Attaching Steel Beams and Columns

by Stuart Jacobson, S.E., P.E.

Steel I-beams are a practical solution for beams and headers carrying heavy loads. Even with the advent of engineered lumber beams, steel is still a good choice: It's stronger, lighter, and typically less expensive than engineered lumber beams. The main problem for home builders is how to integrate the steel into the wood frame. In many cases, builders will go to great lengths to attach a steel I-beam to a wood post using scabbed-on wood blocking when it would be simpler — and stronger — to use a steel post and the kind of steel-to-steel connections common in commercial construction.

In this article I'll explain the right and wrong ways to attach steel beams, and give some options for making strong connections.

Column-to-Beam Connection

For starters, I always advise against supporting any steel member on wood columns of any type. In the first place, the "rolling tolerances" allowed in the manufacture of the steel beam (see Figure 1) mean that the two flanges may not be parallel to each other, or they may be parallel to each other but not at 90 degrees to the web. The result is uneven bearing on top of the wood post, which can cause localized crushing of the wood fiber. (For more on rolling tolerances, consult the *Steel Construction Manual*, published by the American Institute of Steel Construction.)

Second, the wood post may not be cut squarely, so that even if the flanges of the steel beam were perpendicular to the beam web and parallel with the ground, they might not have full contact bearing on the top of the wood column.

The best connection is steel to steel. The simplest way to do this is to have a steel cap plate prewelded on top of the column, with bolt holes prepunched in both the plate and the beam's bottom flange. In spite of the rolling tolerances in the I-beam, the bolts will draw the cap plate into full contact with the flange as they are tightened. Another option, more common in commercial construction, is to have a plate welded onto the column that provides for a bolted connection through the I-beam's web.

Steel columns are relatively easy to integrate into wood framing. A 3-inch-diameter standard column will fit in a stud wall, as will a TS 3x3 or TS 3 1/2x3 1/2 tube.

Column-to-Footing Connection

Steel beams are frequently used as central girders in the basement or garage. In either case, the post usually bears on a footing or thickened slab. For attaching to concrete, use a column with a prewelded base plate, punched for at least two (preferably four) 1/2-inch bolts. The bolts are set in the fresh concrete, using a plywood template for position.

Some builders prefer to use expan-

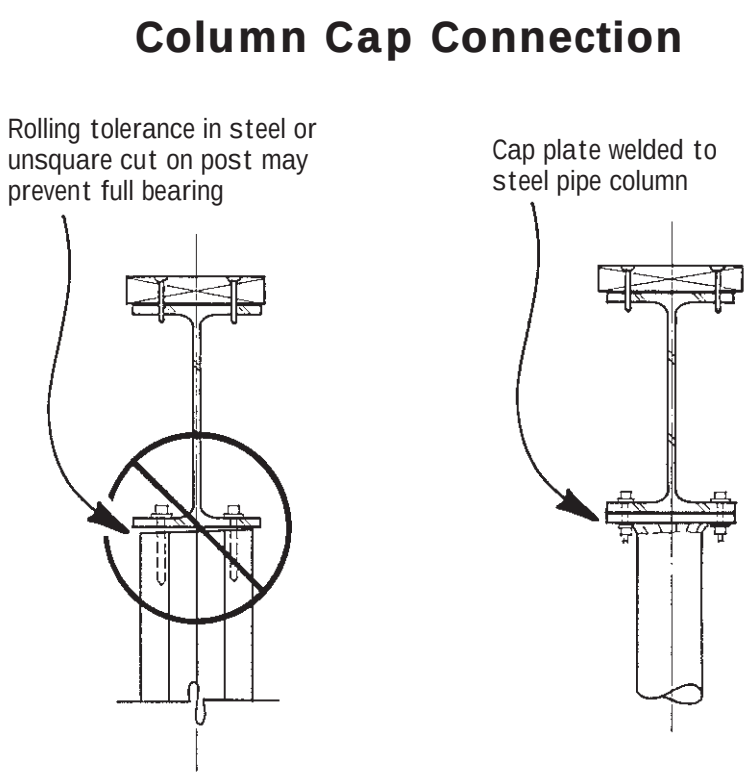

Figure 1. The author recommends against supporting steel beams on wood posts (left). Rolling tolerances in the steel or an unsquare cut on the post could result in uneven bearing. Also, the lag screw into the post's end grain is a weak connection, while the blocking required to make a strong connection is much more time-consuming than simply bolting a steel column's cap plate to the bottom flange (right).

