Framing Red Flags

by Bryan Readling

Catch these common framing and sheathing errors and you'll prevent inspection failures and customer callbacks

As an engineer with the APA/Engineered Wood Association, one of my jobs is to investigate defect claims and job-site callbacks involving the use of structural panels and engineered lumber. Most of the cases I've seen over the past 18 years have been the result of easily correctable errors made by the builder. Some installers fail to follow proper installation guidelines and standard framing practices. Others forget that engineered framing and sheathing are still natural wood products: Their strength characteristics are affected by grain and they're sensitive to moisture, so they need to be handled and installed accordingly.

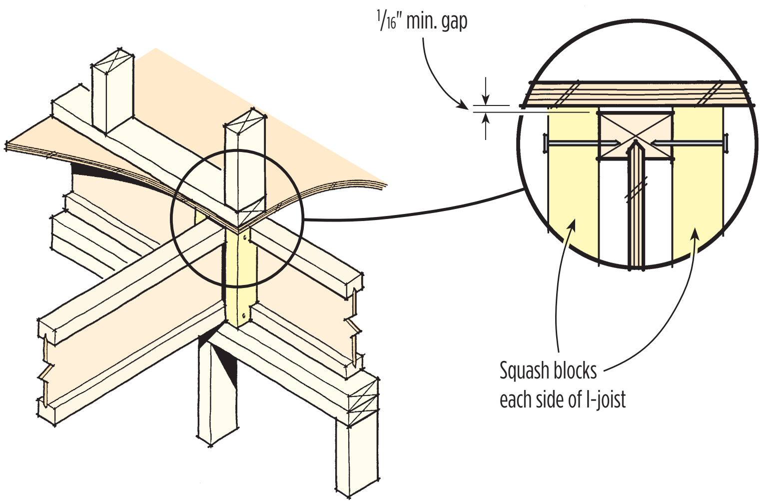
Here are some of the most common problems I've encountered, along with the solutions I typically recommend.

Cutting Holes in I-Joists

In an I-joist, the web carries dead and live loads out to the supports. Under normal conditions, loads accumulate from midspan outward, with half going to one support and half to the opposite. Because this places the greatest amount of shear within the web at the inside face of each support, you need to minimize hole-cutting in this area. As you move away from the supports and toward the center of the joist, you gain more flexibility in where you can place holes through the web, and in how big they are. Wood I-joist manufacturers provide easy-to-follow hole-cutting guidelines.

Although holes don't need to be centered in the joist depth, they should be located far enough away from the top and bottom flanges that there's no risk of cutting them. Under load, the bottom flange of an I-joist is in tension while the top flange carries a compression force; a cut in either flange will seriously compromise the joist.

To avoid the kind of plumbing drop shown above, most manufacturers allow I-joists to be moved up to 3 inches from the specified spacing without a redesign.



OSB webs — which can buckle or knife through the flanges under concentrated loads — require squash blocks (illustration, left) or blocking panels (above) to help with load transfer. Don't mix sawn lumber rim joists with I-joists (below); instead, use same-size I-joists, one or two layers of OSB or plywood, or engineered rim-board stock (bottom), all of which will better match the height of the I-joists.

Inadequate Load-Path Transfer

Since the thin OSB web of an I-joist doesn't work well as a column, squash blocks are needed to transfer stacking gravity loads — such as aligned bearing walls — around rather than through the I-joist.

Each I-joist requires two blocks — one on each side — sized 1⁄16 inch taller than the joist to prevent concentrated loads from crushing it or causing the web to knife through the flange. Engineered rim-board stock is already slightly oversized and won't shrink, so it's an excellent material to use for squash blocks.

Another option is to use I-joist cutoffs as blocking panels. I-joist blocking is good for 2,000 pounds per linear foot of load transfer. As long as loads don't exceed 1,000 pounds per linear foot, blocking panels can be used within every other joist bay, which allows for easier mechanical and plumbing routing. This is a popular method for load transfer because it minimizes job-site waste.

At the perimeter, the web material is already working hard to transfer floor loads in shear; additional load at this location can result in product failure, so avoid using sawn lumber as a rim board. Lumber typically doesn't match I-joist depth and is more prone to shrinkage, increasing the likelihood that the joists will be compressed.

Side-Loaded Beams

One advantage of engineered lumber is that individual members can be fastened together on site to make a single beam. Too often, however, laminations aren't properly fastened together. This is less of an issue when all the loading is coming from the top (though there would still be a minimum attachment schedule from the manufacturer), but it becomes critical when there's off-center loading — when floor joists are face-mounted to a flush LVL girder, for instance. To avoid overloading the outer lamination, make sure individual members are bolted or nailed together according to the manufacturer's recommendations.

Because the individual LVLs in this built-up girder weren't properly fastened together, the outermost lamination is carrying most of the loading, causing excessive deflection.

