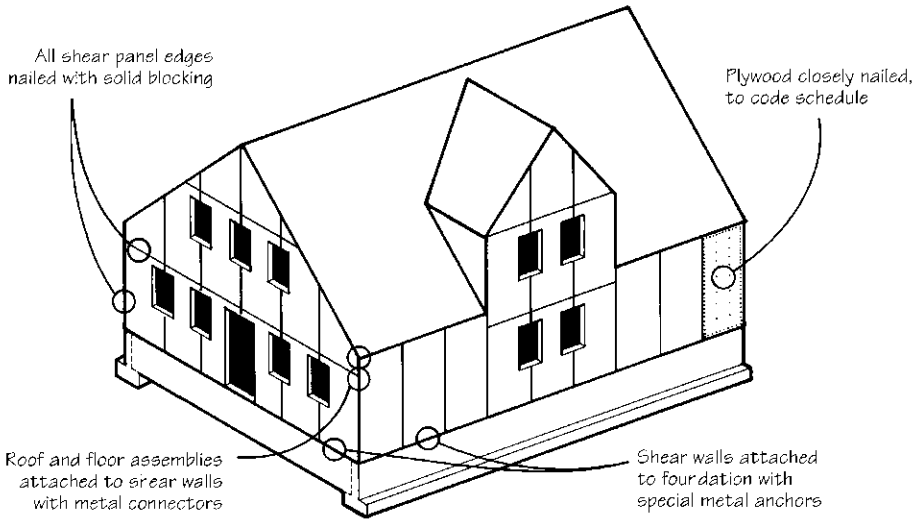
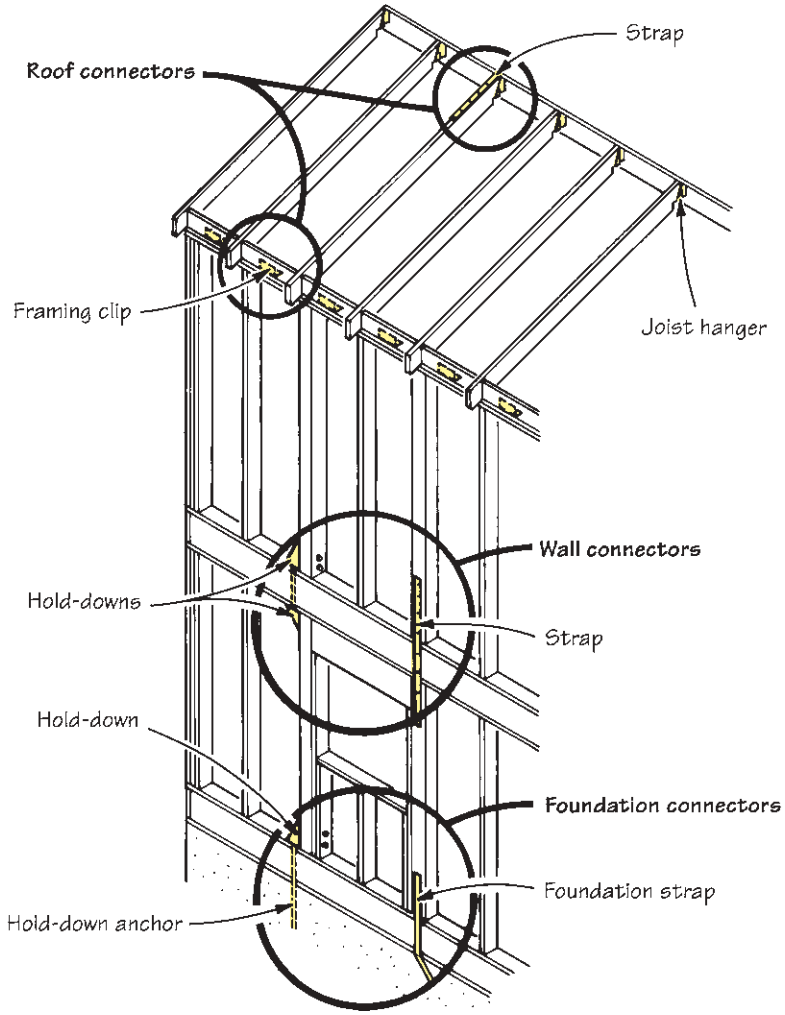
Shear Wall Essentials



Plywood shear walls resist an earthquake's lateral forces by preventing racking. Shear walls get their stiffness from close nailing patterns, solid blocking at all panel edges, and hold-downs and metal connectors at the foundation and roof. ("Shear Wall Basics," 1/93)

