Using Metal Connectors

by Robert Randall, P.E.

Many structural failures in wood-frame buildings occur not because a member breaks but because a connection comes apart. Yet, in residential work, making strong, engineered connections in the field has never been easier. There are many different metal connectors available today, and manufacturers have been innovative as well as responsive to industry needs.

Every designer and builder should have some manufacturers' product catalogs on hand for quick help in finding solutions to connection problems. I keep these catalogs in a ring binder on a reference shelf at arm's reach from my work station, and refer to them often.

In this article, I'll look at some of my favorite connectors, as well as a few that I would avoid.

Strongest Joist Hangers

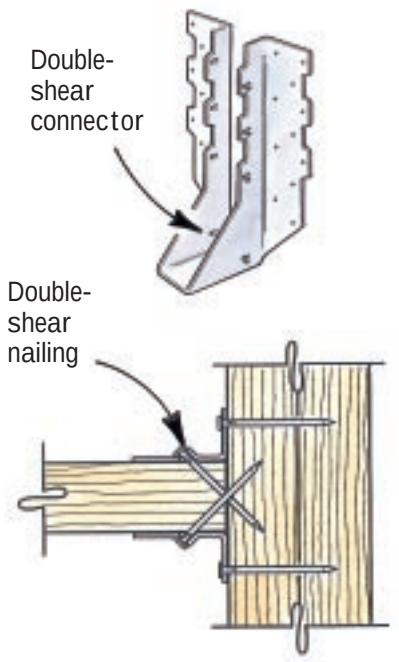

Figure 1. Double-shear connectors provide greater strength with fewer nails than ordinary hangers. The angled nail configuration also makes it easier to drive the nails in a joist bay.

Double-Shear Joist Hangers

High on my list of favorites is the newer series of face-mount joist connectors featuring *double-shear nailing* (see Figure 1), such as the Simpson LUS and HUS series (Simpson Strong-Tie, 800/999-5099) and the USP SU series (USP, 800/328-5934). Installation of these hangers involves cross-toe-nailing through the hanger and the heel of the joist into the supporting header. This nailing pattern increases load capacity, uplift resistance, and resistance to separation between joist and header. The connection is also more resistant to shrinkage sagging of the hung joist and, perhaps most important, is easier to install in most cases because there is more room to swing the hammer on the 45-degree angle.

The downside to these (and most) hangers is that drying shrinkage of the hung joist can either result in settlement at the top of the joist or leave a gap between the hanger's saddle and the bottom of the joist. If such shrinking does occur, you can backfit wedges or shims to support the bottom of the joist and keep the top flush.

Strap Ties

This generic term applies to a variety of connectors that are simple straps of galvanized sheet stock with lots of holes for the number of nails required to develop the full rated strength. Pay attention to the nailing requirements listed in the catalog. It is often surprising how many nails it takes to reach the rated strength.

Strap ties can be used for many applications, several of which have been discussed in this column. These include rafter-to-joist connections in raised eaves construction (see *Practical Engineering*, 7/96), and resisting wind uplift (see "Framing for Corner Windows," 4/97), especially where there are sheathing joints at or near the plate lines. Straps can also be used

Tension Tie

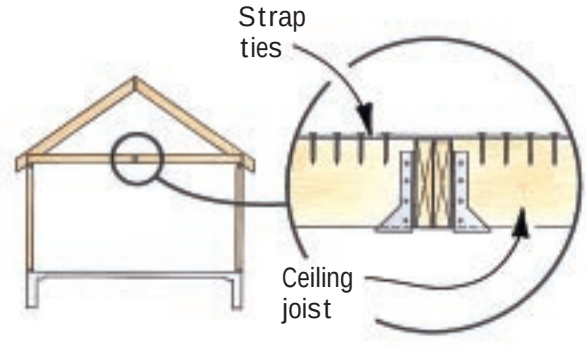

Figure 2. In the absence of a structural ridge or center bearing wall, ceiling joists are critical for preventing rafters from spreading. Where the joists are interrupted by a flush-framed beam, strap ties make an ideal tension connection.

to provide tension capacity through ceiling joists interrupted by a flush header (Figure 2). Joist hangers are never to be depended on for tension perpendicular to a header.

