

Attaching Rail Posts

by Robert Randall, P.E.

In residential construction, wooden posts are often used to support railings. The challenge for the builder is how to attach these posts to withstand the design loads required by code.

Code Requirements

The building codes make a distinction between *handrails* and *guardrails*. Handrails are provided for the users of stairways to grasp for stability while climbing or descending. Guardrails are required along stairways and at the edges of raised platforms — balconies, platforms, or decks — to keep people from falling off. In many cases, the handrail also functions as the guardrail. Regardless, the support posts, whether newels or intermediate posts, must meet the load requirements for both guardrails and handrails.

Most building codes specify how strong railings must be to ensure that they will not break away when people fall against them. For example, both BOCA (*National Building Code*) and SBCCI (*Standard Building Code*) require that the railing be able to resist a horizontal force of 200 lb. applied at any point along the railing. ICBO's *Uniform Building Code* specifies 20 lb. per linear foot of railing — a distributed load that generally results in less force on the post connections. CABO's *One and Two Family Dwelling Code* simply requires railings but gives no strength specifications. For the purpose of this article, I use the requirements of BOCA and SBCCI.

Apply a 200-lb. force outward on the top of a deck post (Figure 1). The bending moment, or leverage, created by this force results in a much greater

force on the post's fasteners. As shown in Figure 1, a fairly common rail post attachment detail, the force on the top bolt varies from 1,213 lb. for 2x10 construction to over a ton for 2x6 construction. The variation results from the different-length lever arms for the resisting forces at the base.

Fastening

In standard frame construction, bolts are the best way to resist this kind of force. I recommend the use of through-bolts in all cases.

Where the post is attached to the side of a rim joist, as shown in Figure 1, two 1/2-inch bolts are adequate. However, this puts a lot of force on the framing connections, which must be strengthened with lag screws as shown in Figure 2. The chart with Figure 2 shows the number of perpen-

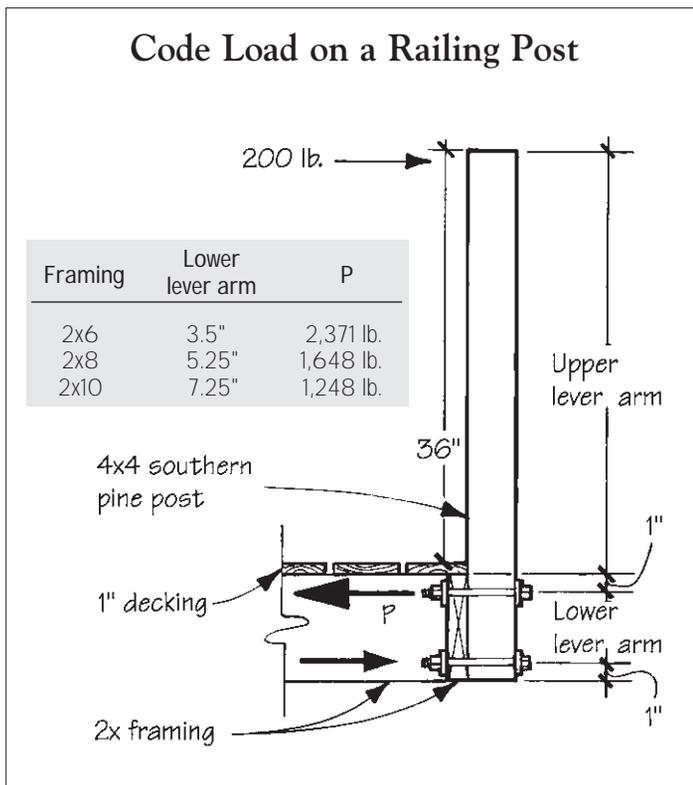


Figure 1. A 200-lb. horizontal load at the top of a typical deck railing develops a huge force on the post's fasteners. Depending on the size of the framing, the resulting force on the top bolt (P) can be more than a ton (see chart, above).

