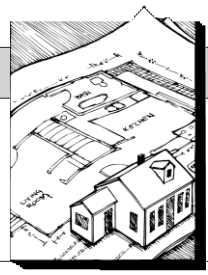
Detailing for Sturdy Decks



by Gordon Tully

There are two overriding issues in detailing decks: making the railing strong enough, and finding materials that will stand up to the weather. In this discussion, I will assume a flush-framed deck, because low headroom usually prevents the use of conventional framing where the joists sit on top of the girders.

Most Railings Inadequate

Residential railings that meet code are as rare as ivory-billed woodpeckers. The BOCA-based code we use in Massachusetts requires that a railing resist a 200-pound horizontal impact load applied at the top of a railing post. On a very small deck the railing itself can transfer this size load back to the walls of the house, in which case the vertical railing supports do not need to resist the load.

In the usual case, however, the load on the railing must be resisted by the deck posts or balusters. There are three kinds of railing supports:

- newel posts (which I will call "rail posts")
- structural balusters
- extensions of the posts supporting the deck

To appreciate the size of the forces created by the code loading, bolt a 4x4 onto a 2x8 rim joist, with a big washer to spread the bolt load over the side grain of the wood. Now push on the 4x4 at rail height with a force of 200 pounds (not easy to do, which is why most railings survive even though they fall short of code).

You will obviously not put a bend in the 4x4, since almost any wood will take the load. The real problem is the terrific twist you put on the rim joist, because the 4x4 acts like a big crowbar (see Figure 1). Here are some of the ways you can help prevent the post from tearing the rim joist off the deck:

- Use deeper joists to frame the deck
- Spread the load out along the rim joist
- Tie the top of the rim joist back into the deck
- Space the rail posts more closely

Assume we are using rail posts spaced at the usual distance of 4 feet apart. An important first step is to use a hefty railing, at least a 2x6, which will distribute the 200-pound push over several posts. Ideally, use a continuous railing. If that's not possible, minimize the number of joints and reinforce under each joint with a steel splice plate at least 24 inches long.

Next, you need to tie the rim joist back to the framing so it won't roll over. Where the floor joists run parallel to the rim joist, you start by blocking between the first three or four joists to resist the twist of the rim joist.

Unfortunately, ordinary joist hangers and toenails aren't good enough to tie the rim joist back to the rest of the framing. Even with 2x12 framing, the bolt pulls on the rim joist with 1,000 pounds of force, as shown in Figure 1. The only positive solution I've found is to attach thin strap ties or steel strapping (such as Simpson CS150 galvanized strapping) to the top of the framing, as shown in Figure 2. Don't omit these, even if they seem redundant. We are talking about resisting extreme loads, not ordinary bumps.

The metal straps can be thin enough to avoid raising the decking. To avoid the glint of the metal between the deck boards,

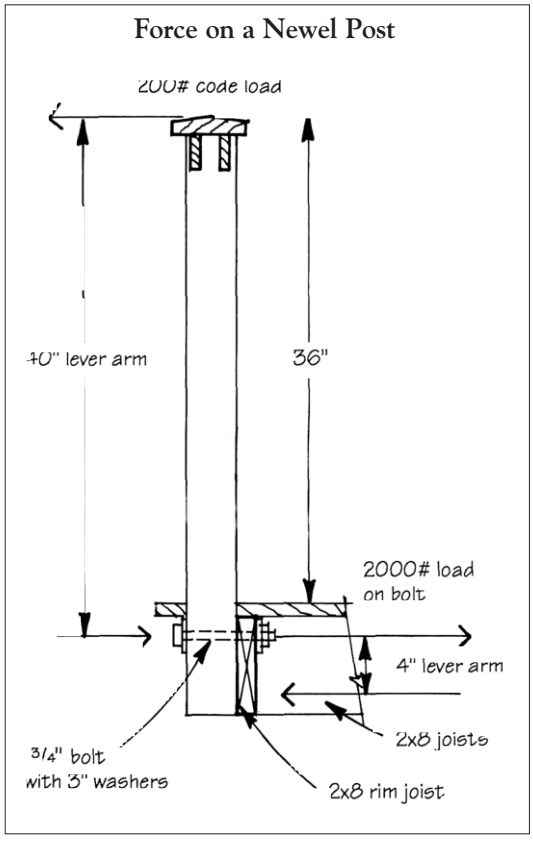


Figure 1. *Bolted-on railing posts rarely meet code because the posts act like a big lever arm trying to twist the rim joist. A 200-pound horizontal load applied at the top (as specified by code) places a 2,000-pound load on the bolt at the bottom. Upsizing to a 2x12 joist cuts this load in half.*