Reinforced ridge beam. On occasion, you'll be asked to remove ceiling joists to create either a tray ceiling or a full cathedral. Or you may be faced with a shed dormer addition, where you have to remove the rafters themselves. In these cases, it may be necessary to double the existing ridge, which is easier if the new beam is added below. If the rafter-ceiling joist connections in the undisturbed portion of the roof are strengthened, the "ridge doubler" can be hung from the existing ridge (Figure 3).

Strap ties are a simple way to provide a high-strength connection at the ends of such a reinforcing beam, where simply nailing a 2x4 on each side would probably not be adequate.

Coil strap. Simpson offers CS and CMST series coil strap, which is simply a long coil of strap tie in a convenient flat box. Many contractors I know keep a box in the cab of their truck to avoid having to run off to the supply house for the right length of strap tie. Just snip the coil strap to the right length and nail it up.

Coil strap is a simple solution when added tension ties are needed between the eaves, whether in new construction or remodeling. When the ceiling joists run the wrong way (Figure 4) or access is difficult to connect to them, you can run coil strap the width of the attic and nail it directly to the rafters at opposite eaves (see *Practical Engineering*, 5/96). Coil strap can also be twisted to lie flat on joists or plywood subfloor and requires no nailing except at end connections.

Twist straps. These handy connectors are simply strap ties with a twist. The 90-degree twist allows them to connect to faces of members that are perpendicular. Usually used in pairs, they serve well to support ceiling joists beneath an *upset girder* (Figure 5). As always, fill all the holes with nails.

Ridge Retrofit

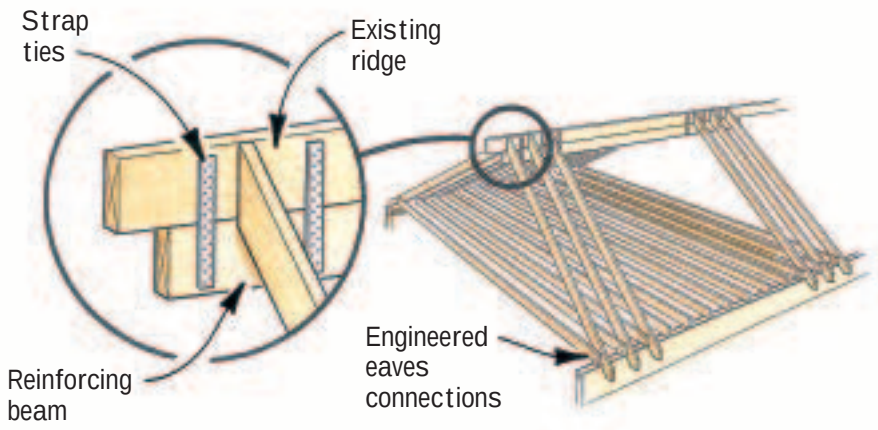

Figure 3. In cases where an existing ridge board is inadequate for carrying vertical roof loads, as in a shed dormer retrofit, you can use strap ties to suspend a reinforcing beam below the original ridge.

Heavy-Duty Angles

Simpson's HL series or USP's KHL angles come in handy for structural connection of perpendicular members in a variety of applications. For example, these heavy angles are often a good answer to the tricky connection of the last deck joist to a flush ledger where a regular joist hanger wouldn't work (Figure 6). Heavy angles can also be used to support connections to the faces of masonry foundations.

Least Favorite Connectors

There are a few products in the connector catalogs that make me wary

Strapping the Roof Together

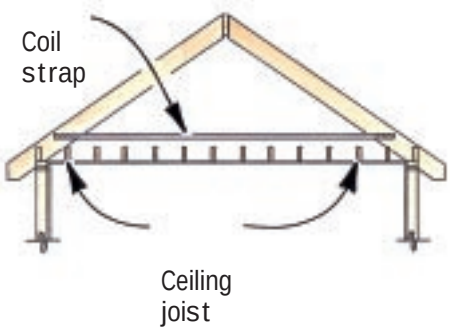

Figure 4. Where ceiling joists run perpendicular to the rafters, coil strap makes an excellent rafter tie.

