

# Structural Hardware

**Today's codes require specialized connections on decks, from footings to framing**

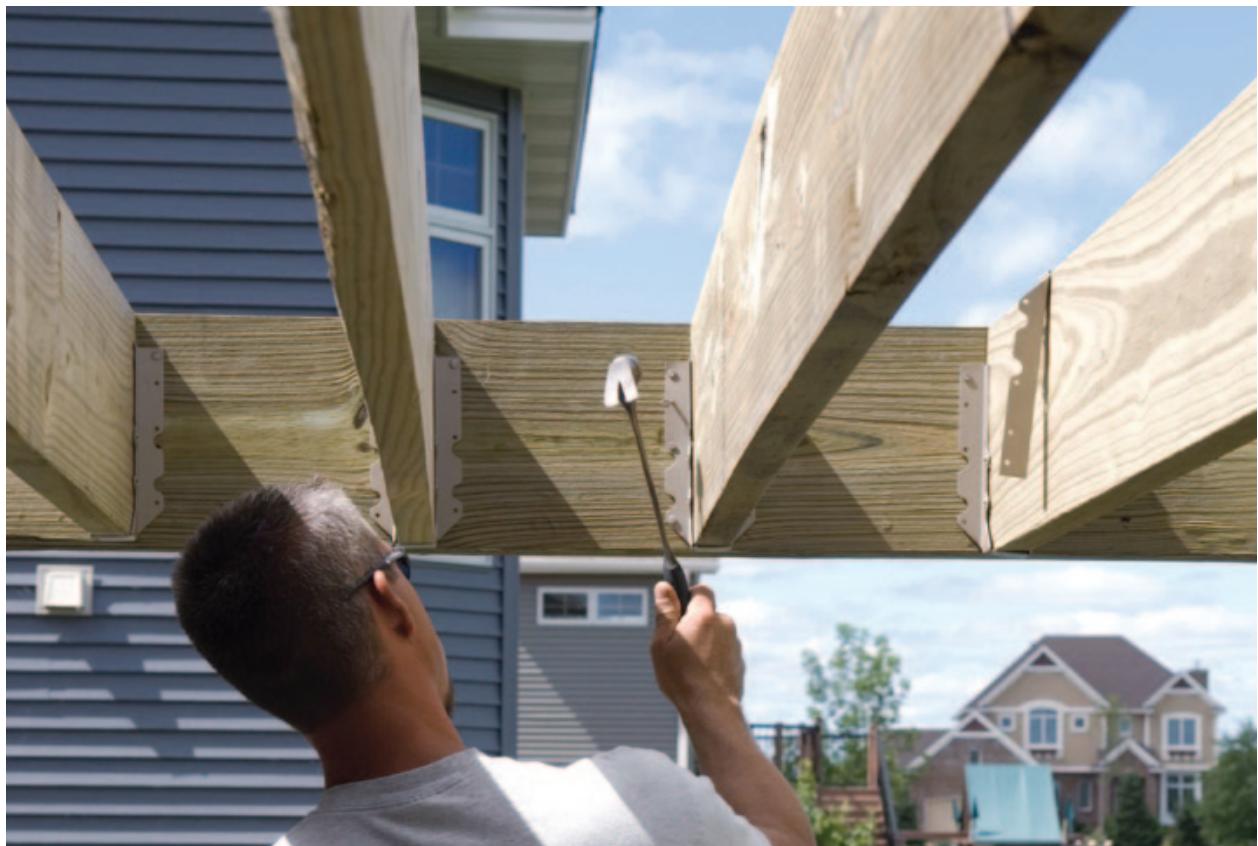
**I**magine a deck builder who met his untimely death in 1982. If you could bring him back to life in 2012 and plop him down on a brand-new deck, he'd see much he didn't recognize: curved composite decking with a matching synthetic railing system, LED lighting, a hot tub, a gas fire pit. The greatest shock, though, might come when he walked under the

deck and saw the number and variety of metal connectors that were holding the whole thing together.

He may have seen joist hangers and carriage or lag bolts before, but all the other structural hardware would astound him. Starting at the ground, he'd see footing-to-post connectors, then more hardware at the top of the posts where they were

bolted onto a beam. He'd marvel at the brackets that secured the rail posts to the joists. And when he got near the building and saw the galvanized bolts and brackets that secured the ledger to the house, he might just scratch his head.

