SOLUTIONS TO COMMON

Framing Problems

As field representative for the California Redwood Association, and before that as District Manager for the Western Wood Products Association, I have inspected a lot of residential construction sites. For the most part, the builders I meet follow the codes closely and use sound construction techniques. Yet, even on well-run job sites, I still see framing errors that undermine otherwise well-built structures. Here's a look at some common problems I've encountered, along with some advice on how to correct them.

by David Utterback

Undersized Joist Hangers

Joist hangers are engineered connectors that will not work as intended if they are undersized or modified on site. If a particular span requires a 2x10 joist to carry the load, for example, then you have to use a 2x10 joist hanger; a smaller hanger doesn't have enough capacity. The reason they make larger hangers is that a larger hanger provides for more nails, which can support a larger load. The hanger also keeps the joist from rotating at the end, which helps to stiffen the floor. If the hanger is too short, it won't resist rotation as well as a taller hanger.

Proper nailing. You also have to fill all of the holes in the hanger with nails of the proper size and length. All of the hanger manufacturers require 10d common nails to support a single joist hanger, and 16d common nails to support a double hanger; otherwise you have to take a reduction in capacity for the hanger. While it may be obvious that roofing nails, masonry nails, and box nails don't have enough shear strength to support the hangers, many builders who frame with 16d sinkers also use these nails in their hangers. The problem is that a 16d sinker is the equivalent of a 10d common — it's the same diameter and it's only 3 inches long. If you're framing with 16d sinkers, you can use them for single hangers, but not for doubles unless you reduce the load the hangers will carry.

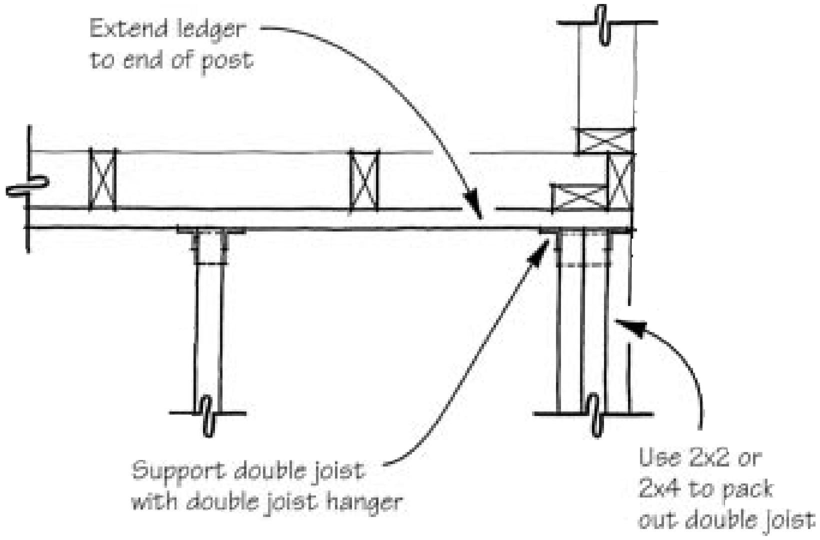
You also have to fill all of the holes in the *side* of the hanger with properly sized nails. Joist hanger nails — those $1^1/_2$-inch-long common nails supplied with the hangers — are made for that purpose. They are designed to hold the joist in the hanger and resist the spreading forces that tend to pull the joist away from the carrying member. These nails are short so they won't come out the other side, but because they're commons, they are large enough in diameter to resist the tension forces. Again, roofing nails, masonry nails, or box nails won't do the job.

Reshaped hangers. Joist hangers also can't be modified on site without reducing their loadbearing capacity. I often find joist hangers that have been reshaped to conform to the framing (see Figure 1). While this may solve the immediate problem of keeping the hanger flange out of the way, bending the hanger causes tiny fractures that fatigue the metal. This reduces the loadbearing capacity of the hanger and may cause the hanger to fail over time and under full loading.

