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Stronger Post-to-Beam Connections

These critical joints must be designed to resist more than just the force of gravity

by Mike Guertin

The most under-appreciated connection on a deck frame is probably the one between a post and the beam it supports. Although this joint may not get the respect it deserves, it is a critical load-path connection that needs to keep the post and beam aligned while properly transferring deck loads to the footing. A less obvious but equally important function is resisting uplift loads. And when a lateral force is applied to the post, the connection also has to resist beam rotation and post displacement.

Metal connectors are good at managing load paths and post displacement, but I haven't found any that are particularly effective at handling beam rotation. For that, I want a wood bridge between the beam and the post. Beam rotation isn't a problem with every post-to-beam connection, though, so I plan accordingly. The specific detail I use depends on the size of the post, the position of the beam, and whether the installation is for a new deck or a retrofit. In addition, I need to be sure that the posts have adequate diagonal bracing to resist deck racking.

Bracing the Beam

When I'm planning a deck, one of the first things I do is assess the risk of beam rotation. Integral beams—rim beams, for example—are stabilized by the joists and joist hangers and usually require no additional beam-rotation bracing measures.

It's a different story, though, when the joists lay over the beam. When posts are less than one foot tall—on what is essentially a grade-level deck—they aren't likely to be knocked sideways, and the metal connectors provide all the bracing needed. But the risk of beam rotation increases proportionally with the height of the post, and I always install lateral bracing on posts that are taller than one foot. There are a number of ways to do this.

Notched posts. A common method of addressing beam rotation is to notch a 6x6 post to accept a two-ply beam while leaving a 2 ½-inch-thick attachment leg to bolt the beam to. Once the beam is fastened to the post with a pair of ½-inch bolts, the assembly will prevent beam rotation, and the integral post leg will also provide uplift-load-path continuity (**Figure 1**). One advantage of this configuration is that it doesn't require any additional metal connectors; another is that it's presented as a code-compliant connection in the American Wood Council's DCA6 *Prescriptive Residential Wood Deck Construction Guide* (awc.org).

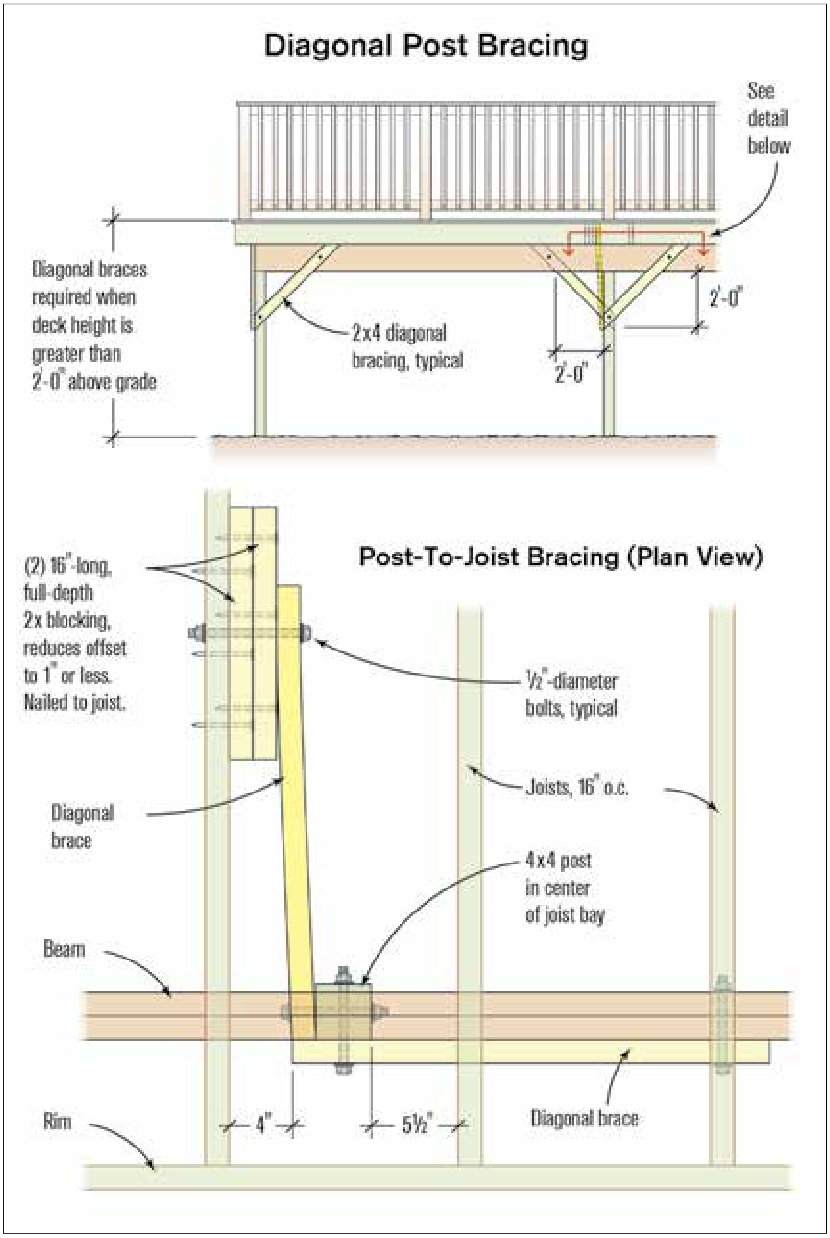
Splice blocks. When a 6x6 post is taller than 5 feet, I add a 2x6 splice block to the face of the notched side of the post so the beam is sandwiched with support on both sides.