"What's with all this metal?" he might ask. "We used to toenail everything and it worked fine. But you know, the last thing



by Jefferson Kolle

I remember is we'd finished a big second-floor deck on a house on the side of a hill, and the homeowners invited us to a party on it. They had speakers out there, and a bunch of us were kicking it to Donna Summer's latest record. I saw some guys wheeling out a few more kegs, and then the whole deck just started to go ...”

Structural hardware is designed — and its use is required by building codes — to keep decks and their occupants safe. Codes are catching up with the fact that the structure of decks differs from that of houses. Not only are a deck's framing and hardware exposed to the degrading effects of constant weathering — something the protected interior framing of a house is never subjected to — but add wind uplift and the way we attach decks to houses, and it's no wonder that today's decks are strapped, bolted, and tied down at a majority of connection points. And changes to the 2012 code make it even more necessary for a deck builder to know his metal.

### Post to Foundation

The two big players in the structural hardware field, Simpson Strong-Tie and USP Structural Connectors, both make a wide variety of post anchors, some designed to be installed in wet concrete and others that are attached to cured concrete with anchor bolts and adhesives.

Many post-base connectors are adjustable to allow for fine-tuning the loca-



SIMPSON STRONG-TIE

**Figure 1.** Most post bases fasten to a bolt that's cast or epoxied into the concrete footing. Once the post is located and the nut tightened, the base is nailed to the post.

tion of the hardware on the footing — a plus for plumbing up posts, particularly if a footing isn't in the perfect location (**Figure 1**). Look for slotted bolt holes in the bottom plate of the connector, which give you varying amounts of wiggle room.

Height-adjustable post bases let you raise a post as much as 4 inches — handy if a footing settles or you want to adjust the pitch of a deck. USP's version (APB44 for 4x4 posts and APB66 for 6x6 posts) costs about \$7 and utilizes a threaded tube that is adhered or cast into concrete. A U-shaped bracket with a threaded rod gets fastened to the post bottom, allowing the post to be raised or lowered by turning the threaded rod into the tube. Simpson's version for a 4x4 post, EPB44T (no offering for a 6x6), costs about \$14 and uses a threaded rod adhered to or cast into concrete (**Figure 2**). After drilling a hole in the center of the post's end grain, you fasten a U-shaped bracket with a nut to the bottom. To adjust the height, rotate the post and the threaded rod advances into the post's hole.



SIMPSON STRONG-TIE

**Figure 2.** The height on some post bases can be adjusted with a threaded rod that's cast or epoxied into the footing.

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## Joist Hangers

Joist hangers are for the most part old news, but there are a few innovative ones that will help you out with nonstandard framing situations (**Figure 3**).

For the end joists, it's been common practice to use a standard flanged hanger and then hammer the flange over onto the edge of the perpendicular framing member, typically the deck's ledger. Aside from the sloppy appearance this results in, especially on an overhead structure that's visible from below, there's a risk the galvanizing may flake off when the metal bends, not to mention that the hanger's warranty will be void (Simpson and USP state in their literature that modifications to their products void the warranty). Flanged hangers might also get in the way, depending on the location and layout of other framing hardware.

Concealed-flange hangers solve all those problems (**Figure 4**). Their flanges bend inward toward the center of the hanger, giving the installation a clean, neat look. Unlike regular hangers — which you might fasten after installing the joists — you install concealed-flange hangers first, because the fasteners will be covered by the end of the joist. Note that the length of the joists will need to be  $\frac{1}{4}$  inch shorter due to the protruding fastener heads.

Skewed hangers come in lefts and rights and allow you to run joists at angles other than 90 degrees to the adjoining framing (**Figure 5**). Simpson and USP make hangers for joists that intersect at 45 degrees, but even more useful might be the field-adjustable skewed hangers that allow you to hang joists at any angle by bending the flange wings. To prevent metal fatigue, Simpson cautions, "Bend one time only." Skewed and adjustable-angle joist hangers cost between \$6 and \$10 each, depending on joist size.