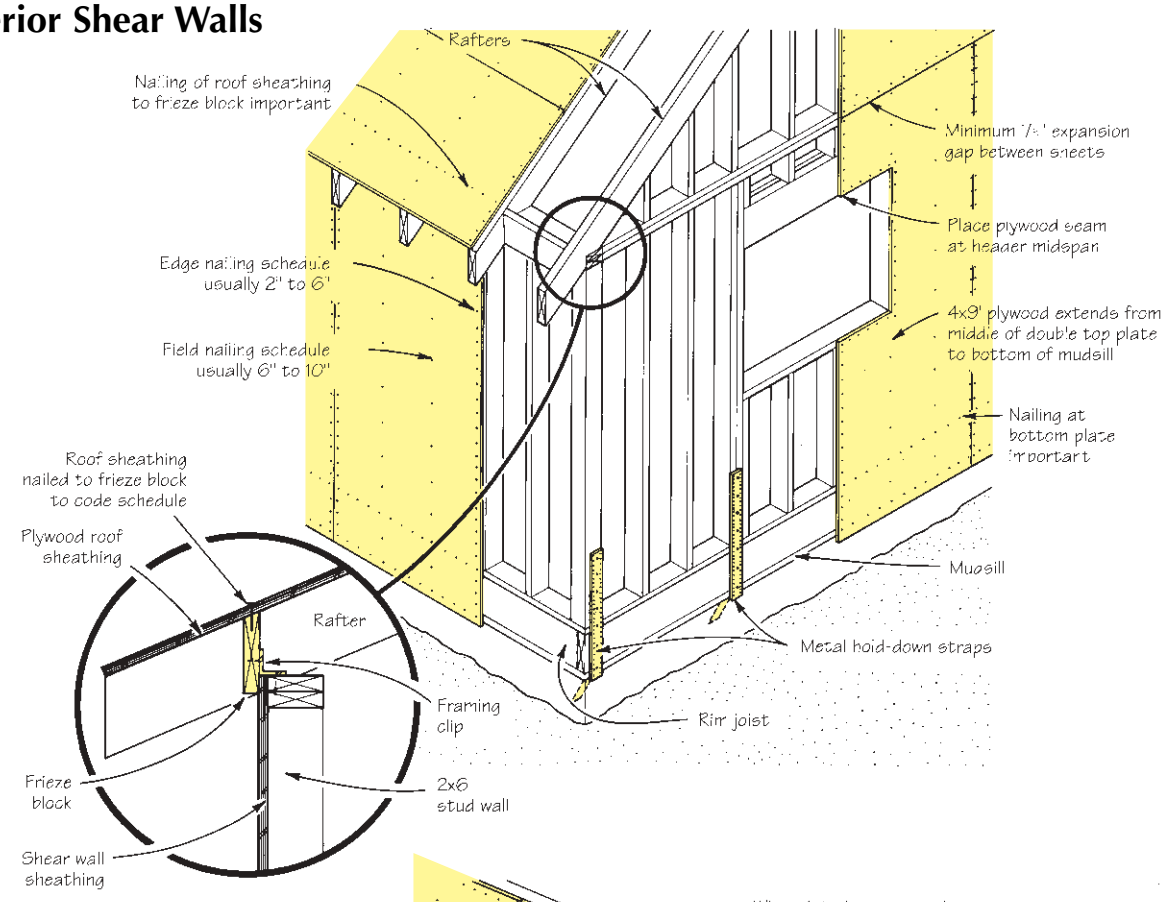
Seismic Connectors



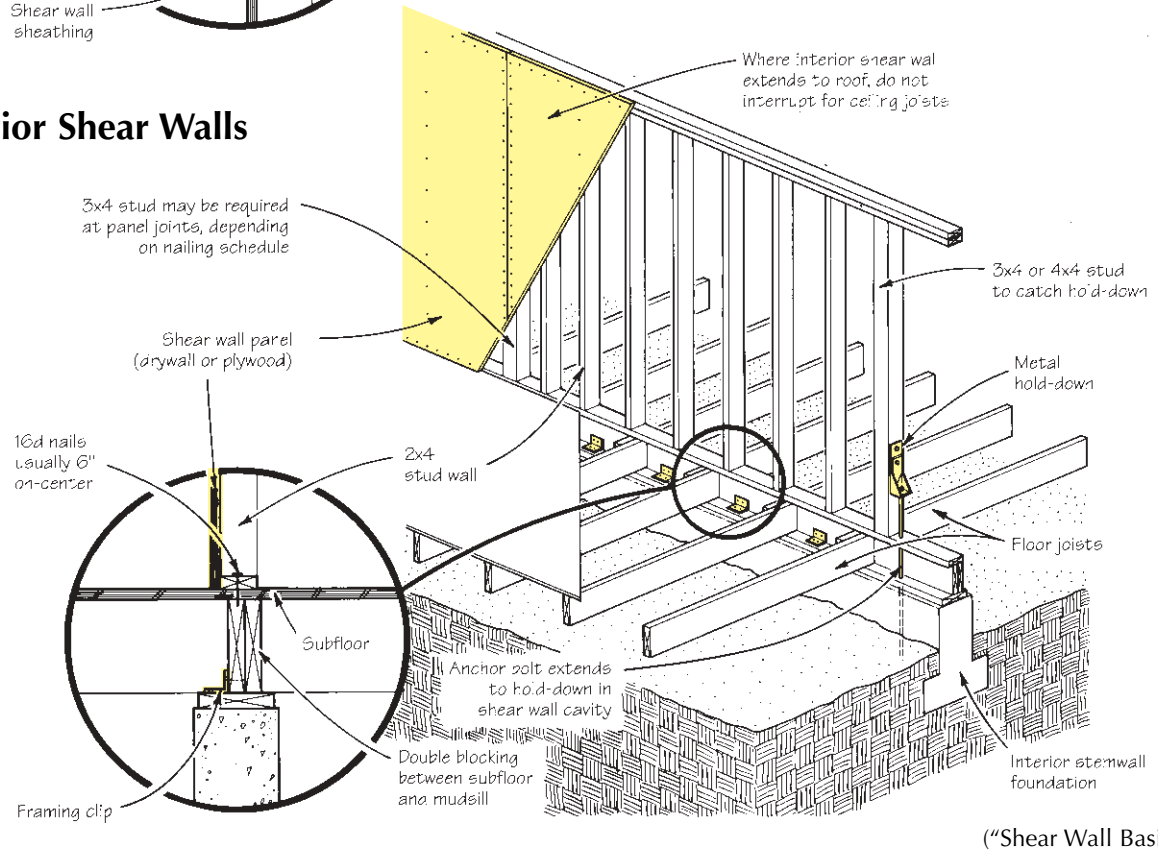
On a new two-story house on the West Coast, a variety of metal connectors are used to tie the structure together and strengthen weak connections against earthquake uplift. ("Installing Seismic Framing Connectors," 7/93)