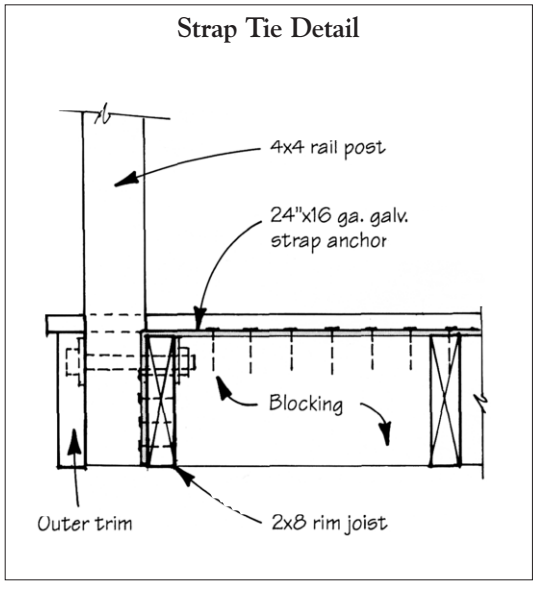


Figure 2. *To stop the rim joist from twisting, tie it back to the floor joists with galvanized steel strapping or strap ties. Where the ties run perpendicular to the joists, attach them to solid blocking.*

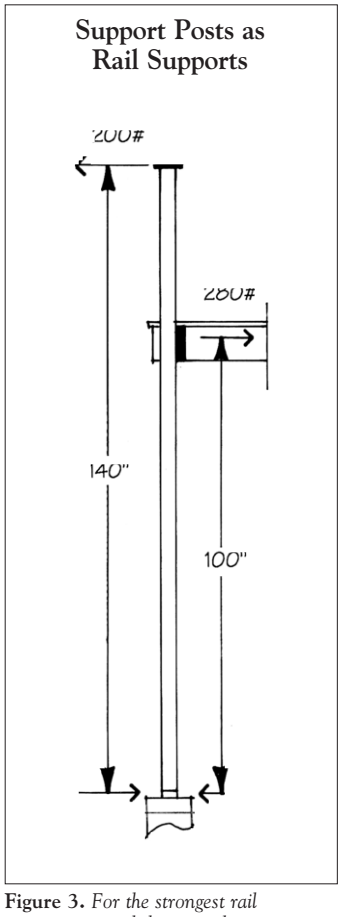


Figure 3. *For the strongest rail supports, extend the posts that support the deck up to the railing height. These typically run 8 feet on-center. In between, use posts securely attached with bolts and strap ties.*

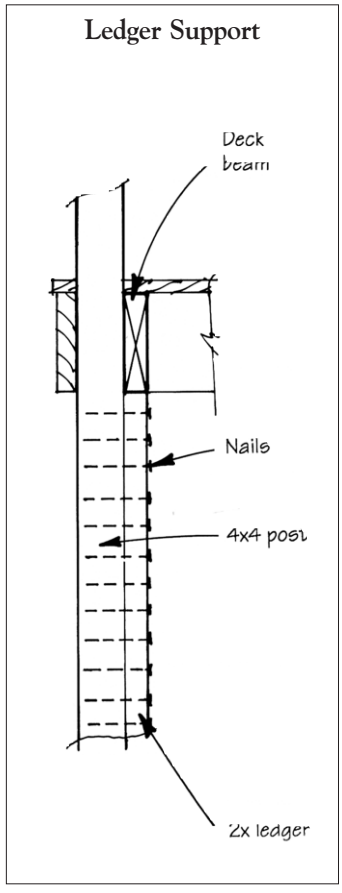


Figure 4. *Hanging the deck's main beams from bolts usually doesn't meet code. One approach is to attach a vertical ledger with enough nails or lags to support the rated load — or run the ledger down to the pier foundation.*

