MASONRY INSIGHTS

Stack Bond from a Structural Engineer's Perspective

When a structural engineer designs a masonry wall, it is typically designed as running bond. This construction method yields good structural integrity using overlapped blocks. Sometimes, however, a stack bond wall might be requested for aesthetic reasons. A masonry wall constructed with stack bond can have structural capacity similar to running bond, provided reinforcing requirements are met.

Figure 1a - Running Bond

Figure 1b - Stack Bond

The general understanding of stack bond is a wall where the head joints in successive courses are aligned vertically. The technical definition of stack bond is any wall where the overlap of a masonry unit over the block below is less than one quarter of the length of the block. Due to this, the Building Code Requirements for Masonry Structures as reported by the Masonry Standards Joint Committee (MSJC) treats stack bond as anything "other than running bond."

Properly reinforced stack bond walls can be as strong as walls constructed with running bond for most loading conditions. TMS Code 402-13 Section 4.5 requires the minimum area of horizontal reinforcement be 0.00028 times the gross vertical cross-sectional area of the wall. This can be accomplished with bond beams or reinforcement in the horizontal mortar joints. Whichever method is used, the maximum spacing of horizontal reinforcement is 48 inches. This reinforcing is meant to limit vertical cracking and provide continuity across the head joints.

For walls spanning vertically, failure from out of plane loading occurs as bond failure between the block and the mortar in the horizontal joints. Since the horizontal joints aren't any different between stack bond and running bond, there is no difference in strength between these wall types when spanning vertically.

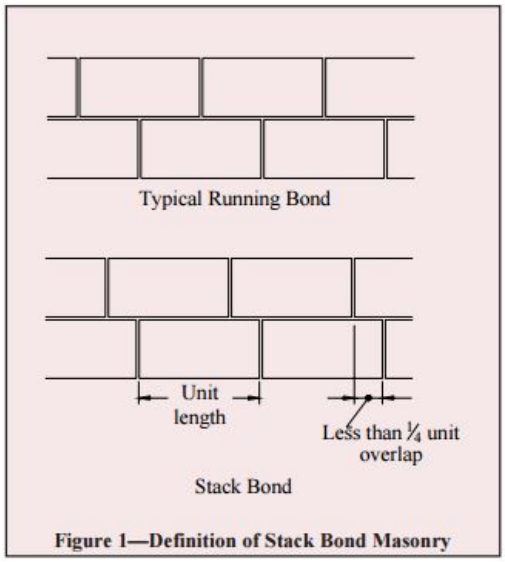

Figure 2 - From NCMA TEK 14-6

The difference occurs when the wall spans horizontally. In an unreinforced wall, the failure of running bond construction occurs as tension rupture of the blocks rather than as mortar failure. Because of this, running bond is about twice as strong when spanning horizontally as when spanning vertically. Stack bond walls have approximately the same strength whether spanning vertically or horizontally since the joints align in both directions. Horizontal reinforcing requirements mentioned above help to mitigate this discrepancy in strength in horizontally spanning walls.

Another difference with stack bond construction is with concentrated loads. Compressive strength of the two construction types are essentially the same, but the distribution of the load is where the change comes in. Per TMS Code 402-13 Section 5.1.3.2, concentrated loads shall not be distributed across head joints in stack bond walls. Bond beams can distribute concentrated loads through its depths, but the load cannot be distributed across head joints below the bond beams. Refer to Figure 3.

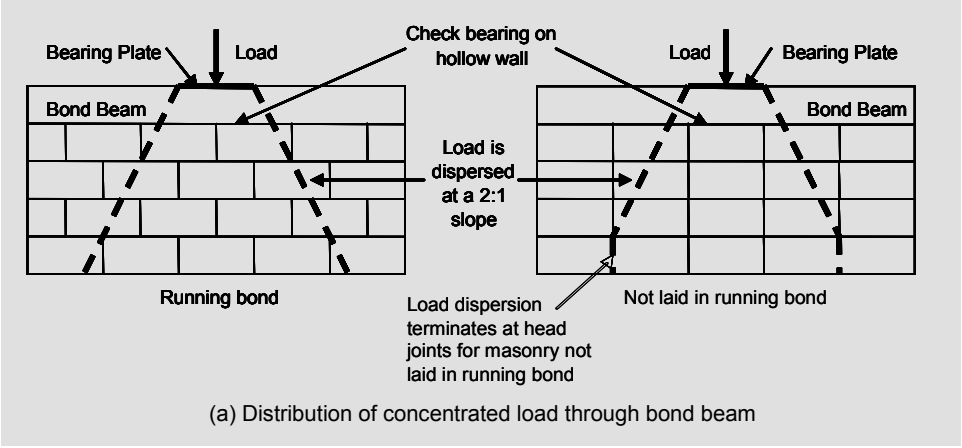

Figure 3 – TMS 402-13 Figure CC-5.1-5

In addition, TMS Code 402-13 Section 5.1.2 sets limitations for the effective compressive width per bar in stack bond walls to resist applied compressive loading. The effective compressive width in stack bond walls with bond beams spaced greater than 48 inches shall not exceed the length of the masonry unit. For stack bond walls with bond beams spaced 48 inches or less and for running bond walls, a larger width of wall can be considered to resist compressive forces —the lesser of the vertical bar spacing, six times the nominal wall thickness, or 72 inches. Refer to Figure 4.

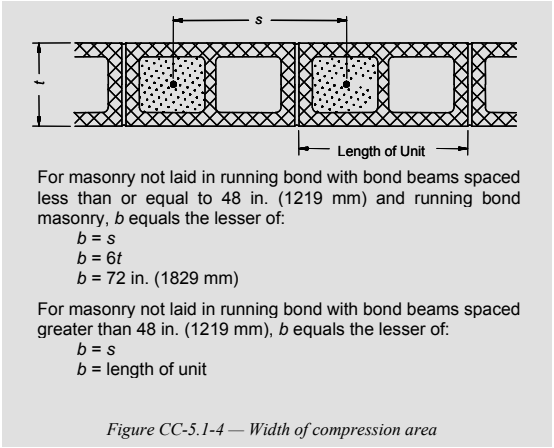

Figure 4 – TMS 402-13 Figure CC-5.1-4

Engineers need not worry if a client wants a stack bond structural wall. The code requires some more reinforcing over and above that of a running bond wall, and more reinforcing still for stack bond walls in high seismic or hurricane areas. However, the inclusion of this reinforcing makes the stack bond wall essentially as strong as a running bond wall.