## Ledger to House

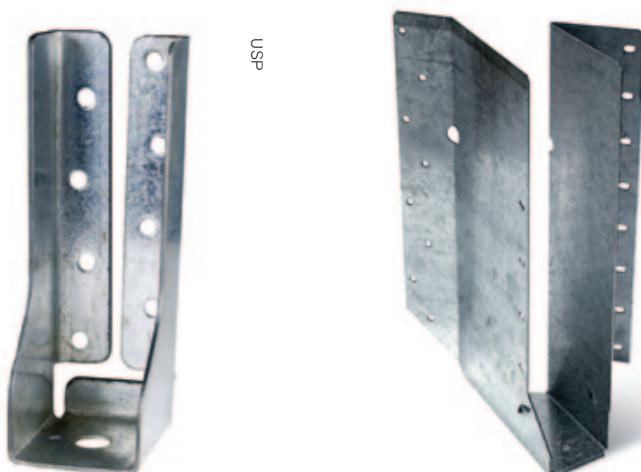
In recent years, there have been more code changes, confusion, and regulation

## Small Manufacturer Offers Custom Connectors

**S**impson Strong-Tie and USP are the two major manufacturers of framing hardware. Their product lines are very similar; which one you buy depends in large part on what's stocked at your lumberyard. Phoenix Metal Products is a family-owned metal fabricator that makes many of the same connectors as Simpson and USP at its Freeport, N.Y., plant. In fact, Phoenix publishes a chart that cross-references its connectors with Simpson's and USP's at [framingconnectors.com/comparison.php](http://framingconnectors.com/comparison.php). Andy Wolf, vice president at Phoenix, says that most of its customers are production builders that buy connectors in large quantities. "But if you need a custom connector that you can't find anywhere else," he says, "our turnaround time is very fast, which is an advantage of dealing with a smaller company."



**Figure 3.** Joist hangers are very common, but people still install them incorrectly. Be sure to fill every nail hole with the diameter nail called out on the hanger or with structural screws made by the same company as the hanger.



**Figure 4.** Concealed-flange joist hangers cost a little more than standard hangers, but they allow for a neat, code-compliant joist attachment at the ends of supporting members such as ledgers.

**Figure 5.** Not all joists run square to their support member. Joist hangers are available in 45-degree and adjustable configurations.

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pertaining to how a ledger is attached to a house than in any other area of deck building. And with good reason — ledger pull-out due to gravitational and lateral forces is a major reason decks collapse.

In the past the only options for attaching a deck ledger to the house were  $\frac{1}{2}$ -inch lag bolts or  $\frac{1}{2}$ -inch machine bolts. Proper installation of lag bolts requires drilling two different-sized holes — a smaller one for the threaded portion of the bolt and a larger one for the bolt's unthreaded shaft. Through-bolts require access from inside the house, which may not exist. Now, a fast alternative to a lag or a through-bolt is available: a self-drilling ledger screw (**Figure 6**). It requires no pre-drilling, and is usually installed with an impact driver. FastenMaster, GRK, and Simpson all make ledger screws, which cost approximately 50 cents each, depending on their length and material.

FastenMaster's ThruLok bolts are a speedy alternative to through-bolting at ledgers, posts, and girders (**Figure 7**). They have a wing nut that spins onto the point of a self-drilling screw. Drive the screw through the members you're fastening, then thread the nut on hand-tight. Tighten the screw with an impact driver, and spurs on the nut grip the wood as the fastener tightens — no wrench needed. ThruLok bolts cost about \$2 each, depending on length.

Don't think you can zip in a few handfuls of ledger screws and satisfy your building inspector, however. According to Rhode Island builder and frequent *PDB* contributor Mike Guertin, "Between the downturn in new construction and the attention decks have gotten in the news (we had two collapses in Rhode Island in the past year that the media picked up) and the code revisions, building officials are becoming deck-hawks." And changes to the 2012 building code have strict requirements about the spacing and locations of these fasteners as they pertain to the structure of the exist-



**Figure 6.** Far faster to install than lag screws or through-bolts, structural screws can be a great alternative for attaching ledgers.



**Figure 7.** ThruLok bolts drive through the wood members with no pre-drilling. A special nut hand-threads on, and then the assembly is tightened with a few more turns of the screw.

ing house (*Structure*, May/June 2012).

