Detailing shelf angles

Flashing and expansion joints are critical

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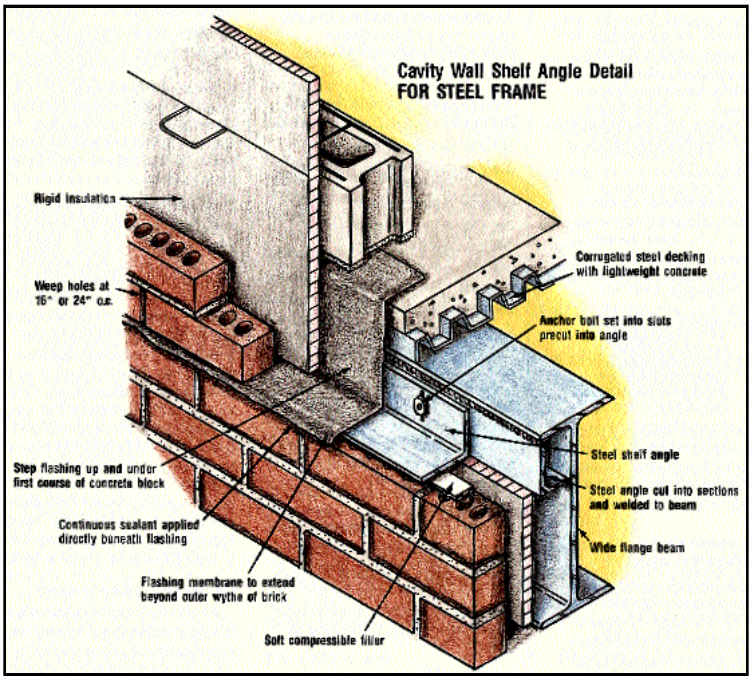
A shelf angle is a structural steel member that supports and transfers the dead load of the brick back to the building frame. Commonly detailed on masonry-clad buildings, these horizontal steel angles are attached to the frame at vertical intervals.

Shelf angles can be connected to the building's structural frame in several ways. If the structural frame is steel, the angle can be bolted or welded to the spandrel beam.

If the structural frame is concrete, the angle usually is bolted to inserts cast in the concrete spandrel or floor slab (see drawings).



A shelf angle that rotates can create high, concentrated stresses in the masonry. To prevent this, shim the shelf angle as needed with shims the full height of the vertical leg. Weld or bolt the shelf angles to the structural frame, with adjustment for proper alignment.

Construct expansion joints under the shelf angles

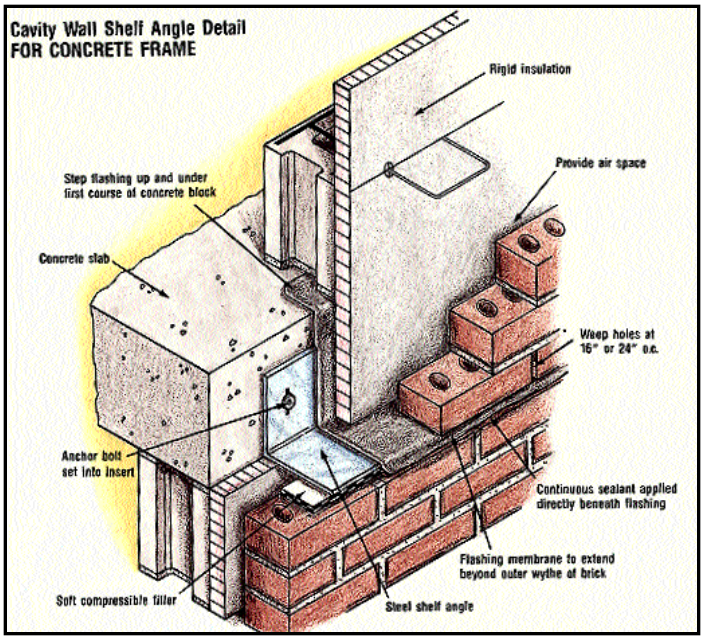
The leg of the shelf angle should be sized to support the load without deflecting more than 3/10 inch (Ref. 1). Differential movement between the brick and the structural frame, such as thermal movements and frame shrinkage, also must be accommodated. Otherwise the masonry can crack.

To prevent this, construct a continuous horizontal expansion joint directly below every shelf angle. Keep the joints totally void of mortar. Fill them with a highly compressible material or leave them open and clean. Then seal them with a permanently elastic sealant. If shelf angles are placed at every floor level, the initial width of the joints should be about ½ inch (5/16- to ⅜-inch steel angle plus ⅛-inch space). A good rule of thumb: A minimum ⅛ inch of space is needed under the shelf angle for every floor level between angles. After movement occurs, the joints will be compressed and less noticeable.

A gap about 1/16 inch wide between shelf angle sections also should be provided so that when individual sections expand in length with temperature changes they don't butt and stress each other, causing damage to the outer wythe of masonry.

Don't forget the flashing

Wherever shelf angles occur in cavity walls they interrupt the cavity. The result: water that enters the cavity collects at the shelf angles. To divert this water to the outside of the building, install a continuous flashing membrane over the shelf angle. Keep the flashing membrane continuous by lapping the ends and sealing them with mastic. The shelf angles should be



galvanized in case water leaks around the flashing.

The fewer shelf angles the better

Detailing and installing shelf angles is tedious and troublesome. Problems may occur if shelf angles are improperly designed or constructed or if faulty materials are used. Consequently, the fewer shelf angles required on a building, the fewer problems that are likely to occur—both in construction and use.

In some cases, one shelf angle can be installed every three stories (Ref. 2). This requires an increased expansion joint thickness and structural analysis by an engineer. The brick cladding of the Hyatt Regency Hotel in Chicago was installed in this way.

In many other cases shelf angles can be eliminated entirely. Brick veneer more than 90 feet high can bear directly on the foundation. Mid-rise buildings with exterior masonry bearing walls are commonly built this way. The Freedom Center, where the Chicago Tribune newspaper is printed, is an example.

References

1. “Structural Steel Lintels,” BIA Technical Note 31B, Brick Institute of America, 11490 Commerce Park Drive, Reston, Virginia 22091.

2. “Cavity Walls: A Case of High Performance,” Masonry Advisory Council, 1550 Northwest Highway, Park Ridge, Illinois 60068.

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