Typical Shear Wall Details

Exterior Shear Walls



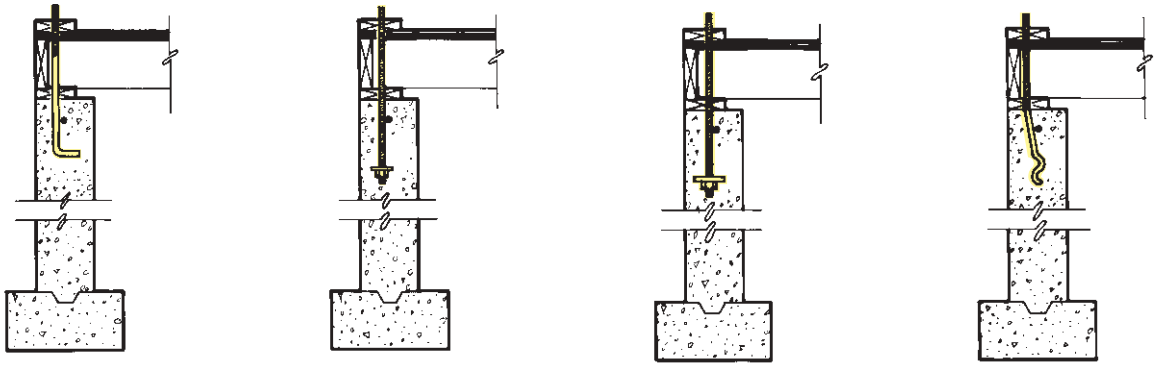
Interior Shear Walls



("Shear Wall Basics," 1/93)