In most cases, framers can avoid having to bend the hanger with better planning. Typically, framing members can be installed in a way that provides enough room to install the hanger as intended. In the case of the double joist shown in Figure 1, the ledger, which is fastened to the stud wall, could have been extended to the corner of the wall and the double joist inset to allow room for the hanger. The double joist could then have been packed out with 2x2s or 2x4s to flush it out with the intersecting wall.

Figure 1. Bending joist hangers to conform to the framing (photo) weakens the metal and reduces the load the hanger can carry. The illustration below shows how this floor could have been framed without having to reshape the hanger.

Proper Framing for Joist Hangers



Special hangers are also available to solve this problem. Simpson Strong-Tie's HUC and HUSC series hangers are made with concealed flanges that can be fastened flush with the end of the carrying member. A top-mount model (HUSCTF) also solves the problem.

Overloaded Cantilevers

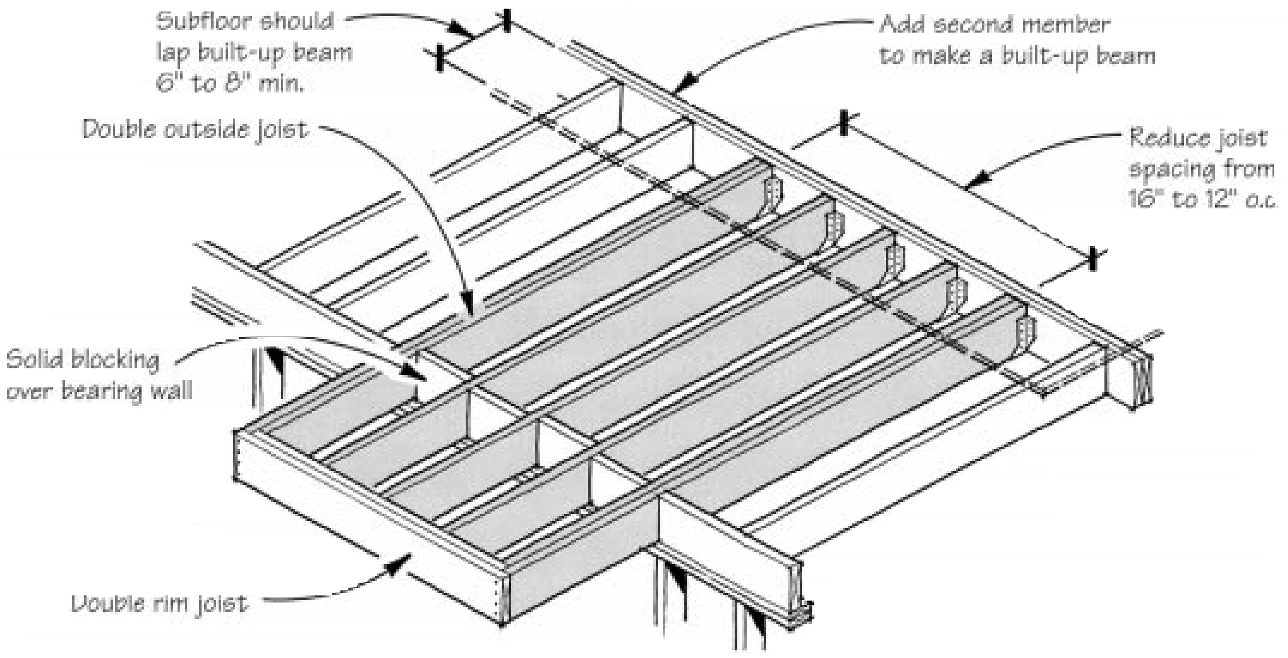
Most framers are familiar with the 1-out/2-in rule for cantilevers. This rule of thumb says that the distance you can cantilever a joist is equal to one-third its total length. In other words, an 8-foot joist can be cantilevered 32 inches, so that 64 inches of the joist remains inside the building. The problem is that many framers don't realize that this rule applies only to nonbearing cantilevers. When a bearing wall comes down on the end of the joists, the cantilever is limited to the depth of the joist. In the case of a 2x10, for example, you can cantilever the joist 9 inches.