If your jurisdiction has adopted the lateral attachment details in the 2009 and 2012 IRC, you'll need more than just bolts or screws to attach the ledger to the house. Unless you have an engineered solution that your building department will sign off on, combatting the lateral forces that a deck is subjected to requires special brackets that bolt through the ledger and band joist to mechanically attach the deck joists to the house's floor joists (**Figure 8, page 46**).

None are simple to install and all require access to the house's floor-joist system — not fun if you've got a finished floor and ceiling to deal with. Simpson's bracket, the DTT2, takes a  $\frac{1}{2}$ -inch-diameter machine bolt and USP's DTB-TZ bracket can take a bolt or threaded rod. For these brackets, the manufacturer's details show the house and floor joists in line with each other. There are alternative details that allow these brackets to work when the ledger is parallel to the joists, but it's up to

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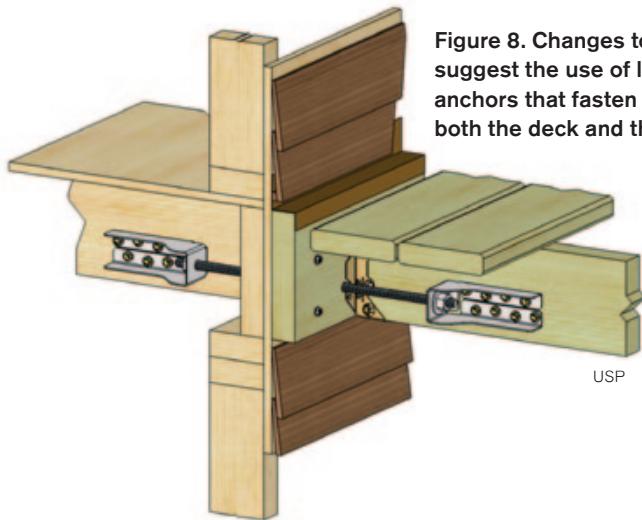
the local building inspector whether or not to accept that installation (*Structure*, January/February 2012).

A bracket made by DeckLok can also be used to provide lateral support. Two DeckLok brackets are needed at each lateral-support location. One bracket through-bolts to the deck joists and through the deck ledger and band joist. A second bracket through-bolts to the house joist and through the band joist and ledger, locking all members together. One advantage is that the house and floor joists can be offset. A disadvantage is cost: Compared with Simpson and USP brackets that cost approximately \$11 a pair, DeckLok brackets cost \$22 a pair (or \$44 a pair for stainless). None of the manufacturers include the necessary machine bolts or threaded rod with the brackets.

### Stairs to Framing

Not surprisingly, there is also structural hardware to attach stair stringers to deck framing. (The code prohibits toenails or “nails subject to withdrawal.”) Simpson’s adjustable LSC brackets get fastened to the framing and then bent onto and fastened to the bottom and sides of the stringers (**Figure 9**). Left- and right-hand brackets are available so that the hardware is concealed to the inside of the stringer. USP’s stringer bracket, CSH-TZ, is similar but reversible, so “handed” versions are not necessary for concealment. Adjustable stringer brackets cost about \$5 each.

DeckLok brackets can also be used to secure stringers to framing (**Figure 10**). These brackets have one bolt hole on one leg of their L-shape and two on the other leg. The company’s president, Jim Miller, says, “It’s important to remember that the two-hole leg of the bracket always gets fastened to the floor joist or stringer — whatever member would be most subject to withdrawal. The one-hole side of the bracket gets bolted to the rim joist or ledger.”



**Figure 8.** Changes to the IRC in 2009 suggest the use of lateral attachment anchors that fasten to the joists of both the deck and the house.