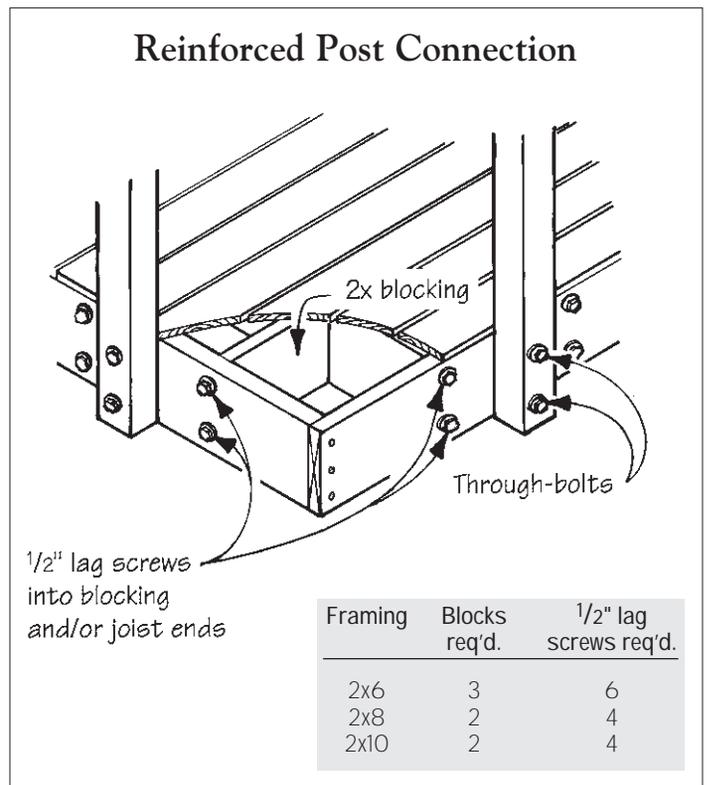


Figure 2. The leverage from a deck railing post will twist the rim joist unless the rim joist is securely fastened to the joist ends or perpendicular blocking. The author recommends a schedule of 1/2-inch lag screws (see chart, above) for resisting code design loads.

It is not uncommon to see a 4x4 post notched around the joist, as in Figure 4. This is never okay — no commonly used construction lumber has enough strength to resist the bending moment when a 4x4 is notched around a joist. This is true even for hardwood posts, such as maple or oak, used in interior stair construction.

There are some cases where it is impractical to attach the post directly to the floor framing. In such cases, the welded steel connector shown in Figure 5 works nicely. It is designed for full code compliance, and makes for a pleasingly rigid post connection. Plan carefully, though — this connection is very hard to undo!

Other Options

There are situations where there is no need for the designed connections described above. A simple way to strengthen deck rail posts is to extend the deck support posts. Where a primary deck support post can be extended from a footing up past the framing to support a handrail, the most serious consideration is likely to be deck support rather than rail support. When bolting on girders to support the deck joists, keep in mind that each 1/2-inch-diameter bolt can support only 470 pounds, or about 9 square feet of deck with 40 psf live load.

Another approach is to use wall connections to strengthen a railing. Where the railing returns to a wall, either fasten a post directly to the wall or use a metal bracket secured with at least two 8g wood screws or 10d nails into the framing to carry the horizontal thrust parallel to the wall. However, if there's a railing corner nearby that could place direct tension on the fasteners, tending to pull them out of the wall, two lag screws would be a much better choice.

Choosing Lumber

When using 4x4 wood posts, it is important to select an appropriate grade of lumber — No. 1 or 2 southern pine, for example. Lower grades, such as “stud,” “standard,” “utility,” or No. 3, are not good enough. Also, pass over any post with a large knot in the lower half, regardless of grade. ■

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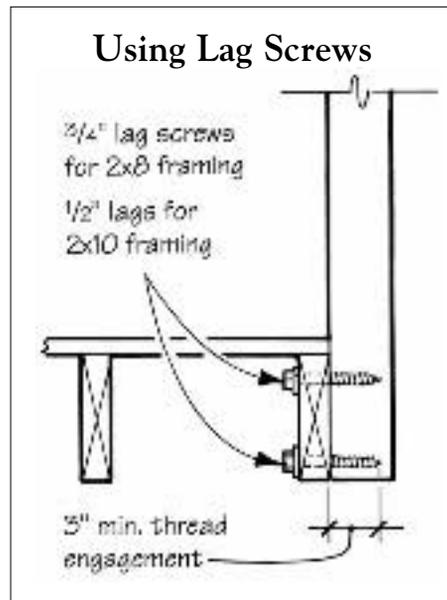


Figure 3. Although they are not the author's first choice, properly installed lag screws can make an adequate post connection. Lags should be inserted through the framing into the thicker lumber of the post.

dicular blocks or joist ends that must be lagged into to resist the leverage from a single post.

