New Code for Resisting Lateral Loads

by Glenn Mathewson

A new section in the 2009 International Residential Code (IRC) has stirred up a hornet's nest of questions about attaching deck ledgers. Section R502.2.2.3 and the accompanying figure (see illustration, below) suggest that all decks will now need to be connected to the floor joists of the house by horizontally oriented hold-down devices and long bolts. This new code section states: *The lateral load connection required by Section R502.2.2 shall be permitted to be in accordance with Figure R502.2.2.3. Hold-down tension devices shall be provided in not less than two locations per deck and each device shall have an allowable stress design capacity of not less than 1500lb.*

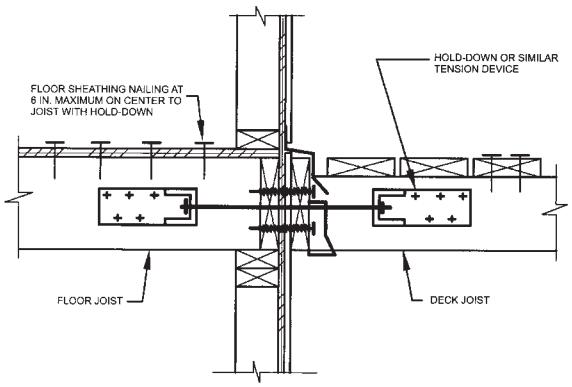


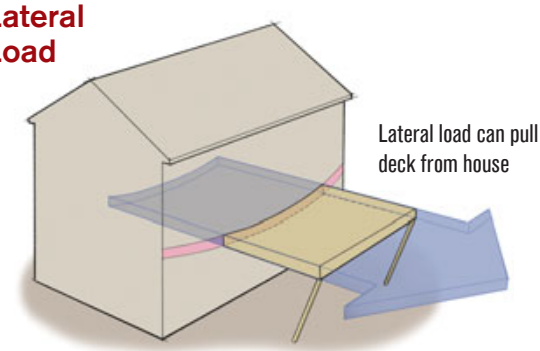
FIGURE 502.2.2.3
DECK ATTACHMENT FOR LATERAL LOADS

It used to be that the bolted connection to the band (or rim) joist was expected to resist all forces applied to the ledger, in both vertical and horizontal directions. The vertical loads are those of the deck itself and the people on it — the dead and live loads prescribed by the code — and they are resisted by the shear strength of the bolts connecting the ledger to the band joist.

The horizontal (lateral) loads work both parallel and perpendicular to the ledger. Those applied parallel to the ledger are resisted by the shear strength of the ledger bolts, like the vertical loads. Those acting perpendicular to the ledger, however, may not be adequately resisted by the bolted connection alone (see illustration, top right). Even when a ledger is sufficiently bolted to the band joist, the load path may not be complete, as the band joist also must be able to resist the horizontal forces.

A band joist properly toenailed to the plate below and

Lateral Load



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Historically, the bolted connection between the deck ledger and the house band joist was expected to resist the shear forces from the weight of the deck and its occupants, plus any lateral loads that might tear the ledger from the house. New additions to the IRC are meant to also prevent the band joist from being ripped away.

fastened by the floor sheathing and wall plate above is able to resist some lateral forces. That assumption gets dicey with large and tall decks, sloppy home construction, or location in a seismic zone, any of which may require additional connection beyond the band joist.

How well the band joist is connected can be difficult to assess on an existing home, leaving builders and inspectors uncertain of the sufficiency of the load path. This concern led to the inclusion in the code of Figure R502.2.2.3, which details a connection that bypasses the ledger and the band joist completely.

The History Behind the Change

The IRC modification cycle takes three years, but the lateral-load connection detail in Section R502.2.2.3 made it into the code with little notice. During the development of the 2009 IRC, code modification proposals were published for public review on July 14, 2006, a little over two months before the code hearing. They included a new ledger bolting schedule, Table R502.2.2.1 (see "New Ledger Attachment Requirements Adopted," July/August 2007; free at deckmagazine.com), the preliminary approval of which was published on December 1, 2006, with the following comment: "This is a much needed addition to the

code, and it brings in a new table that is a good starting point for the attachment of the deck ledger to the band joist. The committee urges additional study of the attachment of the band joist to the framing."