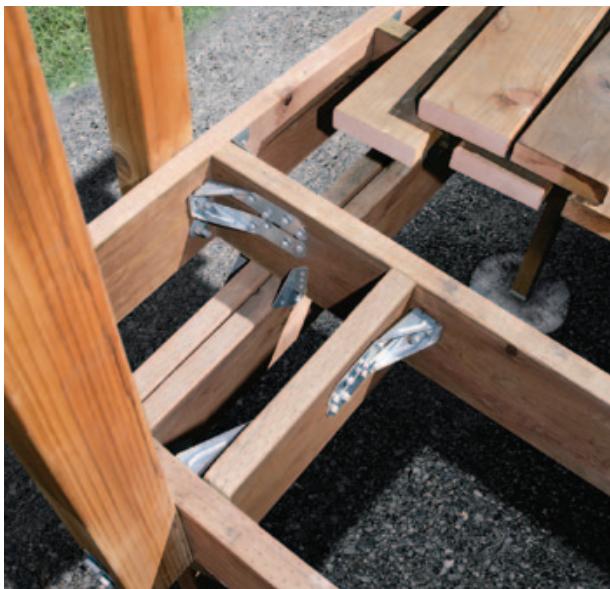


**Figure 9.** Hangers for stairs affix to the deck framing first and then to the stringer.

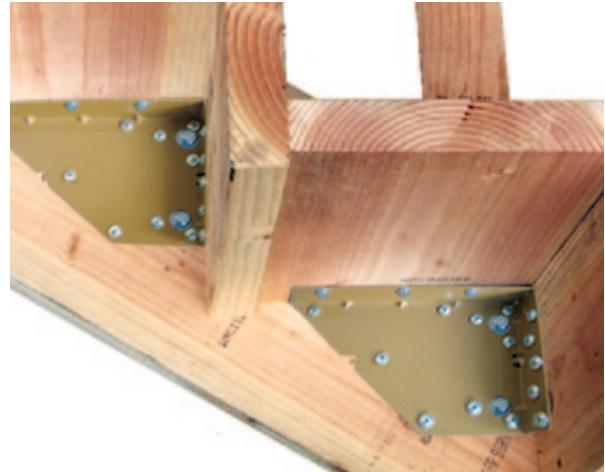


**Figure 10.** Lateral attachment anchors can also be used to fasten stringers to decks.

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**Figure 11.** Railing posts generate tremendous leverage, and lateral attachment anchors can help transfer that force to the floor framing safely.



**Figure 12.** A bracket made by EZ Stairs can reinforce the attachment of rail posts to stair stringers.

### Post to Framing

It's easy to understand why people worry about railing-post failures. If you wanted to pry apart a deck frame, you'd probably use something long with a lot of leverage – like a typical railing post.

Hardware can help offset the leveraging power of the post by transferring it to the floor-joist system (**Figure 11**). Simpson, USP, and DeckLok lateral support brackets can be used for post-to-framing connections ("Code-Compliant Railing Posts," May/June 2011).

EZ Stairs makes bracket sets that take the guesswork out of building stair stringers (*Decking News*, March/April 2008). A single EZ Stairs bracket can be used to make a strong, code-compliant (according to the company's website) post-to-stringer connection on a set of stairs (**Figure 12**).

To use the bracket, sandwich the stringer between post and bracket with two through-bolts. The post gets its ultimate strength from the bracket being screwed both to the blocking between

the stringers and to the stair treads. A pair of EZ Stairs brackets (enough for two posts) costs about \$13, fasteners not included.

For the past six years, at DeckExpo and elsewhere, Mike Guertin has run many post-to-frame-connection workshops, which he says are "always packed." It's a complex topic, full of confusion and false claims. Guertin says, "No piece of hardware or proprietary design is 'code approved.' Only things specifically called out in a code book are code approved. It is entirely up to the local building official to accept alternative construction details on a case-by-case basis. But one official's acceptance is not precedent-setting nor does acceptance as an alternative rise to the level of code approved."

Bottom line: Talk to your building department before you fill your shopping cart with brackets, bolts, screws, and washers. ♦

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### Sources

**DeckLok**  
877/844-8880  
[deck-lok.com](http://deck-lok.com)

**EZ Stairs**  
866/693-9570  
[ez-stairs.com](http://ez-stairs.com)

**FastenMaster**  
800/518-3569  
[FastenMaster.com](http://FastenMaster.com)

**GRK**  
800/263-0463  
[grkfasteners.com](http://grkfasteners.com)

**Phoenix Metal Products**  
516/546-4200  
[phoenixmetalproducts.com](http://phoenixmetalproducts.com)

**Simpson Strong-Tie**  
800/999-5099  
[strongtie.com](http://strongtie.com)

**USP**  
800/328-5934  
[uspconnectors.com](http://uspconnectors.com)