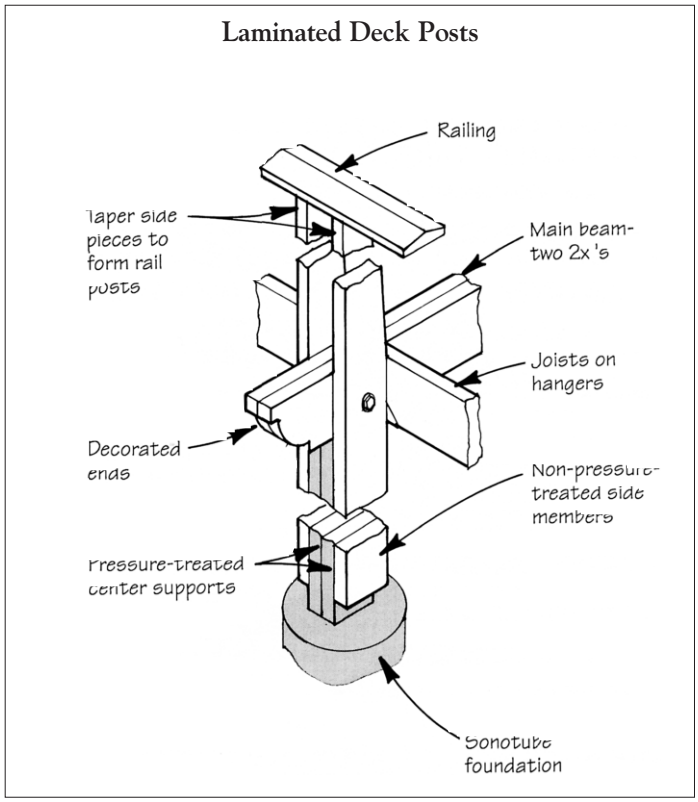


Figure 5. *If you're building with wet lumber, 2x4 stock will shrink and twist less than larger pieces. In this design, the main beam sits on pressure-treated posts that run to the foundation. Untreated 2x4 posts start above ground level and extend to form rail posts.*

cover the straps with building paper or rubber strips (which you need anyway between decking and framing to prevent rot).

Structural Balusters

Another way to spread the load is to put the supports closer together. Let's examine a common and economical system using 2x2 balusters at 6 inches on-center.

If you run the numbers, each baluster can only handle a 10- to 20-pound push, so again you need a continuous or well-spliced railing to spread the 200-pound load over many balusters. Even though this reduces the twist on the rim joists, you still need the straps.

Structural balusters are not a good idea, however, in the opinion of an engineer I use. Here's why: If you bolt the balusters to the rim joist, they will loosen up when the wood shrinks, and few homeowners will bother to retighten hundreds of bolts. With the bolts loose, the railing feels flimsy and puts a sudden jolt on the balusters when they finally take the load, which is not good.

As a result, most builders attach the balusters with lag screws, which stay tighter than bolts. This creates a serious problem, however. If water gets into the screw holes over time, and if the wood is not heavily treated (or is untreated), rot can build up around the screw. Then under load the screws will fail suddenly with no warning. This is dangerous and is not good engineering practice — a fact which can be used against you in court.

When you use bolted 4x4 rail posts, they too will loosen up, but the owner only has to tighten a few bolts to fix the problem. Rail posts attached with bolts are better and safer for outdoor railing systems than are stuctural balusters attached with lag screws.

Posts Make Best Supports

By far the best rail supports are formed by extending upward the posts that support the deck (Figure 3). The long lever arm of the support posts enormously reduces the load where they connect into the deck (by a factor of 10 or more). Use this solution whenever you can.

Since the main support posts are usually on 8-foot centers, you can insert a 4x4 rail support halfway between (detailed as noted above). It's best to beef up the handrail enough to carry the load between the main supports: a 2x6 is usually okay.

In this approach, you also need to pay attention to how the deck beams attach to the main support posts. Surprisingly, most deck designs where the framing hangs on bolts running through the support posts do not meet code. You can use steel hangers rated for the load, but as far as I know there is nothing available off the shelf that will work.

One approach is to notch the post. For example, if you use a 4x6 post, cut it down to 4x4 above the deck to hold up the railing. Rest the deck beam on the shoulder of the notch, which should be flashed to keep water out of the end grain.

The easiest way to solve the problem, however, is to spike an extra 2x onto the face of the post to create a ledger for the deck beam. You can cut the ledger off short of the ground providing it is long enough to take 20 or 30 nails or the equivalent in screws or lags (Figure 4, previous page). Lots of nails are required since even 20d nails only support about 80 pounds each in shear.

Use Small Wood Pieces

The choice of wood has an important impact on the design. If you design with 6x members and want a nice job, you need clear, dry stock. This means using old-growth, nonsustainable, and very expensive timber, such as clear Douglas fir or redwood. (As such wood becomes prohibitively expensive, I hope we'll stop cutting these irreplaceable trees.)

Large timbers in cheaper grades of wood come dripping wet, with various kinds of defects. When they dry out, they move and twist unpredictably. This is especially true with the pressure-treated southern yellow pine commonly used for deck framing.

We desperately need a reliable glued-up composite material for outdoor framing which can take the rain and sun. Nothing that I have seen yet fills the bill. In the meantime, one defense against the problems of cheap, wet wood is to use the smallest pieces you can.

Use 2x material wherever possible. Two-by stock is usually drier than 4x or 6x stock, and you might have time to let it dry out in the field. Also, you can afford to pick through your stock to find the best pieces for use as posts.

Make the main posts out of layers of 2x stock, with the grain reversed to even out warpage. Screw, nail, or lag the pieces together to satisfy the inspector and to prevent failure by sideways buckling.

As shown in Figure 5, if the post is laminated from several 2x members, you can use lengths of pressure-treated stock at the base for support and as ledgers to support the deck beam. The rest of the post can be made of ordinary (dry) framing lumber. ■

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