A lot of the cantilevers I see are overloaded because the framers don't recognize the load that is being applied to the end of the joists. The 2x10s shown in Figure 2 overhang the supporting wall by almost $2^1/_2$ feet and are tied back into a double joist about 5 feet away, running perpendicular to the cantilever. The framer thought this was okay because the cantilevered joists were not supporting any roof loads, just a zero-clearance fireplace.

What you can't see in the photo, however, is that the wood chase enclosing the fireplace and chimney extends upwards for two stories, continues

Figure 2. The floor framing in this photo, which was cantilevered to allow for a zero-clearance fireplace, follows the 1-out/2-in rule of thumb for non-bearing cantilevers. The weight of all the framing and finish materials, however, plus the fireplace and chimney, adds up to well over 1,500 pounds. The illustration shows how the cantilever should have been framed. The solution, however, depends on the species of lumber used. The author recommends that an engineer design any loadbearing cantilevers.

Framing a Loadbearing Cantilever



along the gable end of the 10/12-pitch roof, and extends several feet beyond the peak. In addition to the weight of the fireplace itself, you have to add the weight of some 30 feet or more of insulated metal chimney, plus the studs and sheathing used to construct the chase. On top of that, the chase is clad with hardboard siding, a fairly heavy material. Altogether, these materials add up to well over 1,500 pounds. That kind of load will cause the cantilever to fail both in bending and in shear.

The way this cantilever should have been framed is shown in the illustration. First, the joist holding the ends of the cantilevered joists inside the building should have been doubled to carry the extra load. To resist the tendency of the cantilevered joists to lift up where they meet this beam, the subfloor should span the joint by at least 6 or 8 inches, enough to get 2 or 3 nails on both sides of the beam. A 12-inch overlap would be even better.

Next, the outer cantilevered joists, as well as the rim joist, should be doubled, and the cantilevered 2x10s should be placed closer together. In most cases, the next smaller on-center spacing would probably work — switching from 16 inches on-center to 12 inches, for example.

Finally, the cantilevered joists need to be blocked where they cross the supporting wall. This solid blocking resists the tendency of the joists to rotate under load.

This solution is not a rule of thumb, however. It would have worked in this case, provided the framing material was southern pine or Douglas fir. My recommendation is to have an engineer specify the framing for any loadbearing cantilevers.

Missing Fire Blocking

Many multi-level houses have small sections of floor that are balloon-framed into adjoining walls. The framing in Figure 3 (next page) is typical, and shows good support for the joists where they meet the tall stud wall. The problem, however, is that the fire blocking is missing where the horizontal floor meets the vertical wall. Without blocking, flames in the lower area can migrate to upper stories through the open bay where the joists meet the wall. Solid blocking is also necessary to pro-

Figure 3. The missing fire blocking and edge blocking in this photo can easily be installed at the top and bottom of joists in the bays without ductwork (top illustration). Where ducts get in the way, install a metal collar, which will choke off a fire and prevent it from spreading into the wall. Where soffits above kitchen wall cabinets are framed before drywall is installed (lower illustration), the joint between the wall and ceiling also needs fire blocking.

vide lateral support when balloon-framed studs are taller than 10 feet.

The solution in this case is complicated by the ductwork. It's easy enough to add fire blocking at the bottom of the joists, and to add blocking along the unsupported edge of the subfloor. There isn't enough room, however, to add blocking at the top of the joists in the bays that carry the ductwork. In this case, I asked the builder to fabricate a metal collar that would surround the ductwork. Even without sealants, this collar closes off the air flow enough to reduce the ability of a fire to sustain itself in these stud bays.

Another common area where fire blocking is omitted is in soffits built above kitchen wall cabinets. If the ceiling and wall are drywalled before the soffit is framed, then the drywall serves as a firestop. When the soffit is framed first, however, you need to install solid blocking where the ceiling of the soffit meets the wall.

Improper Shimming

The wall shown in Figure 4 is built directly on top of a poorly formed concrete stem wall that went up and down like a wave. When it came time to frame the roof, the framers noticed that the trusses were out of plane. To bring everything back to level, they drove wedges between the two top plates.

