Building Safer Decks

The prescriptive building codes are moving in the right direction, but some confusion remains

by Glenn Mathewson

Decks have seen little attention from building codes over the years, despite the fact that they often bear the weight of parties and public gatherings. The catastrophic consequences of this oversight are easy to find: Just try Googling "deck collapse" and you'll find story after story of injuries and deaths resulting from poorly constructed decks.

This doesn't surprise me. As a building inspector who is also a former deck contractor, I've seen the realities of deck construction from both sides. The fact is, you can't build a safe deck straight from the IRC. That's partly because most of the code's structural provisions have to do with platform and balloon framing, both of which rely on braced wall panels (sheathing over studs) to resist loads; decks, which are built more like post-frame buildings, don't have those braced panels.

However, with the release of the 2009 IRC, decks have finally begun to be addressed. While we still don't have a pre-engineered, code-prescribed method for building decks, this new focus is a good start. In this article, I'll discuss these new deck requirements.

Ledger Bolting Schedule

Although the 2003 IRC finally prohibited the use of nails to secure deck ledgers, it lacked a prescriptive bolting schedule. That's why, 10 years ago as a deck builder, I could use one ½-inch lag screw every

16 inches no matter the joist span, without being questioned. That's changed under the 2009 code. Section R502.2.2.1 provides a simple way to determine the size and number of bolts or lags required and includes an easy-to-read table with footnotes (**see Figure 1**). The fastening schedule is based on joist length, which determines the load in pounds per linear foot that can be expected at the ledger. Longer spans or conditions other than those addressed by the table may require engineering. (If you look at the table, you'll see that the bolting schedule I used for the ½-inch lags mentioned above is adequate only for joist spans of 12 feet or less.)

Though this table does provide a clear way to design ledger connections, make sure you take a good look at the footnotes and the specifics in all the subsections of R502.2.2. For instance, the bolting schedule is intended only for uniformly distributed loads. Joists that carry other loads to the ledger — like a doubled joist running from the headered opening for a stairway — create concentrated loads on the ledger and will require some thought from you and the code official (**Figure 2, next page**). When you calculate the tributary load from that doubled joist, for example, you might find that you need to use a tighter fastening schedule for that section of the ledger or make some other accommodation for the load.

Note also that you have to use a minimum 2x8 pressure-treated ledger. For builders who prefer to leave a drainage space behind the ledger, rather than flashing the siding over the ledger, the code allows for a ½-inch gap between the sheathing and the ledger — enough for a ½-inch stack of washers.

Height at Which Guard Railings Are Required

In the past, guardrails could be dispensed with on all decks no higher than 30 inches above grade. That rule hasn't changed, but

TABLE R502.2.2.1
Fastener Spacing for a Southern Pine or Hem-Fir Deck Ledger and a 2-Inch Nominal Solid-Sawn Spruce-Pine-Fir Band Joist[c, f, g]
(Deck live load = 40 psf, Deck dead load = 10 psf)

Joist span	6′ and less	6′1″ to 8′	8′1″ to 10′	10′1″ to 12′	12′1″ to 14′	14′1″ to 16′	16′1″ to 18′
Connection details	**On-center spacing of fasteners[d, e]**						
½″ diameter lag screw with 15/32″ maximum sheathing[a]	30″	23″	18″	15″	13″	11″	10″
½″ diameter bolt with 15/32″ maximum sheathing	36″	36″	34″	29″	24″	21″	19″
½″ diameter bolt with 15/32″ maximum sheathing and ½″ stacked washers[b, h]	36″	36″	29″	24″	21″	18″	16″