Upset Beam

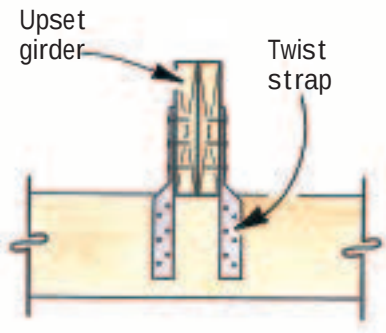

Figure 5. An "upset" girder is often easier to frame than a flush-framed beam. The joists hang by twist straps, installed in pairs.

The Right Angle

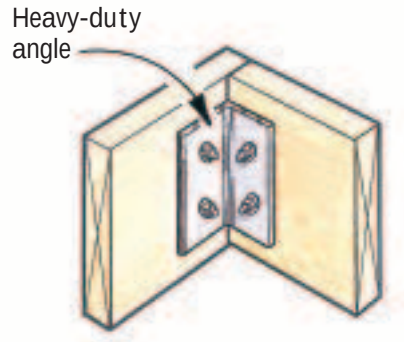

Figure 6. Heavy-duty angles like Simpson's HL or USP's KHL are a good solution for attaching that last deck joist to the ledger board.

Hangers to Avoid

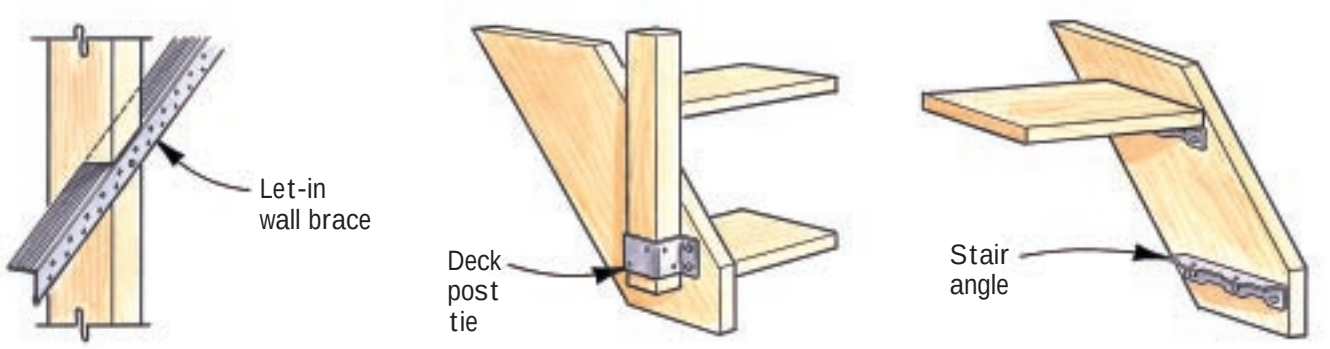

Figure 7. There is a better way to do each of these jobs: plywood sheathing (left), a direct-bolted connection (middle), and mortised treads (right).

(Figure 7). While they may have their place, I think they may lead to unsatisfactory results and advise against their use.

Wall bracing. These metal-strap braces are "designed to fulfill the same code bracing requirements as 1x4 let-in bracing," which isn't saying much. These let-in braces are woefully inadequate for full-blown wind loading and in many cases probably leave it to the plaster or drywall to keep the walls from racking. I strongly advise against depending on this type of bracing.

Deck post ties. This is an interesting idea that I find lacking in merit. Direct-bolted connections are more rigid.

Stair angles. I am a firm advocate of let-in stair treads. Either cut traditional stair carriages, or mortise the stringers (this can be done quickly with a router template) and let the treads bear directly on the shoulder of the mortises for a stronger, stiffer stair.

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