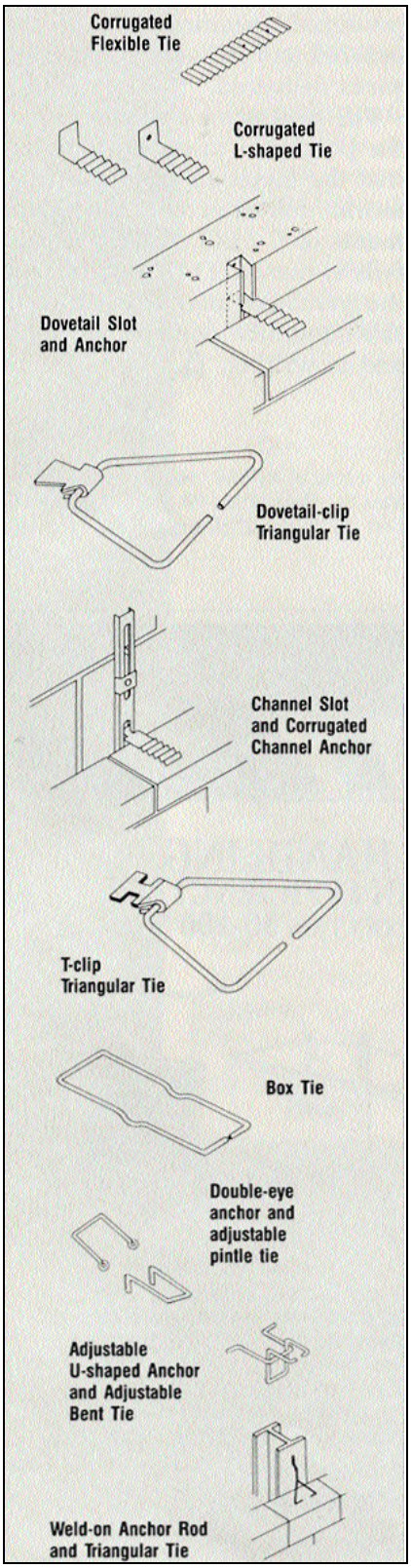
Connecting brick to backup

A specifiers' and users' guide to masonry wall ties

By Paul G. Curtis



To secure masonry veneer to a backup system or to connect two or more masonry wythes, wall ties—made of wire or sheet metal—are necessary (Ref. 1). Horizontal joint reinforcement also can be used to tie wythes together. But how do you choose from the thousands of available shapes, sizes, gauges, and steel types of masonry wall ties?

Despite physical differences, their purposes essentially are the same. Besides providing a physical connection, wall ties transfer lateral loads. They also accommodate differential material movements by allowing in-plane movement. In certain cases, wall ties are used to restrain differential movement. For each application, though, some ties are better suited than others.

Brick to wood studs

The most common notion of a wall tie is the corrugated flexible type with nail holes, ⅞ inch wide by 7 inches long and made of 16- to 26-gauge metal (22-gauge is often recommended; 26-gauge isn't allowed by the ACI / ASCE 530 Building Code Requirements for Masonry Structures).

This versatile tie most often is used in low-rise residential construction. It is nailed to wood studs and bent up to form a veneer tie. A stronger version is a 16-gauge L-shaped tie, 1¼ inches wide by 3½ inches long with a 1½-inch bend. It may or may not have a nail hole.

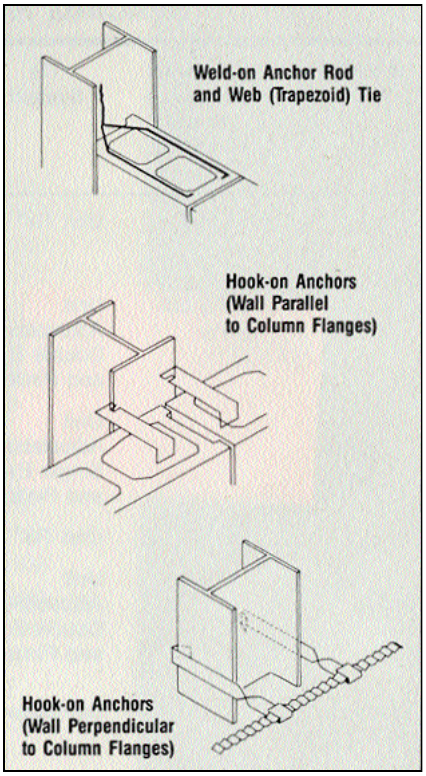
Brick to new concrete

For new concrete walls, dovetail anchor slots are installed in the forms before the concrete is poured. The slot is filled with removable foam or cardboard to prevent the concrete from entering the slot during the pour. When the forms are removed, the filler is stripped to expose the slot.