Splice blocks can be used on unnotched 4x4 posts as well (**Figure 2**). Fastened to the post with structural screws or through-bolts, splice blocks typically run from the top of the beam and overlap the post-beam joint by a foot or two. When posts are shorter than 5 feet, I use a single splice block. On taller posts, I double up the blocks, installing a ½-inch-thick filler between the post and the splice block on one side of the beam. Because there aren't any resources that qualify splice blocks for uplift resistance, I install metal hardware on these connections.

Figure 1. When a 6x6 post is notched to support a 2-ply beam, the post extension acts as a bridge between post and beam, preventing beam rotation and providing uplift-load-path continuity.

Figure 2. When a beam is supported by a 4x4 post (which can't be notched), a 2-by splice block bolted and screwed to the post-and-beam assembly will prevent beam rotation. Note the metal connector, which is required when using this detail.

Figure 3. Diagonal bracing between posts and beams or between posts and joists is needed to counter lateral loads at the perimeter of the deck (see illustration, below). Blocking may be needed when the faces of the posts, beams, or joists aren't aligned.



Diagonal post braces. According to DCA6, on any deck higher than 2 feet above grade, diagonal braces should be installed between the posts and the beam, and the posts and the joists (**Figure 3**). These braces stabilize the post-to-beam joint and help resist lateral loads.

To meet this requirement, I bolt 2x4s to the posts approximately 2 feet below the bottom of the joists at a 45-degree angle to the beam and joists. While code typically allows 3/8-inch-diameter bolts for fastening braces to posts, beams, or joists, I use 1/2-inch-diameter bolts instead. There's no penalty for exceeding code, and it's easier to keep a single bolt size on hand (1/2-inch bolts are required for many other deck connections).

Most of the time, installing post-to-beam braces is straightforward, since the faces are in or close to plane. Installing post-to-joist braces can be trickier, because rarely does a post face align with the side of a joist. When the offset is less than an inch or so, I don't mind running the braces at a slight angle. But when the offset is more than an inch, I nail one or two 16-inch-long, full-depth blocks to the side of the joist to reduce the offset to 1 inch or less. In the worst case—a 4x4 post falling dead center in a 14 1/2-inch-wide joist bay—adding two blocks to each joist leaves just 1 inch offset.

Post-to-Beam Hardware

These days, there are almost too many hardware options for connecting posts and beams together. Some metal connectors are designed for new construction and must be positioned on the post before a beam is placed (or vice versa). There are also connectors that can be applied after the beam is placed atop the posts, making them well-suited for retrofits as well as for new construction. Some connectors fasten posts along the middle of a beam, while others are designed for the end post (**Figure 4**).

When grabbing hardware out of a bin at your local lumberyard, remember that metal connectors are sized for different types of beam stock. Two connectors may look identical, but one model may be designed for solid-sawn beams and measure 3 1/2 inches or 5 1/2 inches between flanges, while another model is designed for built-up beams and measures 3 inches or 4 1/2 inches between flanges. Smashing mismatched hardware into submission is not an option, since hardware manufacturers won't support deformed hardware installations.

Simpson Strong-Tie LCE4 Two-piece corner connector for 4-by or 6-by lumber (new or retrofit construction)

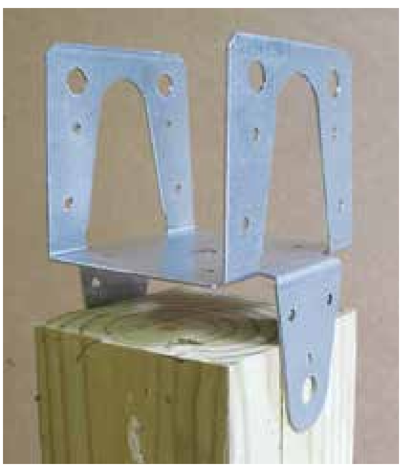
Simpson Strong-Tie EPC44
Medium-duty 12-gauge end-post/beam connector for 4-by posts

Figure 4. Hardware for post-to-beam connections is available for both new and retrofit construction. Connectors should be properly sized to match the framing.