Unfortunately, the shims lifted the upper plate so much in many places that the nails pulled nearly all the way out of the lower plate, effectively breaking the connection. This put the entire truss roof at risk from wind uplift at the overhang.

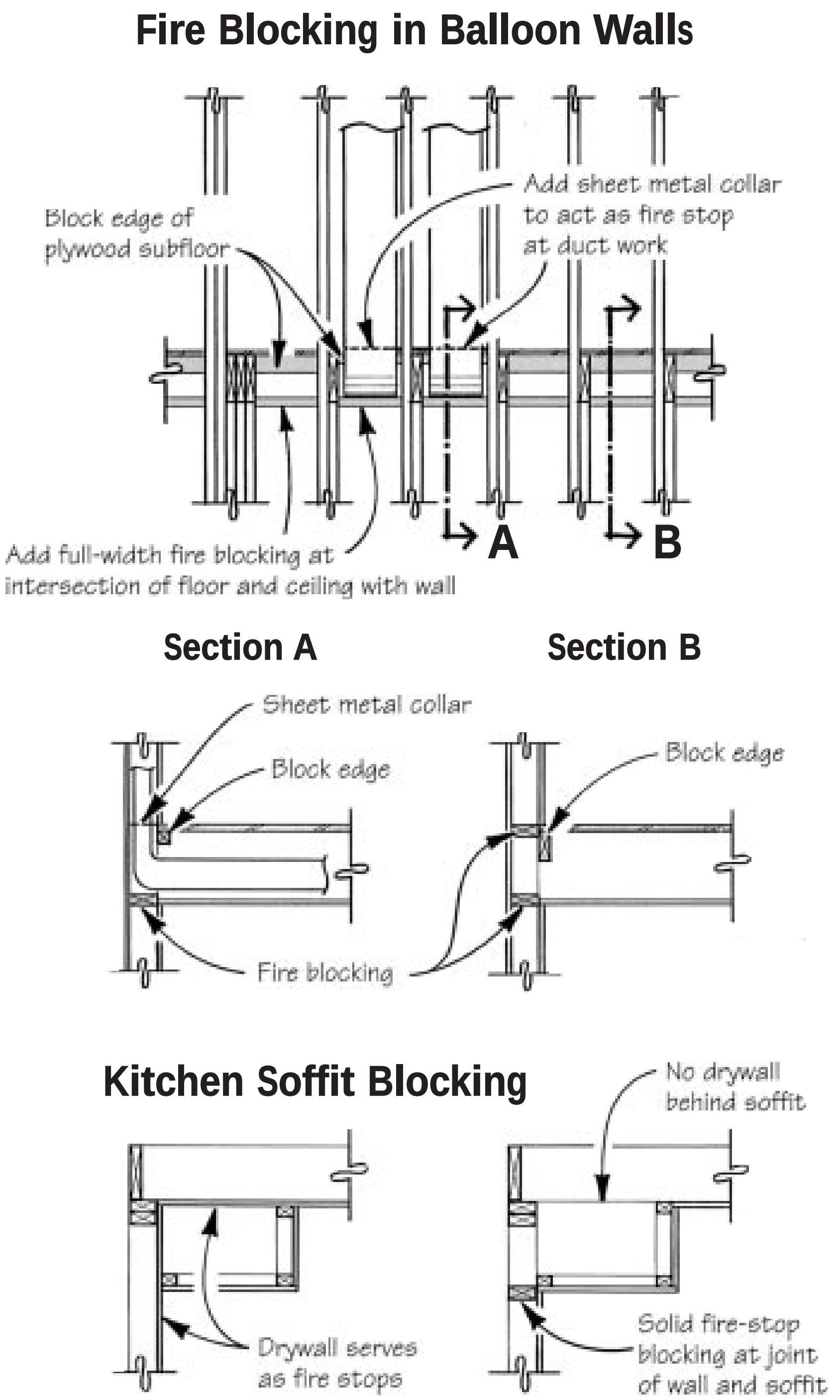


Figure 4. To correct a wavy foundation wall, the framers drove wedges between the top plates, effectively breaking the connection (photo). The best solution would have been to wedge between the bottom plate and sill, then tie the connection together with metal straps or plates, or with well-nailed, continuous sheathing (top illustration). The in-place wall can also be corrected with metal twist ties that connect the trusses directly to the studs, and with metal straps that tie both top plates to the studs (bottom illustration).