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm. 1 pound per square foot = 0.0479kPa.
a. The tip of the lag screw shall fully extend beyond the inside face of the band joist.
b. The maximum gap between the face of the ledger board and face of the wall sheathing shall be ½″.
c. Ledgers shall be flashed to prevent water from contacting the house band joist.
d. Lag screws and bolts shall be staggered in accordance with Section R502.2.2.1.1.
e. Deck ledger shall be minimum 2x8 pressure-preservative-treated No. 2 grade lumber, or other approved materials as established by standard engineering practice.
f. When solid-sawn pressure-preservative-treated deck ledgers are attached to a minimum 1 inch thick engineered wood product (structural composite lumber, laminated veneer lumber or wood structural panel band joist), the ledger attachment shall be designed in accordance with accepted engineering practice.
g. A minimum 1x9½, Douglas fir laminated veneer lumber rimboard shall be permitted in lieu of the 2-inch nominal band joist.
h. Wood structural panel sheathing, gypsum board sheathing or foam sheathing not exceeding 1 inch in thickness shall be permitted. The maximum distance between the face of the ledger board and the face of the band joist shall be 1 inch.

Figure 1. New in the 2009 IRC is a prescriptive table for lag-screwing and bolting ledgers to the house's band joist. A similar table first appeared in *JLC* in March 2004. Note the third line of the schedule, which allows for a ½-inch drainage space to be used behind the ledger.

now the 30-inch height must extend at least 3 feet horizontally away from the deck.

Previous code editions referred to "grade" only as the height of finished ground level "adjoining the exterior walls." That could be interpreted as grade at the deck posts, even if the posts were a foot away from a cliff (**Figure 3**). This loophole has been closed in the 2009 IRC, in Section R312.1. Just as you need a 36-inch-deep landing in front of a door at the top of a stair, you need the same area at the edge of a deck if you wish to forgo the guards. That is, the height of a deck must be measured vertically at a point 36 inches horizontally from the edge of the deck.

Guardrails at Built-In Benches

In the past, the required guard height was measured from the deck's walking surface, even if there was seating built into the guard. Under the 2009 code (Section R312.2), if the deck has built-in seating

Figure 2. Because a doubled joist that supports other joists transfers a concentrated load to the ledger, it will require support beyond the code's bolting schedule. Some inspectors will make an exception for a small stair landing, while others will prohibit all beams from loading at the ledger.

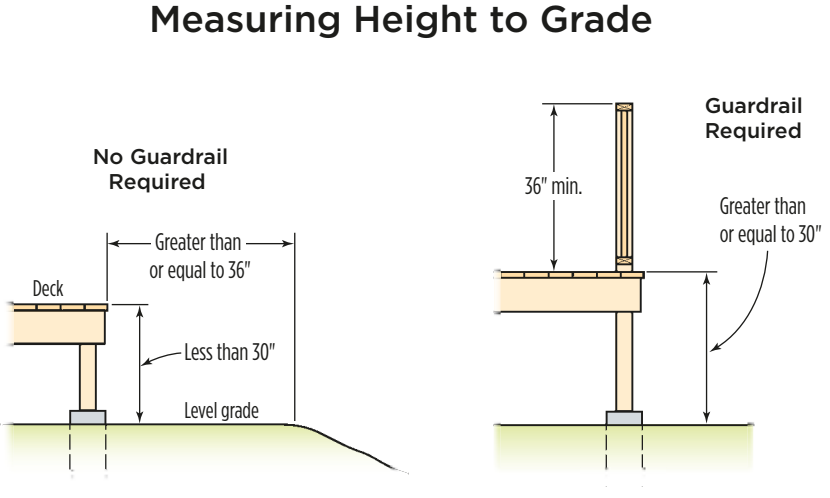

Figure 3. In previous editions of the code, rails would not have been required on this deck (left) — even though there's an obvious fall hazard — because the grade directly next to the deck was less than 30 inches below the decking. The 2009 IRC closes this loophole, requiring that the "landing" area extend 36 inches from the edge of the deck (above).