The slot is 1 inch deep and 1 inch wide, narrowing to a ⅝-inch throat. Slots are available in gauges from 22 to 26. Triangular ties, made of ³⁄₁₆-inch-diameter wire with a 12-gauge dovetail clip are available in lengths from 3 to 11 inches. The dovetail clip inserts into the slot and adjusts vertically so the tie can be placed in the bed joint.

Corrugated dovetail anchors (12- or 16-gauge, 1 inch wide, and 3½ to 7½ inches long) also can be used. Don't specify a width narrower than 1 inch. Corrugated dovetail anchors wider than 1 inch are available, but you pay a premium for them.

The lengths of dovetail anchors are measured from the face of the concrete to the end of the anchor. The dovetail portion isn't included.



Brick to existing concrete

For existing concrete walls without dovetail slots, use channel slots. Channel slots are 16-gauge metal, 1⅜ inches wide and 5, 8, or 10 feet long. They fasten to the concrete wall with expansion bolts. Corrugated and triangular ties with T-clips slip into the channel slots and can be vertically adjusted about 7 inches per slot. The ties are the same lengths as dovetail anchors and are measured from the face of the channel. Channel slot anchors always are 1¼ inches wide.

Brick to concrete masonry

Three types of wall ties are typically used to tie brick to concrete masonry backup. The rectangular box tie is a single piece of wire that joins two wythes having aligned courses. Box ties are 2 or 4 inches wide and 6 to 12 inches long.

For misaligned courses, choose from two adjustable, two-piece systems. The first is a U-shaped double-eye anchor (usually 4 inches wide and 3½ to 9½ inches long) and a pintle tie with 2½-inch adjustment legs. The legs of the pintle tie slip into the eyes of the U-shaped anchor to tie the wythes together. Eye holes in the anchor shouldn't allow more than 1/16-inch play. The other adjustable two-piece anchor comes in the same sizes but allows both horizontal and vertical movement. The legs of the U-shaped anchor are embedded in the backup wythe and the tie, resembling a bent box tie, slides into the loop created by the anchor.

The ACI / ASCE 530 Code says adjustable ties with at least two 3/16-inch-diameter pintle legs should be provided for each 1.77 square feet of wall area. Horizontal and vertical spacing should not exceed 16 inches. Do not use adjustable ties when bed joints fromwythes are misaligned more than 1¼ inches.

Brick or block to structural steel

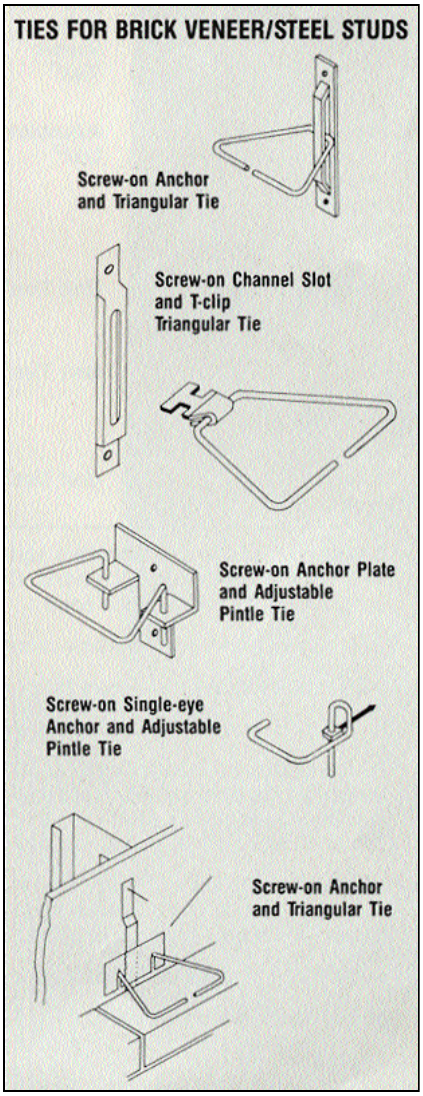
Wall ties can be attached to wire anchor rods or metal straps welded to the steel columns or beams. Welding can be done in the field or in a fabricating shop before the steel is delivered to the jobsite. The rods typically are ¼-inch-diameter wire. They are available in 9-inch-long individual pieces that allow the wall tie 4 inches of vertical adjustment or in continuous sections 8 feet long with 7¾ inches of vertical adjustment.

For walls parallel to the column flanges, use 3/16-inch-diameter triangular ties ranging from 3 to 11 inches long. For walls perpendicular to column flanges, use 12-inch-long web (trapezoid) ties in widths from 2⅜ to 10 inches (depending on wall width).

Weld-on channel slots also are available as column anchors. The channel slots are 16- or 11-gauge metal, 6 inches long with a 5½ -inch vertical tie adjustment.

Some ties don't need to be welded to steel columns or beams; they hook onto the column flanges instead. For walls parallel to column flanges, hook-on anchors typically are 2 inches wide, 7 inches long, and ⅛ inch thick. Each anchor has a 1-inch-deep slot that hooks onto the flange, allowing the anchor to extend into the mortar joint. They come in pairs of one left and one right for the ends of a column flange.

