

Framing Hardware Dos and Don'ts

by Jim Mattison

As a field representative for Simpson Strong-Tie, I'm often called to job sites to resolve issues with metal connectors, usually because a building inspector has flagged a mistake. Installation errors can affect the load capacity of connectors and — if not corrected — cause long-term problems. In this article, I'll discuss some of the most common problems I encounter and what you can do to avoid them.



Anchor Bolts in the Way

Typically a standard cut washer and hex nut are all that's needed to attach mudsills to embedded anchor bolts. In seismic regions, though, code requires 3-inch-square bearing plates .229 inch thick. Installed in place of the washer, these plates are intended to keep sills from splitting during earthquakes.

When anchor bolts are not carefully located, the bearing plates can extend beyond the edge of the sill or conflict with framing. To address this problem, some carpenters simply notch the rim, joist, or stud around the plate and anchor bolt (top), but this is a crude fix that weakens the framing and can lead to a failed inspection. A better solution — and one allowed by code — is to use a slotted plate that can be shifted out of the way (far left).



Another acceptable option is to use strap-like mudsill anchors instead of anchor bolts. These anchors are cast into the foundation, field-bent around sills, and then fastened in place with nails (left). Their low profile eliminates framing conflicts, and they have a lower installed cost than anchor bolts. In most cases they can be spaced about the same distance apart as $\frac{1}{2}$ - and $\frac{5}{8}$ -inch anchor bolts.

Spalling at Embedded Straps

Shear walls must be anchored with hold-downs to prevent wind or seismic loads from overturning them. In many cases, the anchors are strap-tie hold-downs embedded in the concrete foundation and nailed to the framing. If the hold-down is wet-set or bent out of the way while the concrete is green, it can cause spalling in the concrete (top right).

Small spalls — less than an inch tall — will not affect the load capacity of the hold-down. However, spalls between 1 and 4 inches tall (bottom right) reduce the hold-down's capacity by 10 percent. If a spall of this size is present, the building designer can make a quick determination as to whether the hold-down can still handle the required load.

No data exists for spalls more than 4 inches high, so when spalling is severe it may be necessary to retrofit an epoxied threaded rod or a mechanical anchor. Given recent changes in the building code, it's best to have an engineer specify the appropriate anchor.



Strap-Tie Offsets

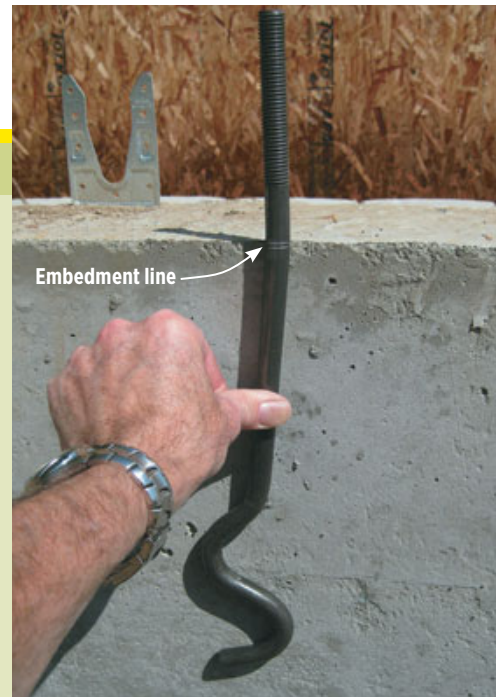
Strap-tie hold-downs are attached either directly to the framing or on top of the structural sheathing. When they're installed over the sheathing, it's sometimes necessary to bend them horizontally — especially if the mudsill hangs past the edge of an out-of-square foundation.

Only a small offset is permitted — up to $\frac{5}{8}$ inch. Easing or lightly notching the panel edge, as was done here (left), and nailing upward will prevent the strap upward and keep wall movement to a minimum. More than one 90-degree bend (far left) is not allowed.