SEISMIC HOLD-DOWNS

Anchor Bolt Options



A. J-bolt

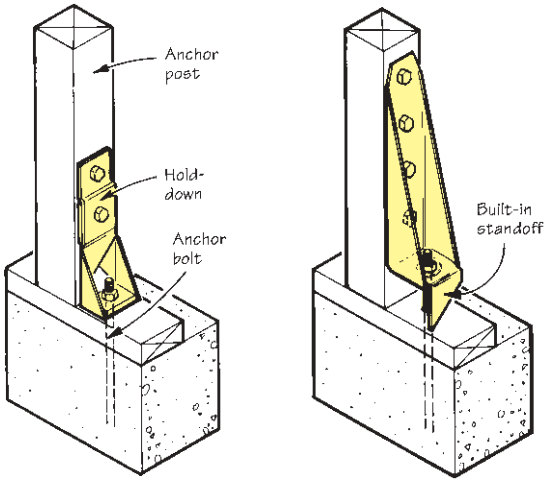
B. Threaded rod with nut and washer

C. Threaded rod with steel plate

D. STAB anchor

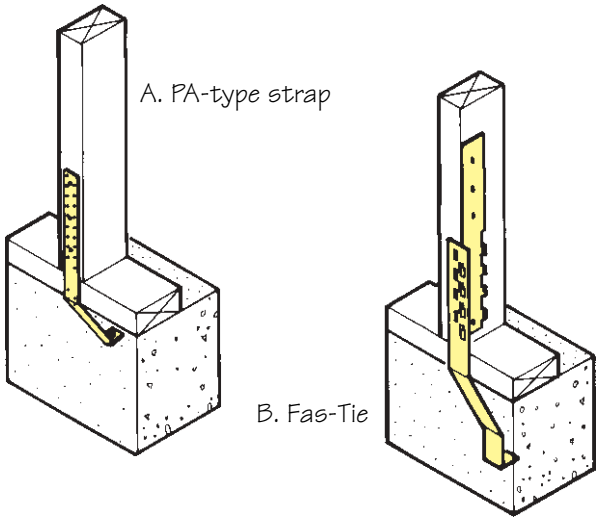
There are four types of anchor bolts for use with foundation hold-downs: (A) A threaded rod with a 90-degree bend in the end, like a large J-bolt; (B) a threaded rod or long bolt with a nut and washer on the end; (C) a threaded rod with a 1/4-inch-thick steel plate bolted to the end; and (D) a manufactured anchor bolt, such as Simpson Strong-Tie's STAB anchor. ("Installing Seismic Framing Connectors," 7/93)

Foundation Hold-Downs



Foundation hold-downs form a strong connection between a 2x or 4x wall stud and a concrete-embedded anchor bolt. One type of hold-down (left) rests directly on the mudsill or bottom plate; another type (right) has a built-in standoff that lifts it off the plate far enough so the bolt holes don't split out the end of the post. When installing a hold-down at an outside corner, be sure to countersink the nuts so they don't bulge the siding. ("Installing Seismic Framing Connectors," 7/93)

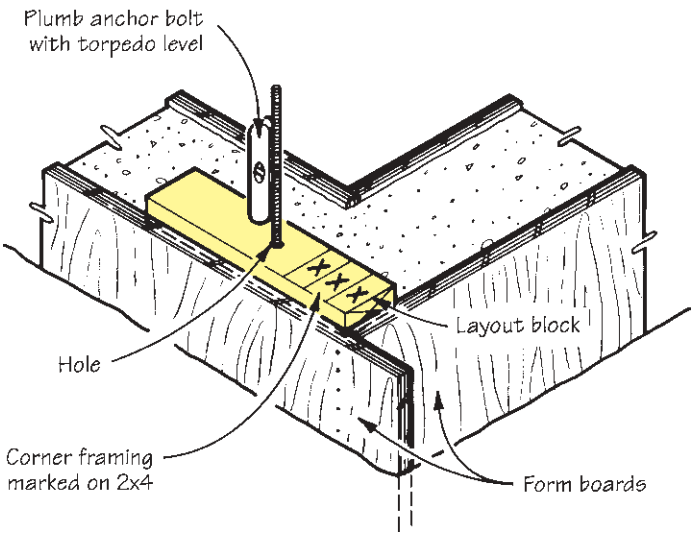
Strap Anchors



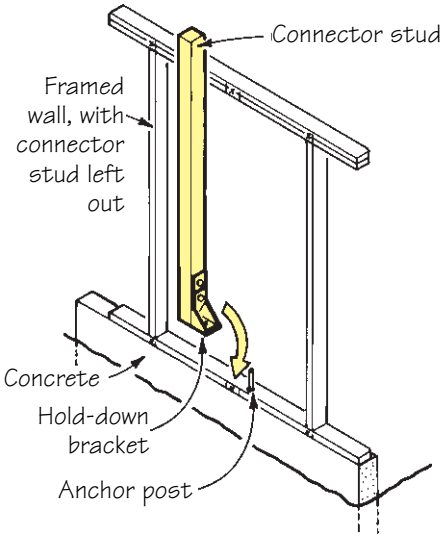
Foundation straps, like the PA series (A), are nailed to the foundation forms during the pour, then nailed to the framing through the exterior sheathing once the walls are up. A new type of strap anchor, Simpson's Fas-Tie (B), has two pieces. The upper piece nails into the wide face of the stud, then interlocks with the part embedded in the concrete. ("Installing Seismic Framing Connectors," 7/93)