For walls perpendicular to the column flanges, anchors are available that hook onto the back of the flange, travel along the flange, and twist 90° where they extend into the wall. These anchors typically are 1¼ inches wide and ⅛ inch thick. Flange length and overall



TIE SPACING RECOMMENDATIONS[1]

Wall Type	Cavity or Air Space Width (inches)	Tie System	Maximum Area Per Tie (square feet)	Maximum Vertical Spacing (inches)	Maximum Horizontal Spacing (inches)
Cavity	≥ 2 but ≤ 3½	Unit Tie[a]	4½	24	36
			2⅔	24	24
	> 3½ but ≤ 4½	Unit Adjustable Double Eye and Pintle[b]	1¾	16	16
			3	24	36
			2	24	24
		Unit Adjustable Single Eye and Pintle[c]			
		Unit Tie[a]			
		Unit Adjustable Double Eye and Pintle[b]			
Veneer/ Wood Stud	1	Corrugated[a]	3¼[2]	24	24
			2⅔[3]	24	24
Veneer/ Steel Stud	2 but ≤ 3	Adjustable Unit Veneer Ties[b]	2	18	24
Veneer/ Concrete or Concrete Masonry Backup	≤1	Adjustable Unit[b]	2⅔	24	24
Multiwythe Brick	—	Unit Ties[a]	4½	24	36
Brick/ Block Composite	—	Unit Ties[a]	4½	24	36
Two-wythe Grouted	—	Unit Ties[a]	2¾[4]	16	24

[1] Based on minimum tie diameters and gauges listed in Table 2 of BIA Technical Note 44B. Masonry laid in running bond. Consult applicable building code for special bond patterns such as stack bond.

[2] One- and two-family wood-frame construction not more than two stories high.

[3] Wood-frame construction more than two stories high.

[4] For high-lift grouted walls. Masonry laid in running bond.

[a] For nonadjustable ties, ACI/ASCE 530 Building Code Requirements for Masonry Structures requires a maximum area per tie of 2⅔ square feet for 9-gauge ties or a maximum area per tie of 4½ square feet for 3/16-inch-diameter wire ties. Maximum vertical spacing is 24 inches and maximum horizontal spacing is 36 inches.

[b] ACI/ASCE 530 Building Code Requirements for Masonry Structures requires a maximum area per tie of 1⅔ square feet, 16 inches maximum vertical spacing, and 16 inches maximum horizontal spacing.

[c] ACI/ASCE 530 does not allow unit adjustable single eye and pintle ties.

Source: Adapted from Reference 1.

Reference

1. "Wall Ties for Brick Masonry," Technical Notes on Brick Construction, 44B, Brick Institute of America, 11490 Commerce Park Dr., Reston, VA 22091.

anchor length must be specified.

Brick to steel studs

Several of the more common anchors used to connect brick veneer to steel studs are shown here. Precision design and construction are a must for this system. Ties must be flexible and resist tension and compression but not shear. Do not use corrugated ties.

Adjustable ties: Pros and cons

Adjustable ties are used when courses of two wythes are misaligned or when bed joints in the veneer don't align with pre-installed anchors in the backup. Most of these ties permit vertical adjustment of about one-half the height of a standard brick. Some permit even more adjustment. The advantages of adjustable ties, according to the Brick Institute of America (BIA) (Ref. 1), are:

- The interior masonry wythe can be built before the exterior wythe, thus the structure is enclosed more quickly
- Less damage to exposed ties because the separate pieces are installed as the wythes are built
- Accommodation of the tolerances found in multimaterial construction
- Accommodation of larger differential movements than nonadjustable ties

The BIA also says there are disadvantages, including:

- Extreme mislocation of adjustable ties before construction of facing wythes can render the ties useless.
- The adjustment factor may encourage less-than-perfect wall layout.

- Large variations in construction tolerances may not allow full engagement of ties installed before facing wythes are built.
- Strength and stiffness of adjustable ties may be less than that of nonadjustable ties.
- Improperly positioned ties may result in large vertical tie eccentricity.
- As vertical adjustment eccentricities are increased, deflections of adjustable ties can become quite large. Deflection is further increased if the tie has mechanical play.

A few tips

When designing metal-tied wall systems, the BIA offers these suggestions:

- Limit the total mechanical play to 0.02 to 0.05 inch (ACI / ASCE 530 permits 0.0625 inch).
- Provide additional ties within 8 inches of openings and discontinuities such as windows, shelf angles, and vertical expansion joints.
- Don't specify ties with drips. Tests have shown that drips can reduce the ultimate buckling load by about 50%.
- Space ties, as shown in the table, based on the tie system and wall system.
- Specify stiff ties with maximum deflections of less than 0.05 inch when tested at an axial load of 100 pounds in tension and compression. For adjustable ties, the deflection limit should be satisfied at the eccentricity expected in the field.

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