A period for public review and comment followed. One of the ensuing comments introduced the lateral-load connection detail; it was published on April 6, 2007 (along with other comments on the preliminary changes), the first time it was available for public scrutiny — just 46 days before the final vote. The substantiation for including it in the code contained no statistical data or engineering fundamentals: "Deck failures do occur where the deck is attached to the rim joist for lateral loads, but the rim is not adequately anchored into the floor system. Positive anchorage of the deck joists to the floor framing addresses this potential failure. The figure is based on a similar figure from FEMA 232."

FEMA 232 is the "Homebuilders' Guide to Earthquake Resistance Design and Construction." The proposed figure actually specified more details — such as fastening floor sheathing and strength values for the tension device — than did the original figure (even though the original applied only to earthquake-prone areas and this one would apply to all geographic regions).

During the final action hearings, beginning on May 21, 2007, the ledger bolting schedule was included in the 2009 IRC as Table R502.2.2.1. Also included was Figure R502.2.2.3, the lateral-load-resisting ledger connection detail. The bolting schedule received 10 months of public scrutiny; the lateral connection detail got just 46 days, and it wasn't reviewed by the IRC code change committee.

The Implications

The intent of including Figure R502.2.2.3 in the IRC is unclear. As written in the code, the lateral connection detail *shall be permitted*; it isn't a requirement. Throughout the International Codes, the phrase *shall be permitted* is used only to clarify when a detail seemingly prohibited by a general statement is actually permitted in a specific application. Section R104.11 of the IRC even states: *The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code.* Therefore, it's not necessary to specifically "permit" a design in the code unless it could be confused as being "prohibited." That's obviously not the case for Figure R502.2.2.3, as it's unlikely that any building official would prohibit a connection like it.

Nowhere does the IRC specify a quantifiable resistance to horizontal loads placed against the band joist. The ledger connection has always been considered an "alternative" and something that must be specifically approved by the local building official. Figure R502.2.2.3 is little more than a "pre-approved" (permitted) alternative for resisting the lateral loads from a deck under all loading conditions. It's only one of many ways that lateral loads can be resisted.

Although Figure R502.2.2.3 seems to be a one-size-fits-all solution to the problem of lateral loading, there are many applications it may not suit. Multi-level decks, decks that wrap around a corner of a house, and decks that jog in and out with creative angles or curves throw a wrench into the idea of a generic requirement for tension devices in at least two locations without reference to where those locations are. In many respects, the provisions of Section R502.2.2.3 are excessive for simple, low-level decks and not specific enough for large custom decks.

One consequence of the adoption of Figure R502.2.2.3 is that products specifically designed for this seemingly required connection are hitting the market. While these tension devices will provide a means to resist lateral loads applied to the ledger connection, they can't provide all the lateral load resistance needed. They do nothing to prevent the deck from deforming in the horizontal plane (swaying). Angled braces or angled decking, wrapping the deck around a corner, or bracing the outer post and beams parallel to the ledger is necessary to resist the effects of sway. Swaying can weaken connections throughout the deck, as well as compromise the integrity of the supporting posts.

Unfortunately, another result of including this figure in the IRC will be that many building inspectors will demand its installation even when it's not the best alternative or when it's unnecessary. Part of a building official's job is to insure that loads applied to a structure are provided a sufficient load path to the supporting soil. However, it's not his or her privilege to decide how that's achieved. That's the responsibility of the builder and the designer.

Addressing the lateral load resistance on your plans is probably the only way you'll avoid a demand for this specific connection. Several alternatives might work (see illustrations at right). Embedding the outer support posts in concrete piers might provide sufficient lateral resistance for lower decks. Bracing between the posts or the foundation wall perpendicular to the ledger, constructing

the deck around a corner, or simply dropping the height of the ledger and bolting into the top plates of the wall or foundation below can provide lateral resistance. However, it's likely inspectors will require substantiation by a design professional such as an engineer.

The Problems

Satisfying all the requirements in Figure R502.2.2.3 may be difficult. In all but new construction, it is unlikely that the floor sheathing will be fastened to the joists at 6-inch centers. Table R602.3(1), which governs most structural fastener spacing, requires fastener spacing at only 12 inches on center in the field, and that's all that can be expected. Tearing up the tile floor in the master bathroom to drive a few more nails through the sheathing is not something most homeowners will agree to. Similarly, access for installing the hold-down device may require removal of drywall from the ceiling below.