SEISMIC HOLD-DOWNS

Anchor Bolt Layout at Corners

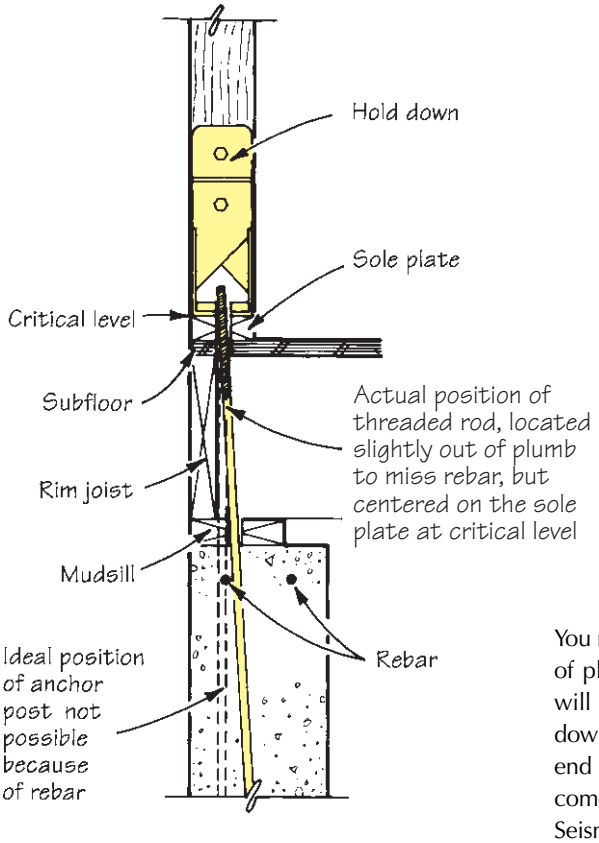


To ensure the exact position of a corner anchor bolt, the author uses a layout block with a hole to hold the anchor bolt in the foundation form. The block is also useful for hold-downs at door and window openings. ("Installing Seismic Framing Connectors," 7/93)



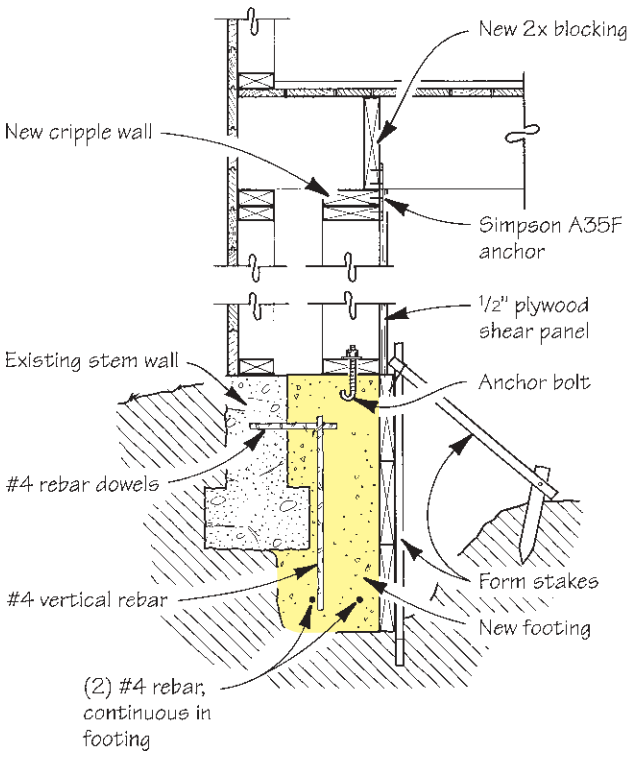
When framing walls, the author recommends leaving out the studs that connect to hold-downs and installing them after the walls have been tipped up. This allows you to accurately attach the hold-down bracket to the stud, then place the stud and bracket over the embedded anchor bolt. ("Installing Seismic Framing Connectors," 7/93)

Out-of-Plumb Anchor Bolts



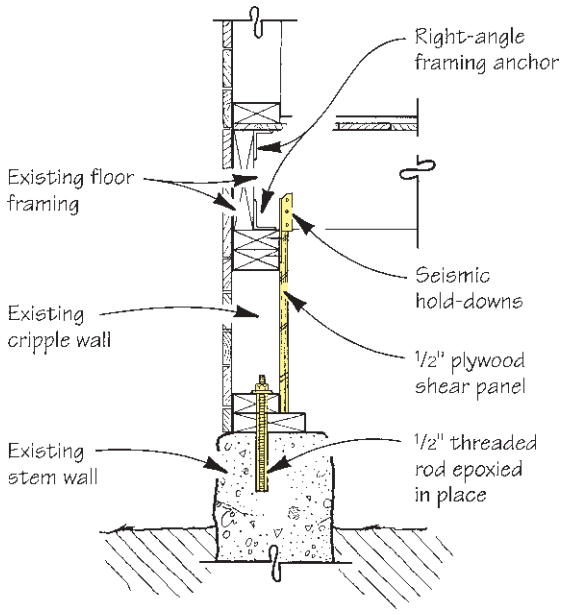
You may install an anchor bolt slightly out of plumb if the rebar is in the way. This will not affect the strength of the hold-down, but you must make sure the top end of the bolt is still centered where it comes through the sole plate. ("Installing Seismic Framing Connectors," 7/93)

