Guardrail Post Kits

Proper blocking is the key to a strong installation

by Mike Guertin

Structural metal guardrail posts and post mounting brackets aren't heavily marketed, and though the assembly instructions for many composite railing systems refer to them, I never gave them much thought. Until recently, that is, when a couple of 4x4 wood posts twisted and bent just months after I had installed them—pulling apart the composite railing that was attached to them.

To see if they might be a good alternative to conventionally installed wood 4x4s, I rounded up a sampling of structural metal posts and post mounting brackets to test. Many of the available products can be installed on concrete, but I focused on those that attach to the surface of a wood deck. The ones I ultimately tested ranged in price from about $20 (without any mounting hardware) to just over $100 when the hardware necessary for installation was included. Some are sold as accessories to specific composite railing systems, while others are sold separately and can be used with many types of guardrails.

I wanted to find out how difficult structural posts and brackets were to install, and whether they were cost-effective. I also wanted to know if they were as strong as properly-mounted 4x4 posts, and if they met building code requirements.

Testing

By code, guardrails must be able to resist 200-lb. concentrated loads anywhere along their length and in any direction (2012 IRC table 301.5). To that requirement, I applied a safety factor of 2.5 (as I do for wood post assemblies; see "Code-Compliant Guardrail Posts," May 2011). IRC section R317.4 calls for wood-plastic-composite guardrail systems to comply with ASTM D7032, which requires that guard posts be capable of supporting a 500-lb.-per-square-foot concentrated load at their tops. ICC-ES Acceptance Criteria for manufactured guardrail systems—AC273 and AC174—use the same load requirements as, and similar language to, the ASTM standard.

Third-party testing services use calibrated equipment and follow set protocols to conduct tests that are recognized by engineers and code officials. My homemade test assembly was not as sophisticated: Made of 2x8s, it was a 54-inch-wide by 8-foot-long framed box, with a "rim joist" and 3-foot-long SYP "joists" set 16 inches on-center (see photo, facing page). I fastened blocking between the two middle joists and to the rim joist according to each product's installation instructions (or drawings). I wrapped a chain at 36 inches or over the top of each post (whichever was lower) and also around a header at the end of the framed box. A 1,500-lb. digital crane scale measured the load on the post, and a hand cable winch provided the force. The downward angle of the winch cable mimicked the direction of a force exerted by someone leaning against a guardrail.

I repeated the test two or three times with each post and bracket. In some cases, if the assembly failed before the load reached 500 lb., I changed the blocking arrangement and measured the highest load the attachment could handle before it pulled apart.

Surface-Mount Posts

I checked out four surface-mounted posts (two of which were similar in design) that were a fair representation of the 10 or more models on the market. Many of the other posts are nearly identical to the four I selected, from the post-sleeve spacers to the thick steel bottom reinforcing plates. Some—like the LMT Blu-Mount steel post mount (lmtproducts.com)—can be used with many different types of post sleeves, while others—such as the Trex Post Mount (trex.com) and Tam-Rail Post Mount (tamko.com)—are branded for specific railing systems.

Most posts can be mounted to concrete or wood, so the appropriate installation kit may need to be ordered separately from the posts. For some models, you'll have to supply bolts, nuts, washers, and screws.

Most of the instructions provide only sketchy blocking and fastener details, and don't include block sizing or fastener quantities. Many include a statement that places the burden of determining proper attachment and code compliance on the installer, and some recommend review by an engineer, an architect, or a building official. I was left feeling that—just as with mounting 4x4 wood posts directly to the deck frame—installers are on their own to sort out the finer field details (see "Blocking Posts," page 35).

EZ Post Mounting System (ezmount.com). The EZ Post is a 36½-inch-tall round galvanized pipe with a 3½-inch-square base plate (**Figure 1**). Round plastic EZ Mounts that come with the kit space the post sleeve and are sized to fit either 4x4 or 5x5 sleeves. Their round design enables you to tweak the post sleeve to be perfectly square to the railing section (the other kits require the post base plate to be installed perfectly square). The company also has a 42-inch-tall version that lists AC174 compliance.

