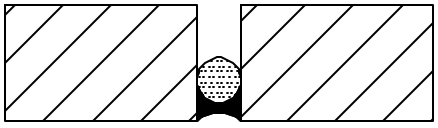
DESIGN CONSIDERATIONS

It is the responsibility of the designer to provide the location and type of vertical and horizontal movement joints required in masonry walls. The requirements for movement joints should be based on the following considerations:

1. Thermal expansion and contraction of masonry.
2. Moisture shrinkage and expansion of masonry units.
3. Creep and shrinkage of concrete structural elements.
4. Deflection of supporting structures, particularly structural steel.
5. Drying shrinkage of wood frame.
6. Earthquake movements

The *National Building Code of Canada* and CSA masonry standards do not specify the spacing of movement joints, so they are to be determined by the designer based on calculations, past experience and industry recommendations. Although there is much material written on this subject, the literature is often confusing due to the multitude of masonry construction types. The designer must give careful consideration to the type of material, the wall system and the structural frame before selecting the movement joint spacing.



Movement joints should be left clear of mortar, and properly sealed with caulking over a backer rod.

MASONRY UNIT PROPERTIES

Clay brick typically expands after production, due to the re-entry of moisture into clay after it has been fired in the kiln. However, much of this expansion will have taken place while it is inventoried and shipped, and before it is installed. In addition, there will be some shrinkage in the mortar joints between the units, with the result that there will be minimal net expansion from this process. Clay brick will undergo moisture cycle movement from regular wetting and drying due to the weather. Thermal expansion and contraction will occur, and the

coefficient of expansion is horizontally 0.5-0.6 mm per metre per 100°C and vertically 0.7-0.9 mm per metre per 100°C

Concrete block undergoes a non-reversible shrinkage due to carbonization and the loss of moisture that occurs with time in a cement-based product. In addition to the non-reversible shrinkage, concrete block also undergoes moisture cycle movements with wetting and drying as well as thermal expansion or contraction. The coefficient of thermal expansion of block is 0.8-1.0 mm per metre per 100°C.

Glass Block has a considerably higher coefficient of expansion than traditional masonry, steel or concrete. Manufacturers' literature should thus be consulted for maximum panel size, reinforcing and expansion joint detailing.
(For more information on movement refer to *Table 1, CSA S304.1*)

REINFORCED STRUCTURAL WALLS vs. VENEERS

Horizontal reinforcing, either in the mortar joints or grouted into bond beams, can be used to increase the tensile resistance as a means of crack control in structural walls. The use of reinforcement thus permits a larger spacing of vertical movement joints.

Movement joint spacing for veneer depends to some degree on the rigidity of the support system. Structural steel typically will have larger deflections than concrete frame buildings. Veneers on taller buildings also require horizontal movement joints formed by gaps under shelf angles to accommodate vertical movement.

VERTICAL MOVEMENT JOINT LOCATIONS

Possible Joint Locations:

- Wall openings
- At given spacings in a continuous wall
- Changes in wall height
- Foundation or support structure joints
- Changes in support conditions (foundation vs. framing)
- Proximity to wall corners or intersections
- Changes in wall thickness

When selecting vertical movement joint locations, the primary consideration should be the location of large openings where stress concentrations can be expected to occur. Other considerations include: changes in wall height, changes in wall thickness, corners, offsets and wall intersections. The aspect ratios of walls will also at times influence the maximum joint spacing. Thermal stresses, differential movements, foundation settlements or structural deflections should all be taken into account before deciding on joint locations.

Corners of openings are often good joint locations, with symmetrical layouts sometimes considered for aesthetics. Movement joints should be shown on elevation drawings, or determined with the masonry contractor at a pre-construction meeting.

Typical Maximum Vertical Control Joint Spacings		
Wall Type	**Material**	**Movement joint spacing**
Veneer	Clay	7m – 10m
	Concrete	5m – 7m
Reinforced masonry	Clay	15m
	Concrete	15m

HORIZONTAL MOVEMENT JOINT LOCATIONS

Horizontal movement joints are formed by, and located at, shelf angles. While lintel angles provide support over openings, shelf angles within the wall are primarily for movement control, not vertical support. It can be efficient to locate shelf angles so that they coincide with lintel angles in the wall elevation. Horizontal movement joints are usually specified once the building height reaches three or four stories. They are typically spaced at each floor level, but could be located at greater spacings depending on the back-up system and expected movements. There is no maximum spacing specified in engineered masonry design.

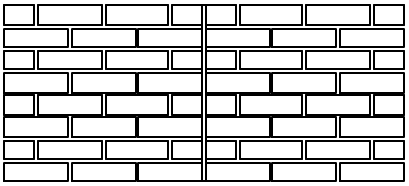
Movement Joints

VERTICAL MOVEMENT JOINTS

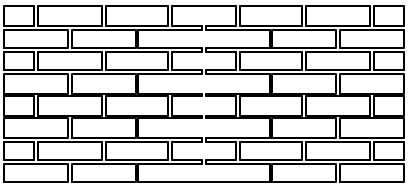
Vertical movement joints span masonry panels vertically (both structural and veneer). They allow for movement of the masonry along the length of the panel.

To construct a vertical joint, half units are used every other course (in running bond). In order to hide the joint, a caulking colour that approximates **the units** should be specified. Vertical banding details can also hide these joints.

If a vertical movement joint is placed above an opening, the arching effect of the masonry will be eliminated. This will affect the design of the lintel over the opening.



Caulk does not match



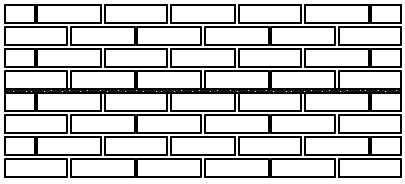
Caulk matches brick

HORIZONTAL MOVEMENT JOINTS

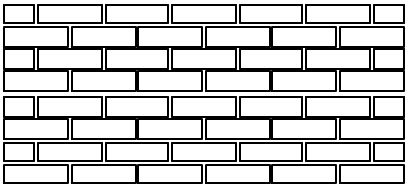
Horizontal movement joints span tall masonry veneer panels horizontally. They allow for movement of the masonry over the height of the panel.

Horizontal joints are formed by the gaps below shelf angles.

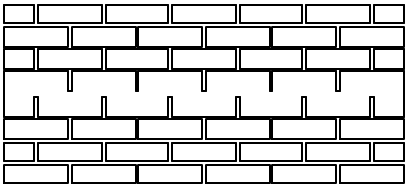
Since the thickness of a horizontal joint at shelf angles is larger than normal, it is important to minimize its impact. Joints are hidden by using caulking that approximates **the mortar** in colour and by incorporating them into horizontal banding designs.



Caulk does not match



Caulk matches mortar



Caulk matches brick