. However, these walls were made of multi-wythe brick construction, unlike typical structures built today.

When it is necessary to anchor a masonry wall to a foundation or to a roof, it is still possible to detail the walls in a manner that allows some differential movement, as shown in Figure 14a and Figure 14b. Such anchorage is often required for loadbearing walls subjected to high winds or seismic forces.

SUMMARY

This *Technical Note* defines the types of movement joints used in building construction. Details of expansion joints used in brickwork are shown. The recommended size, spacing and location of expansion joints are given. By using the suggestions in this *Technical Note*, the potential for cracks in brickwork can be reduced.

Expansion joints are used in brick masonry to accommodate the movement experienced by materials as they react to environmental conditions, adjacent materials and loads. In general, vertical expansion joints should be used to break the brickwork into rectangular elements that have the same support conditions, climatic exposure and through-wall construction. The maximum recommended spacing of vertical expansion joints is 25 ft (7.6 m). Horizontal expansion joints must be placed below shelf angles supporting brick masonry.

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