Simpson Strong-Tie AC6Z Two-piece connector for end-post installation where the sides of the post and the beam are flush (new or retrofit construction)

Simpson Strong-Tie BCS2-3/6 One-piece connector for attaching a triple 2-by beam to a 6x6 post

Simpson Strong-Tie LPC4Z Two-piece connector for beams that are narrower than post width (new construction)



USP BC400-TZ One-piece connector for attaching a double 2-by beam to a 4x4 post

USP PBS44 Two-piece connector for attaching a 4x4 post to a 4-by beam (new or retrofit construction)

USP PB66-6 Two-piece connector for beams that are narrower than post width (new construction)

Figure 5. Side-applied beams are inherently weak and prohibited by most building codes, unless the post is beefy enough—6x6 minimum—to be notched to support the beams.

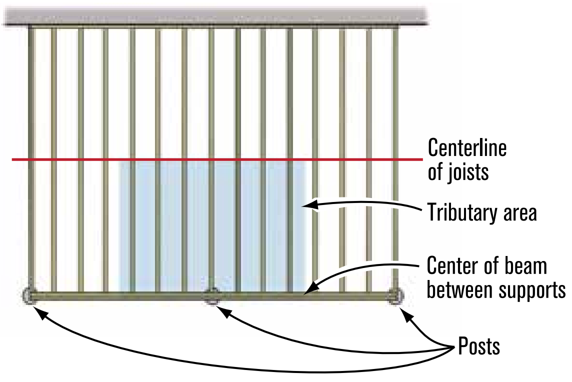
Figure 6. On 4x4 posts, metal hardware—including Simpson Strong-Tie's DJT14Z (shown) and USP's SDJT14-TZ—can be used to support side-applied beams.

Side-Applied Beams

Some deck builders like to bolt 2-bys to either side of the posts, though this detail generally won't comply with building codes without an engineer's stamped drawing. But a few options do meet code if you like the idea of side-mounted beam plies. One approach is to notch a 6x6 post on both sides to provide shelves for the 2-bys to rest on (**Figure 5**). A second is to install jack studs beneath the 2-by beam plies. Screwed, bolted, or even nailed to the primary 4x4, 4x6, or 6x6 post, each jack should extend from the bottom of the beam ply all the way down to the footing in a single piece, one on each side of the post.

You can also use metal hardware to secure the connection (**Figure 6**), though if you choose this option, you'll have to do some calculating to determine the post spacing based on the deck load. Since the hardware is rated for vertical loads, you have to determine the tributary loads (see Tributary Loads, right) the deck will impose on each connector, to ensure the connectors aren't overloaded.

The load capacity of this hardware depends on the brand, size, and diameter of the nails, screws, or bolts used to make the connection. Once you've determined the maximum load per connection based on your chosen fastening method, you then space footings and posts according to the maximum tributary load at each beam-post connection. And even though the connectors can be installed with nails alone, I recommend using bolts in addition for a more robust connection (see Bolt Alternative, page 46).



Tributary Loads

The tributary area supported by a post equals half the beam length on each side of the post multiplied by half the joist length to the next support, such as another beam or the ledger. Multiplying the square footage of the tributary area by the design load (typically 50 psf) yields the tributary load.

Nails or Screws?

Instead of using nails to install metal hardware, consider using structural connector screws instead. I prefer structural screws for almost every piece of deck hardware, including joist hangers, post-to-footing and post-to-beam connectors, and wind-uplift ties (**Figure 7**).

Not only do screws often increase allowable loads, but they make it much easier to remove and reinstall hardware (which is next to impossible with nails). They install just as quickly as pneumatically-driven nails and with far more control. Compared with pounding in nails by hand? There's no contest.

Connector screws come in 1 ½-inch and 2 ½-inch lengths (the longer screws are used for the diagonal "shear" holes on joist hangers). Both USP and Simpson offer connector screws for many of their hardware pieces, though I haven't found stainless steel connector screws for stainless hardware. My local lumberyard stocks Simpson connector screws (800.999.5099, strongtie.com); USP screws (800.328.5934 uspconnectors.com) seem to be a little harder to find in my area. The screws are rated for use only on same-brand hardware, so technically, you can't mix and match.

A 100-count package of Simpson's 1 ½-inch #9 screws costs me about $11, while a 100-count package of 1 ½-inch connector nails costs about $2.75. Allowing for 10 fasteners per hanger, a deck with 30 hangers would cost about $25 more with screws than if nails were used. Considering that a single decking board costs around $50 these days, the added cost for screws is minimal. ❖

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Bolt Alternative

You have to bore out a lot of clearance holes when bolting beams to posts or when bolting braces. To save time (and money), I use FastenMaster ThruLok bolts (800.518.3569, fastenmaster.com) instead, which screw right through lumber without predrilling. I've found that ThruLoks are usually less costly than hot-dipped galvanized bolts, washers, and nuts, and they install faster, making them a win-win.

Figure 7. Using structural screws instead of nails will increase the uplift and lateral-load-bearing capacity of most metal connectors.