Pouring a New Stem Wall



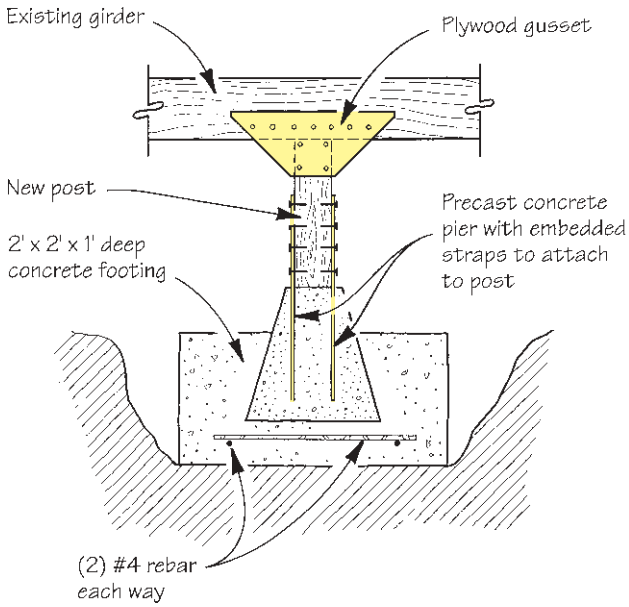
In cases where the old foundation is too weak to hold anchors, it's necessary to pour a new wall. In the case shown here, a new stepped stem wall was poured tight to the existing one, with new cripple walls built on top. Simpson A35F clips secure the cripple wall to solid blocking between the floor joists above. ("Seismic Support for Old Foundations," 4/97)

Basic Seismic Retrofit



Where there is good access, the least expensive retrofit involves threaded rod anchors epoxied in place, plywood shear paneling, and framing anchors between the top of the cripple wall and the floor framing. ("Seismic Support for Old Foundations," 4/97)

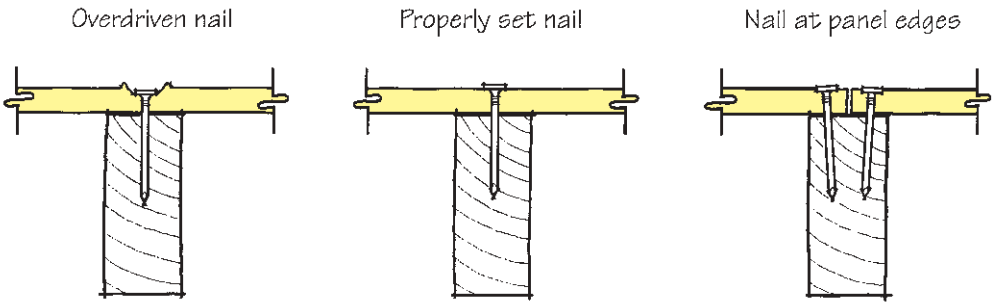
Reinforced Post Footing



New post-and-pier supports are built in place using precast pier blocks set in a 2-foot-square concrete footing. ("Seismic Support for Old Foundations," 4/97)