I couldn't find installation instructions online or in the box, so I set double 2x8 blocks perpendicular to the rim joist and screwed them to the rim and to a vertical block screwed between the joists. Then I installed the post using ⅜-inch by 5½-inch galvanized bolts and regular washers. At 373 lb., the double blocks broke through. I did another test—this time adding a metal plate beneath the blocking, through all of which ran the bolts—and reached 500 lb., though the bottom plate on the post bent a little.

The post doesn't come with leveling shims, but you could stack washers between the decking and bottom of the post to plumb it.

The EZ Post kit is available through EZ Mount's website for $37.50 plus shipping.

Figure 1. The EZ Post system doesn't come with fasteners, an adjusting system, or a reinforcing base plate (top right). When fastened with 7/16-inch-diameter bolts and regular washers to doubled-up blocks that ran perpendicular to the rim joist, the washers and nuts began to pull through the blocking as soon as force was applied; at 373 lb., the blocking split, with more than a foot of deflection. When reinforced with another system's base plate, the assembly was able to handle 500 lb. of tension, though the mounting plate bent (bottom right).

Figure 2. The TimberTech/Azek post is sold separately from the install kit, which includes an adjusting plate and adjusting screws along with a reinforcing bottom plate and bolts (top left). The top block has set-screw locations to lock onto the post for 36- and 42-inch-high railings. Anchor bolts drop through the holes at the corners of the base, while the smaller holes in the edges are threaded for the adjusting screws that are used to plumb the post (bottom left). The 3½-inch-square bottom of the post shows no signs of bending after testing at 500+ lb. of tension (above).

TimberTech/Azek Secure-Mount Post (timbertech.com). The Secure-Mount post is made of heavy-gauge square steel tube and a 3½-inch-square base plate and comes with leveling shims to adjust the post plumb (**Figure 2**). Repositioning a set screw in the top plastic spacer block adjusts for 35½-inch or 41½-inch heights. The install kit includes four ⅜-inch by 5½-inch galvanized anchoring bolts, nuts, and washers; a leveling plate and adjusting bolts; and a thick steel reinforcing plate. The eight predrilled holes in the reinforcing plate hug two edges so the bolts can be located within ¼ inch of the rim joist and side joist. The holes align with those in the post's base plate.

The blocking requirements—double 2x8 blocks run flat and perpendicular to the rim joist, with a vertical block between the joists to pick up the end of the flat blocks—are fairly clear in the included installation diagram. The blocks must run alongside one of the joists. The installation figure shows four #10 x 3½-inch screws driven into the edge and ends of the blocks for a total of 12 screws. I erred on the conservative side and installed double rows of screws—one row into each flat block. The installation was rock-solid with less than 2 inches of deflection when the post was subjected to a 500-lb. load.

Expect to pay between $75 and $90 for a post and another $20 to $25 for the wood-deck installation kit.

Figure 3. The UltiMount ProSpec kit comes with a galvanized surface plate and bottom plate, plumb adjusting bolts and nut plate, and a post-sleeve spacer and skirt (left). Not included are 5/16-inch-diameter mounting bolts. While the reinforcing plates prevent the bolts from pulling through or splitting the blocks, the weld between the thin-wall steel post and the plate snapped at a little over 350 lb. (above).

UltiMount ProSpec 36 (americanwaymfg.com). This post is made of a medium-gauge square steel tube with a 3 3/8-inch base plate (**Figure 3**). A heavy-duty 42-inch post is also available, as are kits for concrete and wood decks. The wood-deck kit includes a post, surface leveling plate, leveling bolts, block reinforcing bottom plate, and anchor bolts. While the posts are 31 inches tall, plastic top-rail stabilizer caps extend the overall height to 36 1/2 inches. The lower post stabilizer is a sheet-metal ring welded onto the post; a separate snap-on plastic rail stabilizer is installed once the post is fixed to the deck.

The instructions show a single 2-by flat block and a single vertical block between joists to pick up the edge of the block, with no references to the type or size of fasteners; I used 3-inch exterior wood screws and drove three in through the ends of the block and four along the edge into the vertical block. The weld between the post and the base snapped at 354 lb. during the test. A close look revealed a poor weld job—even though the weld bead ran all the way around on the base plate, barely 30% of the steel tube's perimeter was welded properly. The paint finish had bridged the gap between the weld and the side of the post, obscuring the defect.