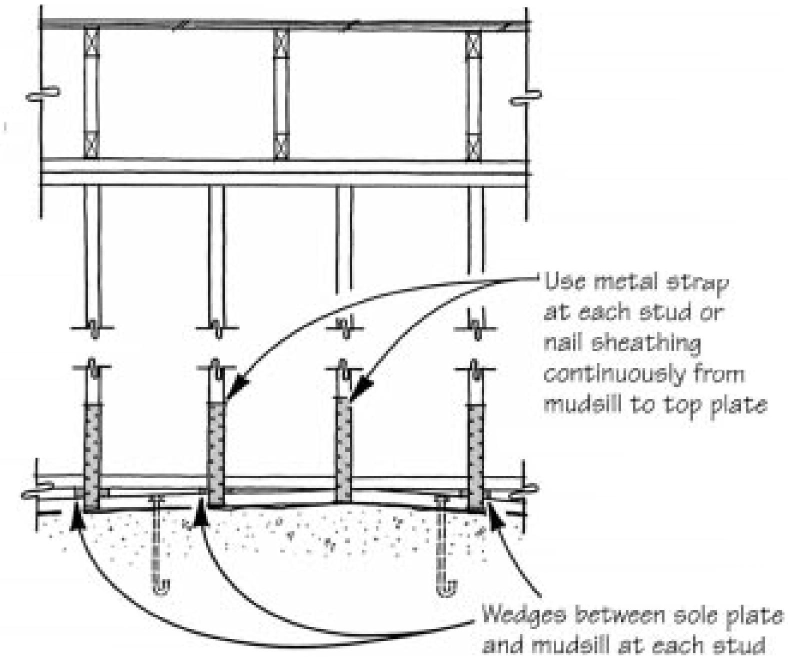
What the framers should have done was shim the wall directly under each stud between the bottom plate of the wall and the sill. The shims can be steel, or wedges made out of the same material as the plates; a softer wood, like cedar, would crush under the load. The two plates would then have to be connected with metal straps or plates. Alternatively, the exterior sheathing will serve to connect the shimmed plates so long as it is installed continuously from the sill to the top plate of the stud wall. Use nails 6 inches on-center along the entire shimmed portion of both plates and at all edges.

While this is the simplest and cheapest fix, the wall shown in the photograph can be fixed using metal twist-tie connectors, such as Simpson's LTS/MTS series or USP's LSTA/MSTA series, to fasten the trusses directly to the studs. Since the framing intervals for the trusses and studs differ, this would provide a solid connection every 4 feet. Where trusses fall over stud bays, a metal strap could be run up each stud and across the top of the plates, then fastened securely to both sides of the stud. This would effectively reconnect both plates to the studs.

Unbraced Knee Walls

A lot of builders want to provide extra ceiling insulation over the eaves walls. When using trusses, this can usually be accomplished by raising the heel. When using conventional rafters, the best way to add room for insulation is to carry the ceiling joists to the outside of the wall,