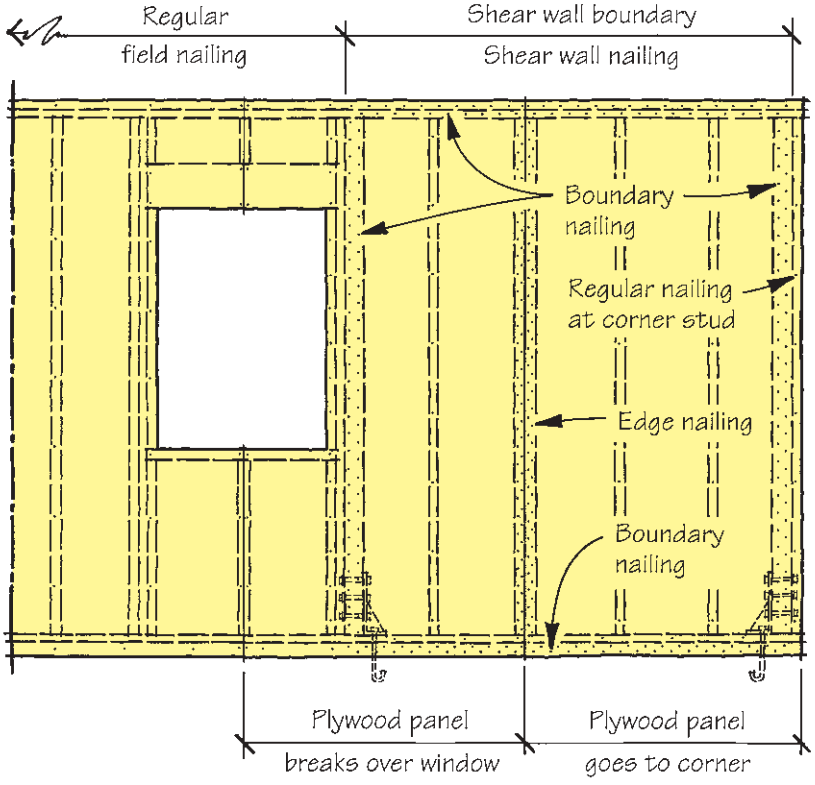
NAILING SHEAR PANELS

Setting Nails



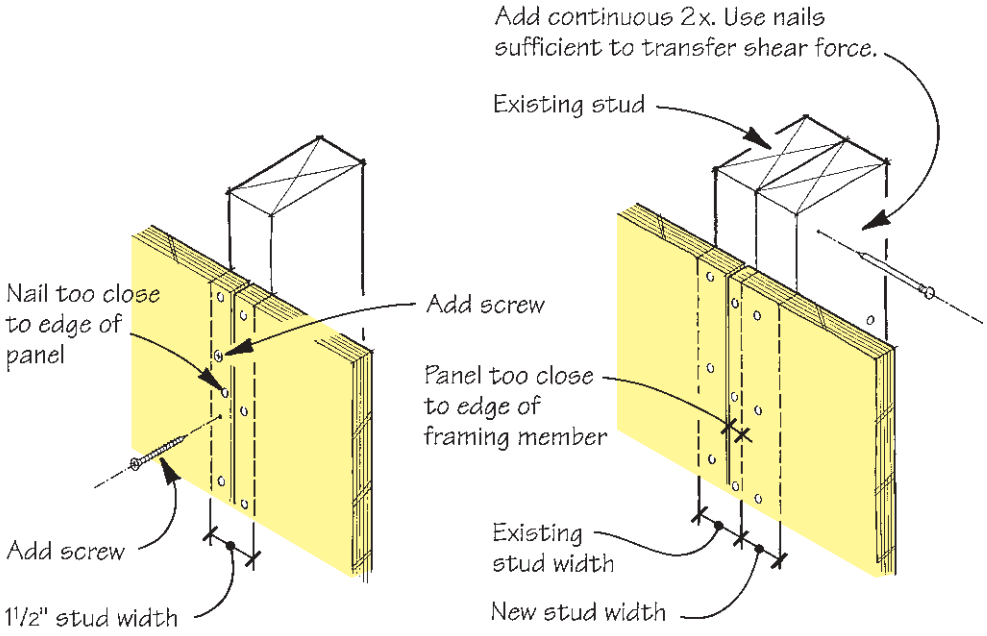
A nail that ruptures the outer plies of the panel (left) has less shear strength and should be reinforced with screws. A properly set nail should either sit snugly on top of the plywood (middle) or slightly dimple the outer ply. When panels break on a 2x4 (right), set the nails at a slight angle to ensure proper embedment into the framing. (*Practical Engineering*, 8/98)

Nailing to the Right Members



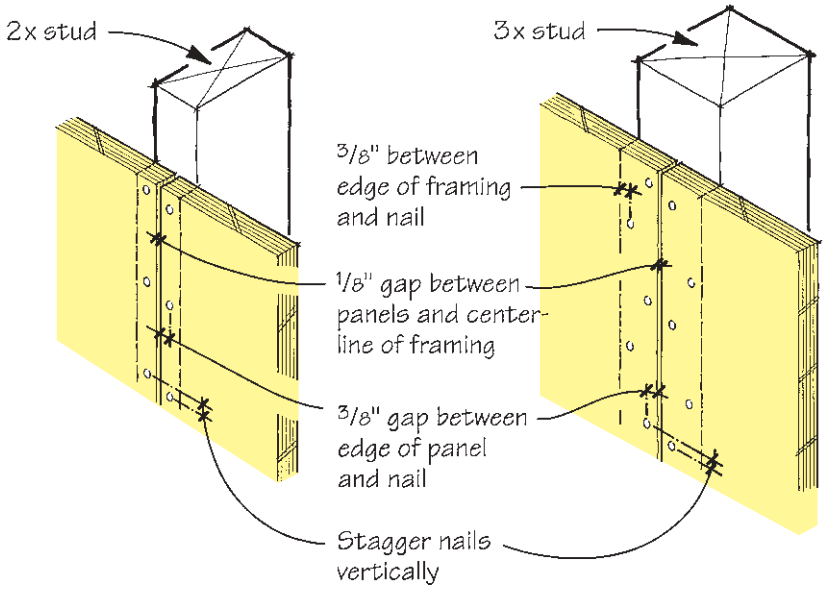
This illustrates code nailing for a shear wall designed to handle forces above 350 pounds per foot. Note that where plywood edges fall within the shear wall boundary, 3-by framing is required to prevent splitting from the close nailing pattern. Where a plywood edge falls outside the shear wall boundary, however, as at the window opening, standard sheathing nailing is permitted. (*Practical Engineering*, 8/98)