An UltiMount ProSpec36 wood-deck kit runs $60.

Plumb Perfect Adjustable Mount (palisaderail.com). Vinylast's Plumb Perfect is a 37-inch-tall heavy square steel tube with a 3 1/2-inch base plate (**Figure 4**). The installation kit includes bolts and a reinforcing base plate. The post itself is 32 1/2 inches tall and the top block is bolted through the center of the post. What sets the Plumb Perfect apart is the adjustable top post-sleeve block. A large hole in the bottom of the

Figure 4. Vinylast's Plumb Perfect post and blocks are sold separately from the mounting kit, which includes a reinforcing base plate and four bolts (top). The top block on the Plumb Perfect post is adjustable up to 7/16 inch in any direction to account for the post being out of plumb, even after a post sleeve has been slid over the post (above).

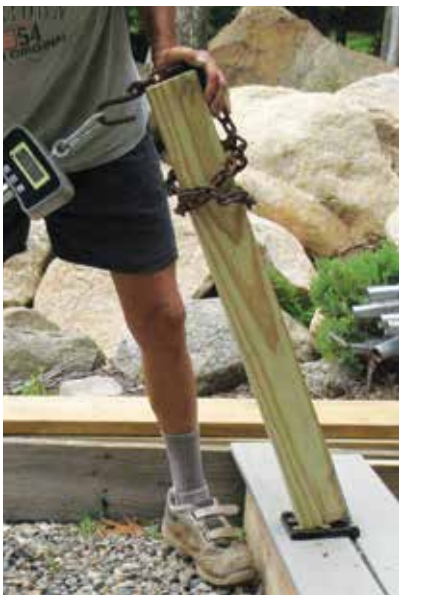

Figure 5. The Titan Post Anchor requires lag screws to secure the base plate to the post and 3-inch-long screws to fasten the base to the decking and blocking. Accessories such as a 1¼-inch-diameter hole saw (for drilling a mounting hole into the center of the post), a hammer cap, and a hole-saw centering tool are also available from Titan (above left). When the anchor was installed according to instructions, the inner screws pulled out of the blocking and decking at between 220 lb. and 270 lb. of force (above center). Using double blocking with the grain parallel to the tension force and through-bolts and washers instead of screws improved performance, but the top of the post deflected almost 12 inches (above right) before the bottom of the post finally split at 374 lb. of tension (right).

plastic block permits access to the bolt in the center so it can be loosened to adjust the top block 7/16 inch in any direction. Steel plates sandwiched at the bottom of the block reinforce the bolt connection to the post. When the metal post within is out of plumb, the post sleeve can be adjusted plumb from the top after it's installed—just remove the post cap to access the bolt. There's no need to deal with adjusting bolts or shims at the base.

The blocking diagram is the same as in the TimberTech/Azek instructions. When installed according to the instructions, the Plumb Perfect showed minimal deflection under a 500-lb. load.

Each post sells for about $30 to $50, depending on the distributor, and the mounting hardware kit runs about $15 more.

Surface-Mounted Wood-Post Anchors

While I found a number of post bases that bolt or screw to the surface of a deck and support 4x4 wood posts, many of them were made of plastic and didn't seem suitable for structural guardrail anchoring. Two that did seem appropriate and that were readily available were the Titan Post Anchor and the Fiberon Post Sleeve Surface Mount.

Titan Post Anchor (titanbuildingproducts.com). The Titan post mount consists of a steel cylinder welded to a base plate (**Figure 5**). The cylinder is designed to fit into a hole bored by the installer into the center of a wood post. The bottom plate is then screwed both to the post and into deck blocking. The anchor is available in galvanized, powder-coated, and stainless steel versions for 4x4 and 6x6 posts, and is sold with or without the screw hardware kit. The system can be used with site-built wood railings or with a composite railing system with post sleeves that fit over the wood posts.