Though they are not my preference, lag screws can also be used for attaching posts. The lags must be inserted from behind, through the framing and into the post as shown in Figure 3. For

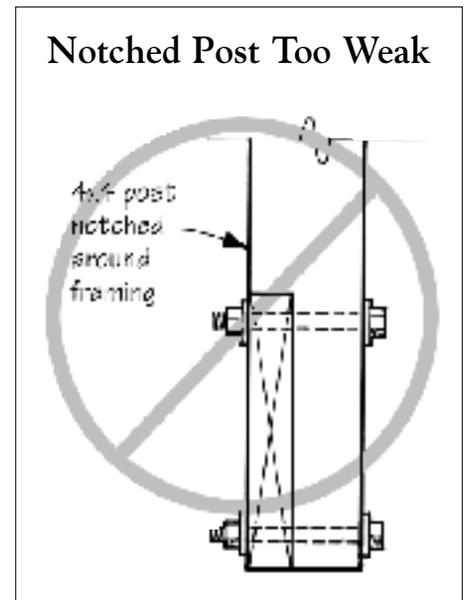


Figure 4. A notched 4x4 post is too weak for guardrail duty, as defined by the BOCA and SBCCI codes.

2x10 deck framing, use 1/2-inch-diameter lags with 3 inches of thread engagement (assuming a southern pine 4x4 post, with bolts located as shown in Figure 3). For 2x8 framing, the lag screw would need to be 3/4-inch diameter. With 2x6 framing, don't even think about using lags.

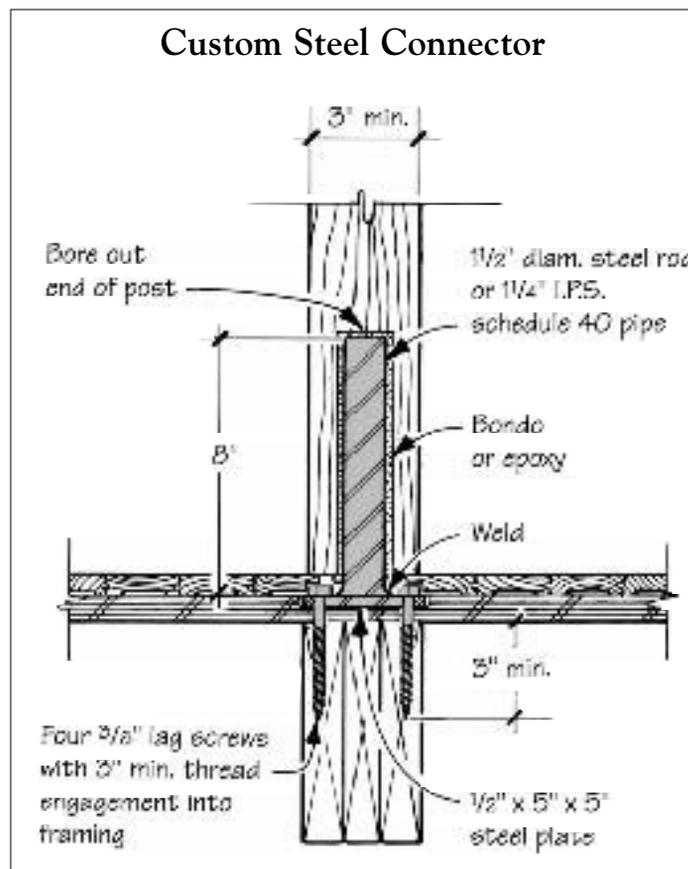


Figure 5. The author designed this railing post connection for situations where it is impractical to tie into the deck or stair framing.