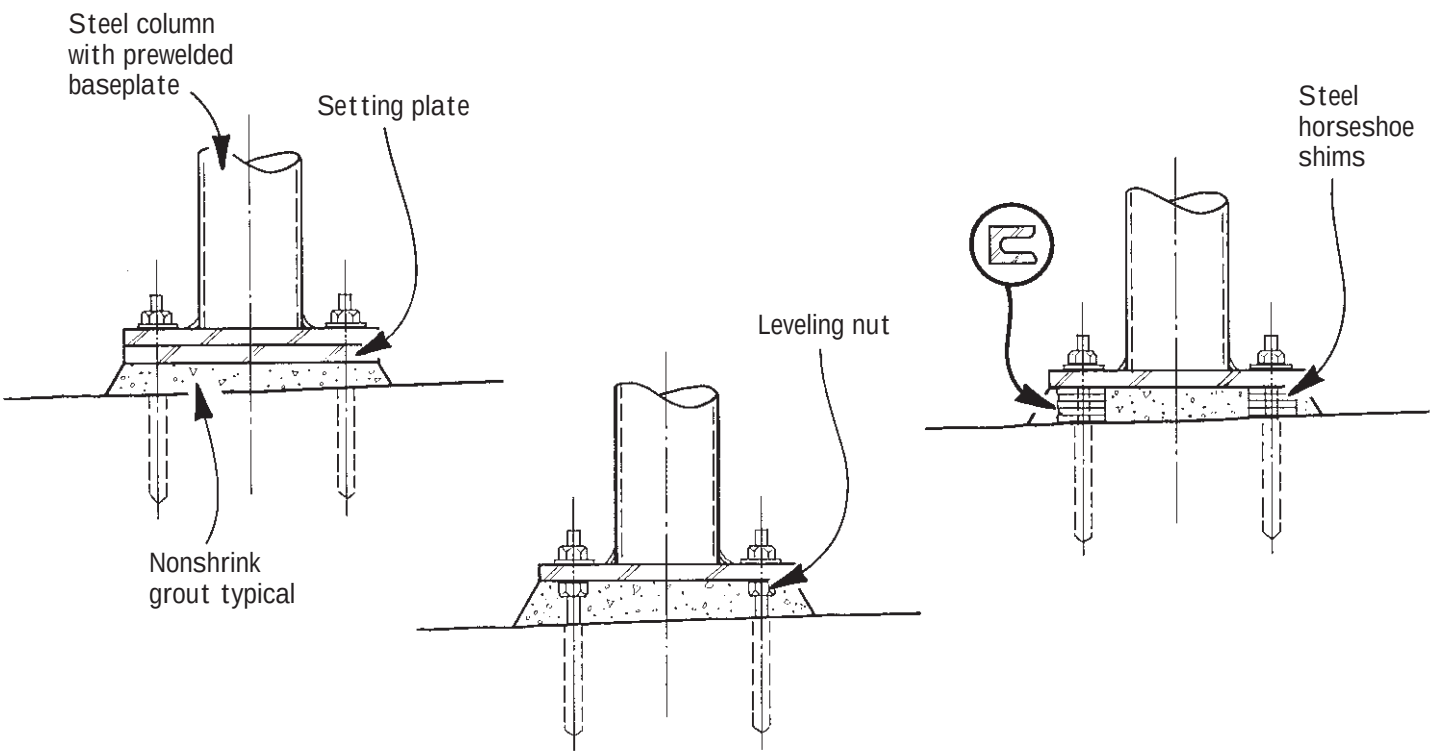

Figure 2. On large jobs where there are a lot of columns, it may be fastest to level a separate loose setting plate in a bed of nonshrink structural grout (left). Then, after the grout has set, the column can be quickly set in place. On smaller jobs, you can plumb the column as it is installed, using either leveling nuts (middle) or shims (right). Then use nonshrink grout to fill the void under the baseplate.

sion anchors because they allow the slab to be finished without interference from embedded bolts. When using expansion anchors, make sure to maintain the manufacturer's required "minimum edge distance" — the space from the bolt centerline to the edge of the concrete. Otherwise, the expansion anchor may fracture the concrete. When this edge distance cannot be maintained, you may be able to use an epoxy system, which doesn't create horizontal pressure. However, epoxy systems also have minimum edge distance requirements that must be followed. Also, cold temperatures may prevent the use of epoxy anchors.

Setting Columns

There are three ways I commonly recommend for installing the column (Figure 2). With the first method, a loose 1/4-inch-thick setting plate the same size as the baseplate is first set over the bolts into a 1/2- to 3/4-inch-thick bed of nonshrink grout. (Nonshrink grout is a special structural grout with high compressive strength, available from concrete suppliers.) The grout bed is slightly higher than needed so that the loose baseplate can be tapped into place and leveled with a carpenter's level. The nuts are then used to snug the baseplate in place while the grout sets. This method is popular with contractors on big commercial jobs because it enables them to quickly and accurately set large numbers of level baseplates. It's then easy to install the columns: You simply remove the nuts, place the prewelded baseplate of the column over the bolts, and retighten the nuts, fastening the two plates together.

On residential jobs where there are only a few columns to set, it may be easier to plumb the column as it is installed. The column with its prewelded baseplate is set onto the embedded bolts, then plumbed using either leveling nuts or "horseshoe" shims. (Horseshoe shims are usually available from your steel supplier.) Once the column is in final position, it is bolted into place and nonshrink grout is used to fill the void under the plate.

When using either shims or leveling nuts, I recommend allowing space for at least 1 inch of grout beneath the baseplate, and preferably 1 1/2 inches. This makes it easier to work the grout under the baseplate and around the shims or leveling nuts. ■

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