Hold-Down Bolts Too Short

When an anchor bolt is set too low in the concrete, there's not enough exposed thread to properly connect the hold-down. To achieve full strength, the nut must be threaded a minimum of one full bolt diameter, so that the bolt is flush with or projects beyond the top of the nut. In this connection (right), the bolt is too short; extending it with a coupler nut and threaded rod and raising the hold-down above the sill may be a good fix. (Check with the manufacturer to make sure a specific hold-down is approved for this use.) A simple way to make sure there will be adequate thread is to use an anchor bolt that has the embedment depth clearly marked on it (far right).



Misaligned Hold-Down Bolts

Hold-down bolts frequently end up in the wrong place, because of layout mistakes or last-minute changes to the plans. If a bolt is too close to the post, it may have to be abandoned and a new anchor retrofitted. If a bolt is too far away, it sometimes can be salvaged by extending it with a coupling nut, then gradually offsetting it to meet the raised hold-down. The usual rule is that the rod should be within 5 degrees of plumb (no more than 1/4 inch of offset for every 3 inches of additional height), but it's best to check with the hold-down manufacturer.

Nailing Mistakes

The most common fastening problem I see is that hardware is missing nails. If nail holes are left unfilled, the connector won't fully resist the loads it was designed to handle and may deflect, resulting in damage to floor and ceiling finishes. Worse yet, the connector may fail. Unless otherwise noted on the plans, it's best to fill all the holes in the framing connector. The truss hanger shown here would support an additional 500 pounds if the four triangular holes (two in each side) had been filled.

I sometimes see hardware installed with the wrong size and type of nails, often because someone decided to save money by using standard collated nails. This reduces the load the hardware can carry; smaller-diameter fasteners are less resistant to shear, and shorter ones are less resistant to withdrawal.



Pneumatic Nailing

When a nail misses the factory-punched hole and makes its own hole — as happened to this hurricane connector (top right) — it reduces the shear capacity. If you install a lot of framing hardware, invest in a gun designed to accurately place nails in the factory-punched holes.

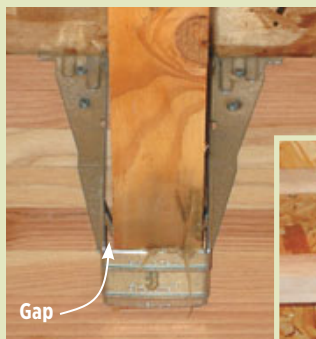
The collated nails designed for use in dedicated hardware nailers come in reduced lengths — $2\frac{1}{2}$ inches versus 3 or $3\frac{1}{2}$ inches for hand-driven nails. In most cases, these lengths are okay as long as the nail achieves the minimum required penetration into the framing (not counting the sheathing). For example, a .148 x $2\frac{1}{2}$ -inch nail needs about $1\frac{1}{2}$ inches of penetration.

The excessive dimpling on this connector (bottom right) is the result of overdriven fasteners, which can weaken the hardware by fracturing the steel around the nail hole. To check for excessive dimpling, lay a straightedge across the nail head and the metal on both sides. If there's any gap between the top of the nail head and the straightedge, it's time to lower the gun's driving depth.



Hanger Sizing Mistakes

Hangers not only need to have enough load capacity — they also must be sized to fit the framing members they carry. This hanger (below left) is too wide for the I-joist, which could allow the joist to move side-to-side and lead to callbacks for a squeaky floor. The bad fit could also cause the hanger to deform, because it's designed for the joist to bear across the entire width of the seat.



Sometimes you can shim the carried member to fit the hanger — but never shim it off-center (below right), because that loads the hanger unevenly.