Properly Shimmed Wall



Site Fix for Incorrectly Shimmed Wall

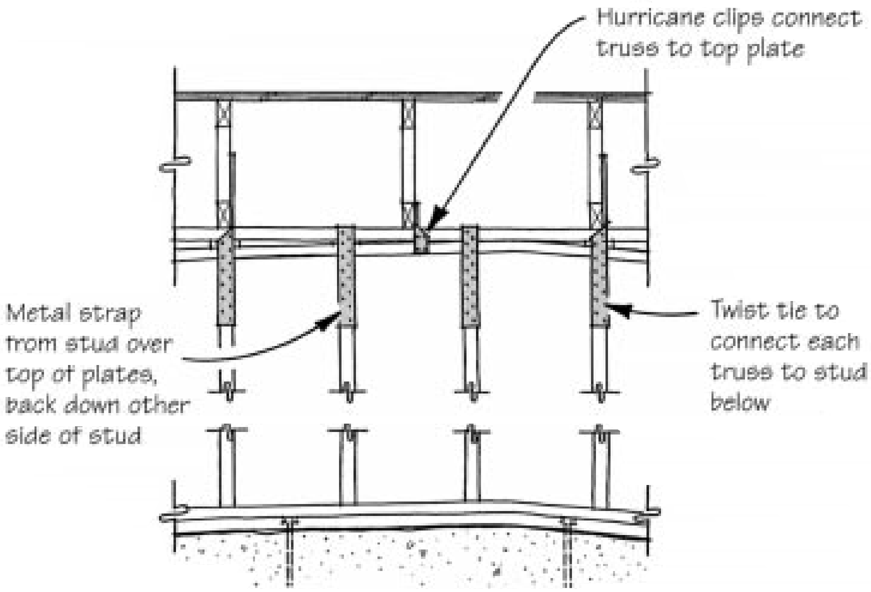


Figure 5. This short kneewall (left) is designed to add extra insulation space over the exterior wall, but it is framed only half-right. The 2x4 diagonals nailed between the top of the wall and the ceiling joists brace against outward thrust, but the wall needs to be sheathed to prevent racking. In a similar situation (right), a kneewall has been added to accommodate two different ceiling heights. The joists themselves provide resistance to any hinge action, because they are tied to an existing wall. But the wall needs drywall on both sides or plywood sheathing on the attic side, 4 feet in from each end, to prevent racking.

add a rim joist, then fasten a 2x6 on the flat to provide nailing for the rafters.

Unfortunately, I often see short kneewalls built on top of the exterior wall to provide the extra insulation space (Figure 5). The problem here is that the kneewall creates a hinge point that could kick outward when the roof is loaded. The kneewall can also rack laterally.

The framing in the photo, above left, is done half-right. Every other ceiling joist has a 2x4 diagonal fastened to the top of the kneewall. With three or four common nails in each end, this diagonal bracing will keep the kneewall from kicking out.

The kneewall can still rack from side to side, however. Luckily, the simple solution is to sheathe it with plywood, just like the full-height wall it sits on. Better yet, run the sheathing so it overlaps the joint between the plates of the two walls.

The other kneewall in Figure 5 also needs sheathing to keep it from racking. In this case, outward thrust is not a problem, because the ceiling joists it supports are tied back into a wall. But it still needs lateral support so it won't fall over sideways.

The wall will be finished on one side with drywall, but that won't help. Drywall on both sides may be enough to provide the lateral bracing the wall needs. But with an open attic space behind it, the easiest solution is to use plywood to sheathe at least 4 feet in at both ends.

Rim-Joist Header

It sometimes happens that there isn't enough room over a window or door for a proper header. That's the case in the photo of the top of a patio door opening (Figure 6). Fortunately, this builder didn't rely on the flat 2-bys to carry the load — a situation I see all too often. Instead, he scabbed an LVL onto the rim joist and fastened his I-joists to it.

There are several important points to remember when using a rim joist as a header. First, depending on whether the wall is framed with 2x4s or 2x6s, you may have to use joist hangers because there may not be enough plate left for the joists to sit on. Secondly, the scabbed rim joist has to be long enough to bear on the king studs at both ends of the opening. Most openings will have double king studs to add stiffness; if not, you should double them anyway to increase the bearing area for the header. The header over the first-floor opening in this photo, for example, must also carry the load of a second story. Such a large compression load concentrated on the plate above a single king stud could cause the plate to crush.

Figure 6. When there is not enough room for a conventional header, the rim joist can be doubled to take the load. Use joist hangers on 2x4 walls, where the doubled rim joist doesn't leave enough bearing surface. Also, be sure that the inner rim joist is long enough to bear on the doubled king studs; otherwise, the plate may crush.

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