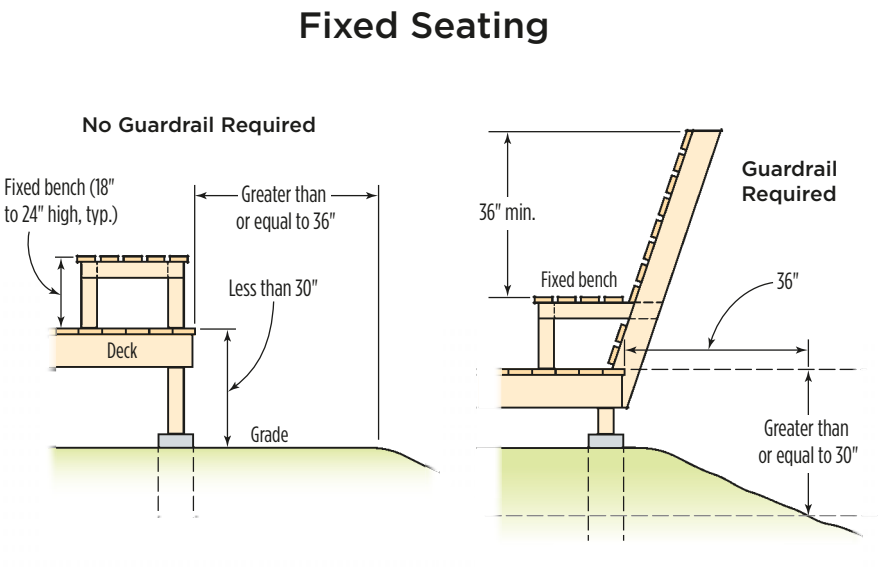

Figure 4. When this deck (above) was built under the 2003 IRC, the slanted bench-back, which is 24 inches tall, was considered a compliant guard. Under the 2009 IRC, the back of this bench would have to rise 36 inches above the seat (see illustration, top). Although the bench seat at left is higher than 30 inches above grade, the deck's walking surface is not, so no guard is required.

around the edge, the 36-inch guard height must be measured from the seat (**Figure 4**). This addresses the concern that children will climb on the seating and be at risk of falling. Many of the built-in benches I've seen have backs that are only about 18 to 24 inches high — perhaps not enough to prohibit one of those little ones from falling over.

Interestingly, the new rule doesn't mean that the height of the seat as measured from the ground dictates when guards are required. So if the deck surface is 29 inches above grade — lower than the 30-inch guard cutoff — you can still have a bench at the edge of that deck, with or without a back, even though the seat will be well over 30 inches above grade.

As someone that loves built-in deck features, I can't say that I agree with this new provision. Children should certainly be protected, but it's hard to see the point in regulating fixed seating when there's so much movable seating on decks. It also seems that if 36-inch rails are adequate to protect adults, a lower height — for children — could be specified for bench backs.

Electrical Outlets

A tamper-resistant wet-use outlet is now required on all decks larger than 20 square feet. Based on NEC provisions, this rule is intended to eliminate fire risk from extension cords that might be used to power grill rotisseries and other outdoor amenities. Section E3901.7 has been expanded from requiring a receptacle outlet at the front and back of a home to also requiring one on all decks, balconies, or porches that are accessible from the home and have more than 20 usable square feet. Regardless of deck size, only one outlet is required.

Composite Decking

In the past, wood-plastic composite decking was viewed as an "alternative" material, which could sometimes cause delays for builders. While the International Code

Council Evaluation Service (ICC-ES) has long provided an "acceptance criteria" for testing composite decking, an ICC-ES report does not guarantee universal approval. It merely provides evidence for a code official to review in deciding whether a product is equivalent to what the code prescribes. The code official can then decide whether or not to accept the material. By contrast, where the IRC specifies a particular test for a product, a universal approval is provided; the product becomes "code."

Section R317.4 of the 2009 IRC now specifies such a test — ASTM D 7032 — for wood-plastic composite decking. It will take some time for manufacturers to get their products labeled with the new standard, but ultimately this will make approval of composite decking much easier for contractors.

New Hardware Suggested For Lateral Loads

I saved this item for last because it's quite controversial in the deck-building industry. In the past, lateral loads on decks were rarely addressed. But in the last decade, a number of incidents have occurred in which live loads generated by people on decks produced dynamic lateral loading that caused well-attached ledgers to pull the band joist of a home straight from the floor system. Most often, this happened when the band joist was cantilevered over the foundation wall. As a result of these accidents, some code-change proponents introduced a provision for addressing lateral loads toward the end of the 2006/2007 code-change cycle, when the ledger schedule was being discussed.