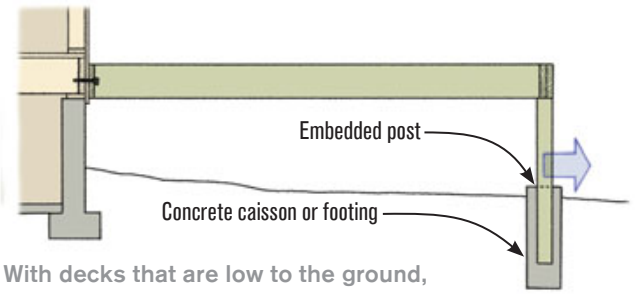
When researching for my book *Deck Construction Based on the 2009 International Residential Code,* I often spoke with the International Code Council's (ICC's) technical staff regarding this new figure. They agreed that this detail is not intended for every deck built under the IRC, but only for those that require lateral load resistance greater than the band-joist-to-floor-system connections provide. Of course, that isn't necessarily easy to quantify. The deck design has to be considered: Are the posts embedded, how high is the deck, does it wrap around a corner, is it in an inside corner, is there bracing in the posts, and is the existing construction of the home visible for inspection?

I also discussed with the ICC staff how to use this detail when the floor joists run parallel to the band joist. Blocking installed between the band joist and the next floor joist, with another block between that joist and the second one in, was found to be a sufficient alternative. The tension device would be installed on the innermost of the two pieces of blocking, so the lateral forces are shared by both the band and the first joist, effectively eliminating the possibility for the band joist to be pulled from the floor system individually.

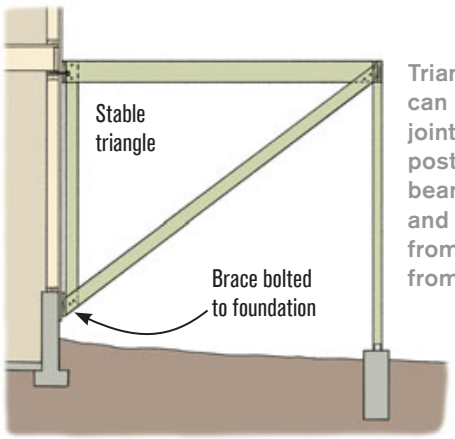
As regulatory authorities across the country adopt the 2009 IRC, be prepared for misguided and unfounded interpretations of this new connection detail and the associated code text. The phrase *shall*

Lateral Loads Can Be Resisted in Other Ways

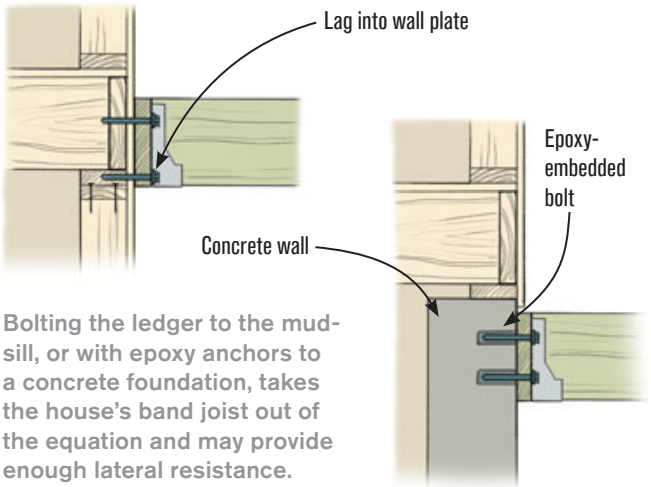
Although a building inspector may require engineering, there are a number of other approaches to resisting lateral loads. The appropriateness of these designs will depend on the deck, but the point to all of them is the same: Prevent the deck from falling away from the house.



With decks that are low to the ground, simply embedding the outer posts in concrete piers may provide sufficient lateral resistance.



Triangular bracing can prevent the joint between the posts and the outer beam from hinging and so keep a deck from falling away from the house.



Bolting the ledger to the mudsill, or with epoxy anchors to a concrete foundation, takes the house's band joist out of the equation and may provide enough lateral resistance.

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be permitted is the key to realizing that it isn't a "requirement." The simple existence of this detail, however — even though it's not required — will likely stir up a considerable number of questions and concerns regarding the lateral load resistance of a deck design. Although it can be expensive, an engineered design will be a quick way to approval, and it will provide you with some control over how you construct your deck.

The code development process has already begun for the 2012 IRC, and I strongly encourage deck-building contractors to take part in it. The ICC's Web site, iccsafe.org, is easy to navigate and provides a comprehensive amount of information regarding each step of the process. Remember, it may take only 46 days for the code to drastically change. ❖

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