For the 4x4-sized Titan anchor, I drilled a 1⅞-inch-deep hole in the center of a treated SYP post using a 1¼-inch-diameter

Blocking Posts

I played around with a few different blocking schemes to see what worked and what didn't under different circumstances. Here's what I learned.

Grain direction matters. Blocks that run parallel to the rim joist (A) tend to split when the bolts are installed only with washers, even when the blocks are doubled up. This makes sense—the two inboard bolts on the posts receive the most tension when a post is pushed outward. Since the two bolts are in line, the grain is more likely to split. Blocks whose grain ran perpendicular to the rim joist didn't split even when the load on the post was cranked up to 500 lb.

Vertical blocks keep flat blocks from lifting. When the blocking's grain is parallel to the rim, attaching a vertical block to the blocking helps secure it. Without the block, the inside edge of the blocking can pull upward. When the block grain runs perpendicular to the rim joist, snug one side of the block up to a deck joist (B).

A heavy steel backing plate makes a big difference. Posts installed with heavy base plates to reinforce the blocking (like the ones supplied with the Vinylast and TimberTech/Azek posts) had less than 3 inches of deflection, no matter which direction the grain in the blocking was oriented (C). When washers were used instead of the plates, the washers deformed and the wood blocks compressed so much that some test posts deflected up to 11 inches before 500 lb. could be reached (D).

Blocking should be screwed, not nailed. Unless the manufacturer's instructions noted something different, I installed four 3-inch exterior wood screws into the ends and side of each layer of double blocking—24 screws minimum. When I used only 12 screws, as was depicted in some instructions, the blocks showed evidence of lifting on the inside edge. Nails worked okay, but the joints at the ends of blocks opened up a little—something I didn't notice when screws were used.

Don't sandwich crushable decking under a structural post. One company's instructions require that the posts be mounted to the blocking before the installation of hollow-core decking (like GeoDeck, GeoLam, Genoa) or cellular PVC decking. Hollow or soft decking sandwiched between the base of a structural post and blocking will likely be crushed when a force is applied to the post, resulting in excessive deflection or connection failure. —*M.G.*

(A) Double blocking is stronger than single blocking, and screws hold better than nails. The author attached two blocks to the rim, joists, and vertical block (not yet installed) using four screws per block per side. Blocking installed parallel to the rim joist, as shown above, tended to split along the bolt line unless a heavy steel reinforcing plate was used.

(B) The strongest blocking runs perpendicular to the rim joist. It's best to align the blocks with a nearby joist for extra stiffness and add a solid block between the rim and first inboard joist at the ends of the deck.

(C) TimberTech/Azek's reinforcing plate is predrilled with eight holes (two pairs of four holes) positioned near one corner of the plate, to match the pattern in the base plate. This arrangement enables the plate—and the post above—to be located close to the rim joist and a deck joist. The same plate design is used to reinforce the blocking on the Vinylast and UltiMount posts. The post must be oriented such that the bolt holes clear the rim joist and deck joist by at least 1/4 inch so the base plate will fit.

(D) When post kits were installed with bolts and washers rather than with a reinforcing base plate, the washers and nuts began to pull through the blocking long before test loads on the post reached 500 lb.

Figure 6. The Fiberon Post Sleeve Surface Mount kit comes with a heavy steel post box and plate, a rabbeted 4x4 post, and a concrete anchoring kit (left). The post base box stands 8 inches tall and bolts through double 2-by blocks with four 5/16-inch-diameter bolts you supply. The author used the fender washers supplied with the concrete anchors to back up the nuts at the bottom of the blocking. The Fiberon mount had no trouble handling more than 500 lb. of force with only about 3 inches of deflection (above).

hole saw, leaving the plug core in place when I removed the saw. Then being careful to orient the anchor square to the post's edges, I drove it onto the post using a small sledgehammer. For hardwood posts, the hole needs to be at least 3 1/4 inches deep. To reach this depth, you'll need to either remove the first cut center plug using a hole saw, or bore the hole partway using a Forstner bit. The cut can be finished to the final depth using the hole saw—just leave the second cut plug core in place.