Truss Clips

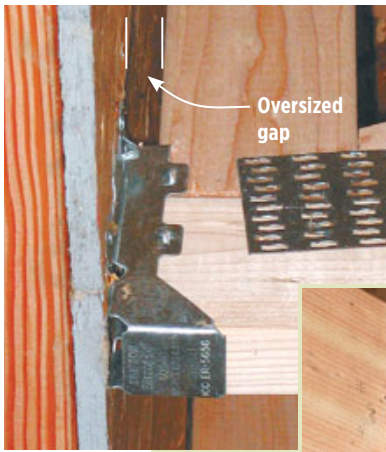
Sometimes cracks appear where partition walls meet trusses. This could be due to differential shrinkage or settling of framing members, improper drywall installation, or truss uplift. An effective way to allow for vertical movement at this location — while laterally supporting the wall — is to use slotted truss clips.



These clips must be correctly installed, with the nail in the center of the slot (left), or they will restrict truss movement. A few of

the common errors I see are nailing too high in the slot, driving the nails in the slot all the way home, and toenailing the truss to the partition (right).





Hanger Gaps

Most hangers are designed so that the gap between the end of the joist (or truss) and the back of the hanger is no greater than $\frac{1}{8}$ inch. An oversized gap — like the one at the back of this truss (top left) — places the downward force further from the supporting header, increasing the rotational force on the hanger and reducing its load rating.

Luckily, there are ways to deal with oversized gaps. For starters, a number of joist and truss hangers have been tested with gaps of up to $\frac{3}{8}$ inch and the reduced loads published. When oversize gaps occur, the designer should compare the design load to the published load and determine whether there is a problem.

It may also be possible to shim or build out the header, though such field repairs should be approved by the building or truss designer. A third option is to use a hanger that has a deep seat and added nailing capacity, and can handle gaps up to $\frac{1}{2}$ inch (left).



Poorly Installed Top-Flange Hangers

Because of their flexibility, top-flange hangers are often installed with the sides splayed open (right). This lifts the seat, which puts bumps in the floor and creates the potential for squeaks. A similar problem occurs when the bottom of a top-flange hanger is not tight against the header. Not only does this put a lump in the floor — it also reduces load capacity. When the framers dropped the I-joist into this hanger (far right), they should have pushed it back against the header.



Improper Attachment of Top-Flange Hangers

Top-flange hangers frequently hang from sills or plates attached to foundations and steel I-beams. Keep in mind that the edge of the nailer should be flush to the edge of the supporting concrete or beam, or overhang it by no more than $\frac{1}{4}$ inch. If the plate overhangs too far, it may split. It's also important to select a hanger rated for use with a wood nailer and to install it with the right fastener. The installation instructions for the hardware include a table identifying the suitable nails, depending on whether the nailer is a single or double 2-by or a 4-by. Here, the hanger on the foundation wall is correctly installed (far left), but there are several problems with the hanger on the I-beam (left). The nailer projects too far beyond the beam, and the empty holes in the flange indicate that an inappropriate hanger was used. There should be 16-penny nails in those holes.



Penetrations Through Wall Plates

Well-intentioned trade contractors usually try to repair top plates at mechanical and plumbing penetrations, but they don't always do it correctly. Under IRC section R602.6.1, when more than 50 percent of the width of a top plate is drilled or notched out, the plate must be reinforced on both sides with a 16-gauge metal strap attached with eight 16-penny nails on both sides of the hole or notch. IRC section

P2603.2.1 specifies that any pipes that aren't cast iron or steel within 1½ inches of the edge of the framing must be protected by a 16-gauge steel plate that extends 2 inches past the top and bottom plates. The small nail stoppers on this wall (left) meet neither requirement and should be replaced with a protecting shield plate like the one shown (above).



Field Modifications

Unique and unexpected framing connections always seem to come up at just the wrong moment. While it may be tempting to save time and trouble by modifying a connector that is already on site, don't do it. Bending can cause fractures, changes the geometry of the connector, and may reposition fasteners into weaker areas of the lumber. The side flange of the hanger supporting this glulam beam (left) was hammered flat, and someone cut this hurricane tie (right) in half to make it fit a double truss. Both pieces of hardware will have to be replaced, because no manufacturer will warrant or guarantee the performance of modified connectors unless they're specifically engineered for field sloping or skewing.



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