Inconsistent I-Joist Spacing

Designers are sometimes tempted to take advantage of the greater capacity of I-joists by laying some out 24 inches on-center and others 16 . But floor sheathing that spans 16 inches has two-and-a-half times the strength — and stiffness — of sheathing that spans 24 inches. Even though the wider-spaced joists may technically be sufficient, the perception will be that floor sheathing spanning 24 inches is "softer" and therefore defective.

This is also the case with floor-joist spans. Although an I-joist floor designed for L/480 deflection is usually considered adequate by owners, they may think differently if other rooms are framed with shorter spanning joists (and therefore less deflection).

If the I-joists in an engineered floor system are unevenly spaced or have inconsistent spans, soft areas can result.

Upside-Down Glulams

Glulam beams can be manufactured with or without camber, which is a slight upward curve along the top surface. Camber counteracts the beam's deflection under dead load and helps prevent "creep," or the tendency for wood to continue to sag after initial loading. Properly sized, a glulam with a $1\frac{1}{2}$-inch camber will immediately deflect 1 inch when fully loaded. Creep typically equals about half the initial deflection, so after six months or so the cambered beam should lie perfectly flat.

Cambered beams are useful when spans exceed about 23 feet. At this span, a straight beam will noticeably deflect, even if it meets code deflection limits. The top of a cambered beam is always clearly marked, yet I've seen plenty of them installed upside-down. This places the critical tension laminations on the wrong side of the beam and builds deflection into the structure.

Some longer glulam beams are cambered to offset deflection; installing them upside down will build deflection into your structure.

■ Roof Sheathing Too Narrow

A serious problem occurs when narrow rippings are used to complete roof sheathing near the ridge. For rated sheathing to maintain its span rating, panels must be ripped wider than 24 inches. If a 250-pound roofer carrying 80 pounds of shingles walks along the ridge and steps on a 6-inch-wide strip of sheathing spanning 24 inches, he could step right through the roof. So either plan ahead so that sheathing is at least 24 inches wide, or supply blocking at the edges of narrow panels.

Span ratings are also based on the assumption that the sheathing is continuously spanned across at least three joists or rafters. For this reason, patches in floor or roof sheathing should encompass two joist or rafter spaces or be supported by extra blocking; otherwise, the floor or roof system may feel soft underfoot.

Roof sheathing that's narrower than 24 inches or that doesn't span at least three rafters can feel soft or even break under the weight of a roofer (above right).

To avoid squeaky floors, use plenty of adhesive and make sure your fasteners don't miss the framing (above). Fully fasten the panels while the adhesive is still wet, using your own weight to provide clamping pressure while you nail (right).

■ Improper Floor-Sheathing Installation

Squeaky floors are a common customer complaint; 95 percent of them are caused by sheathing errors like sloppy nailing. Since fixing a squeaky floor is so difficult, it's worth the effort to install the sheathing properly in the first place. Each floor joist should have a generous and continuous bead of adhesive, and each panel should be fully nailed before the adhesive skins over.

For a good bond, glued joints need to be clamped. But nail guns — unlike hammers — rely on velocity rather than mass to drive the nail, so extra clamping force is needed when sheathing is nailed pneumatically. Instead of nailing out — away from the body — place nails close to where you're standing so that your own weight is clamping the sheathing to the joist.

Insufficient Spacing Around Panels

Wall sheathing needs room to expand. Some framers butt panels tightly together, hoping to minimize air infiltration, but this can lead to buckling and wavy walls.

During the production of both OSB and plywood, wood fibers are dried to a low moisture content before being pressed together, which keeps steam from developing and counteracting the compression force within the press. As a result, panels shipped from the mill are very dry — until they reach the job site, where they quickly reach an equilibrium moisture content of 10 percent to 15 percent. To accommodate the accompanying expansion, floor, wall, and roof sheathing needs to be installed with a space of at least 1/8 inch along the panel edges and ends.

Floor panels don't tend to buckle, simply because they're thicker and stiffer than wall panels. But expansion due to changes in moisture can cause compression stresses, which can crush material at the joints and damage the tongue and groove.

Bowed framing and wall sheathing installed without 1/8-inch expansion gaps between the edges and ends of every panel can lead to panel buckling and wavy walls.

Missing Clips

Without room for expansion, roof panels can buckle. Most (but not all) H-clips have a self-spacing mechanism, but clips aren't necessary for proper panel spacing. A couple of eight-penny nails driven in at each joint will also work.

Even slight buckling can be visible under three-tab shingles, which conform very readily to the profile of the roof deck. Panels more commonly buckle up or down between the framing, but cross-panel buckling — where the panel buckles between fasteners along its weak direction — is also a problem when there isn't space for expansion along the panel edges.

Bryan Readling, *P.E., is a senior engineer with the APA/Engineered Wood Association.*

The use of self-spacing H-clips would have prevented this roof sheathing from buckling, which can occur either along the edge (above) or at the end (left) of panels that have been installed without the necessary 1/8-inch spacing.