Titan offers two accessories to get you to this point: a center guide that positions the hole saw in the middle of a 4x4 or 6x6 post, and a hammer cap to assist in driving the anchor onto the post. The alternatives are to draw a cross between the post corners to get the centerpoint; or to drive the anchor using a 5-pound sledgehammer and a hardwood block to protect the bottom plate finish.

Four 3/8-inch by 5-inch galvanized lag screws are used to fasten the bottom plate to the post. Holes are predrilled in the plate but pilot holes are required in the 4x4s to prevent splitting.

The blocking diagram included with the kit shows a single 2x8 fastened on the flat between joists. The instructions don't specify the size, type, or number of fasteners, but a note from the company recommends three #10 x 3 1/2-inch screws through each side joist into the ends of the block. The Titan anchor is then secured to the decking and the blocking beneath with six 1/4-inch by 3-inch screws.

According to the manufacturer, independent testing had determined that the Titan anchor complied with ICC-AC 273, where the main test is a 500-lb. load at the top of a 36-inch-tall post and a deflection measurement at a 200-lb. load. When I installed the Titan anchor according to the instructions, the inner screws pulled out of the block and decking at between 220 lb. and 270 lb. of force. I tried a different blocking arrangement using double 2x8 blocks with the grain parallel to the tension force and used through-bolts and washers instead of screws. Though the post deflected about 12 inches in the second test, the arrangement reached up to 374 lb. of tension before splitting the bottom of the post.

Prices range from $15 to $30 depending on finish, size, and whether the hardware kit is included (you supply the wood post).

Fiberon Post Sleeve Surface Mount (fiberondecking.com). The Fiberon post mount is a powder-coated steel box with a welded base plate that bolts through deck blocking (**Figure 6**).

Also included in the Fiberon kit are a rabbeted PT 4x4 that fits inside the base, and fasteners for anchoring to concrete (5/16-inch concrete screws and heavy-duty fender washers).

The box that receives the post measures 3 1/2 inches on each side so that a 4-inch post sleeve will slip over it. The blocking instructions are explicit: Fit double 2x8 blocks on the flat between the joists and against the rim board and install a vertical block between the joists at the opposite edge of the flat blocks. The 38 3-inch-long stainless steel screws needed to fasten the blocking together and to the joists and rim are not included in the kit, nor are the four 5/16-inch by 5-inch galvanized hex-head bolts used to secure the mount through the decking and blocking. Holes are bored in the sides of post receiver box for screws, to attach it to the 4x4.

There's no out-of-plumb adjustment built into the Fiberon mount, but you could slip some washers between the bottom of the mount and the decking as shims before tightening down the thru-bolts.

One issue Fiberon doesn't address in its instructions is how to mount bottom rail brackets to the post sleeve. Since the steel post box is 8 inches tall, I suppose you'll have to drill through the side of the metal post box to keep the bottom rail at the proper height off the deck.

According to Fiberon, this post mount is ICC-AC174 compliant. My test scale reached more than 500 lb. with only about 3 inches of deflection at the top of the post—and that was mainly due to the washers crushing into the block by about 1/4 inch.

The kits sell for between $45 and $60 online and through dealers (they're also available at Home Depot under the Veranda brand).

Structural metal posts have height-adjustable plastic mounting spacers at the top and bottom that are sized to fit standard 4x4 post sleeves. Rails and rail brackets can be fastened through the post sleeves into the spacers.

Specialty Role

Structural railing-post systems won't twist or bend weeks or months after installation, but that stability comes at a price: Anchoring a manufactured post to a wood deck frame costs considerably more than installing a 4x4 wood post using tension ties. In part this is due to the cost of the posts themselves, but it is also because the blocking for these structural railing posts and brackets takes more time to install adequately than the blocking and associated hardware for 4x4 wood posts. But with proper blocking and adequate reinforcement, most of these systems comply with building code requirements and testing criteria.

I don't see these post kits as a full-time replacement for wood posts, but they might be a problem-solver for certain applications, such as a ground-level deck with shallow joists, for example, or a finicky composite railing. ❖

Mike Guertin is a deck builder from East Greenwich, R.I., and a regular presenter at DeckExpo and JLC Live.