This provision, R502.2.2.3, has a number of problems. One is that it addresses lateral loads with a hardware detail adapted from a FEMA document actually intended for seismic loads; it uses horizontal hold-downs and long-threaded bolts to bypass the band joist and connect the deck joists directly to the home's floor joists (**Figure 5**). Another problem is that it gives no consideration to the magnitude of the loads; it prescribes two hold-downs for any deck, regardless of whether it's 100 square feet or 2,000. There is also a required nailing schedule for the subfloor on the joist above the hold-downs that makes it difficult and expensive to retrofit in an existing home.

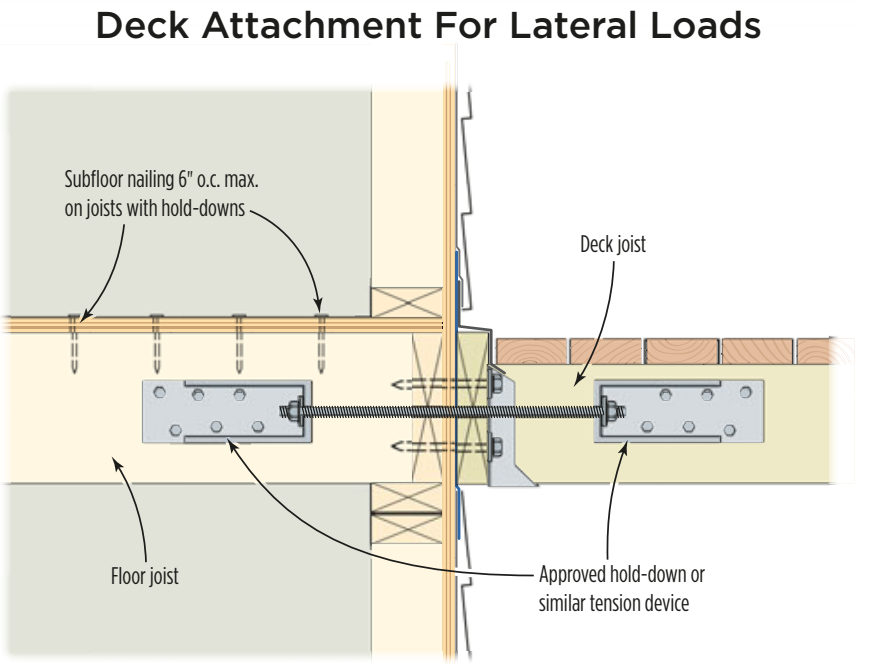

Figure 5. A new controversial anchor detail is now "permitted" — though not explicitly required — under the 2009 IRC, and has raised inspectors' awareness of lateral loading issues. From a practical standpoint, installation may be difficult in existing homes because the tight subflooring nailing schedule would likely require ripping up the finish flooring.

The code language states that the detail is merely "permitted," although inspectors in some areas are interpreting this as a minimum requirement. That's making a lot of builders unhappy, though no doubt it pleases the hardware manufacturers.

In my jurisdiction, we are not enforcing this requirement because we make sure that decks are properly built to withstand lateral loads without resorting to this troublesome detail. For example, a well-built low deck with its pressure-treated posts sunk into the concrete piers can resist lateral loads. Also, the American Forest & Paper Association's *DCA6 Prescriptive Residential Wood Deck Construction Guide* provides pre-engineered knee-bracing methods that will resist lateral loads, though they are not intended to be equivalent to the IRC anchor detail and would need approval by an inspector.

Despite its drawbacks, the presence of the lateral load connection detail in the code has put the question clearly in the face of all deck builders and code officials: "How are you resisting lateral loads if not by this detail?" If you don't provide an engineered design, the code official will likely take a hard look at how well the ledger is attached and what it's attached to.

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