Fixes for Common Nailing Errors



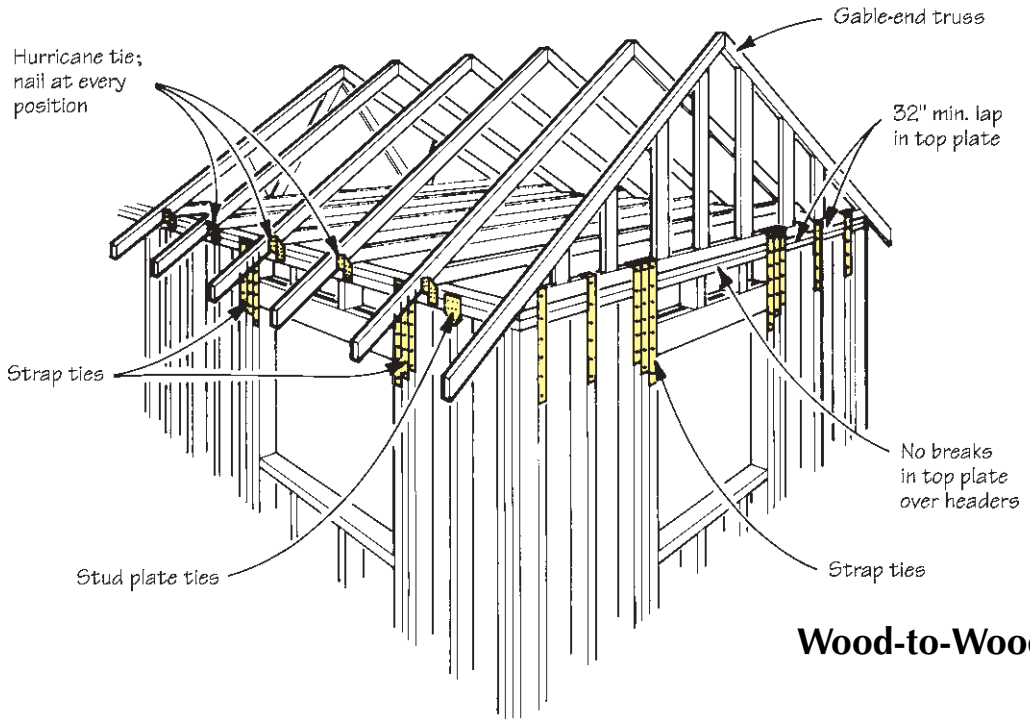
If you nail too close to the edge of a panel (left), install two screws of the same diameter in predrilled holes on both sides of the stray nail. When the panel edge falls so close to the edge of the stud that it's impossible to nail correctly (right), nail on a second framing member for backing. The two studs must be securely attached to one another to transfer all the shear forces. (*Practical Engineering*, 8/98)

Proper Nailing at Panel Joints

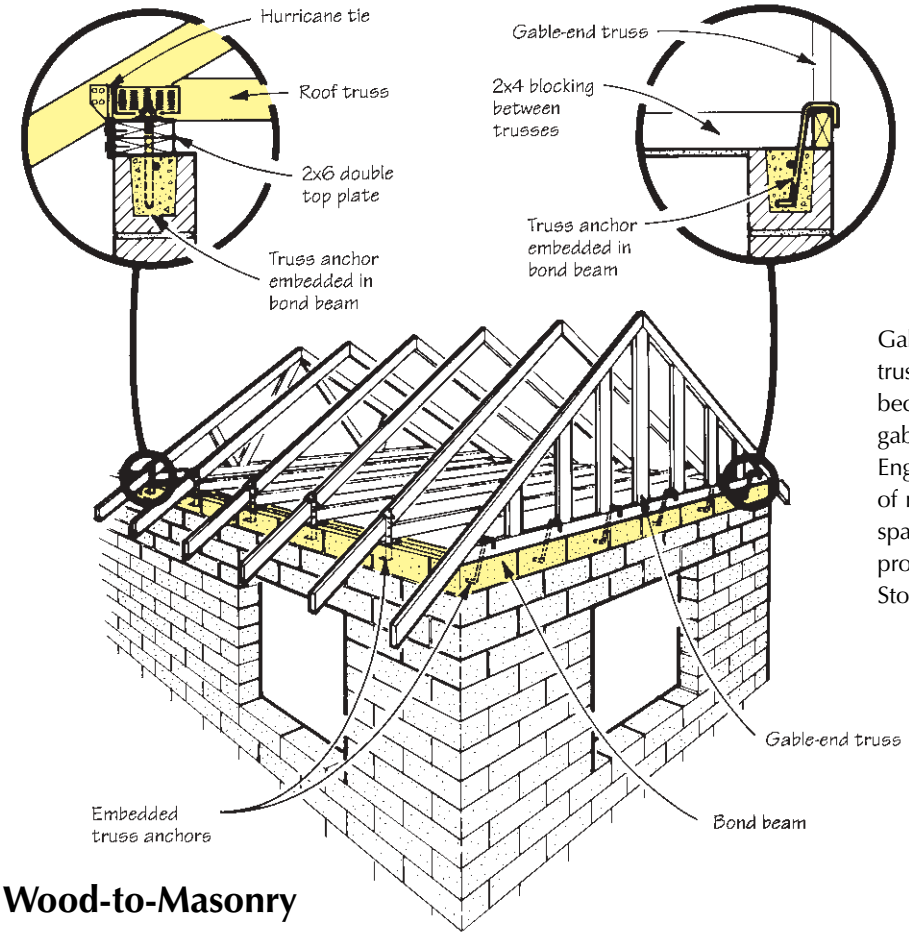


Where shear panels break on a stud, leave a 1/8-inch gap and hold nails back 3/8 inch from the panel edges. Where nails are spaced closer than 6 inches on-center, code now requires 3-by framing; the reduced nail spacing would tend to split a 2x4. (*Practical Engineering*, 8/98)

Better Roof-to-Wall Connections



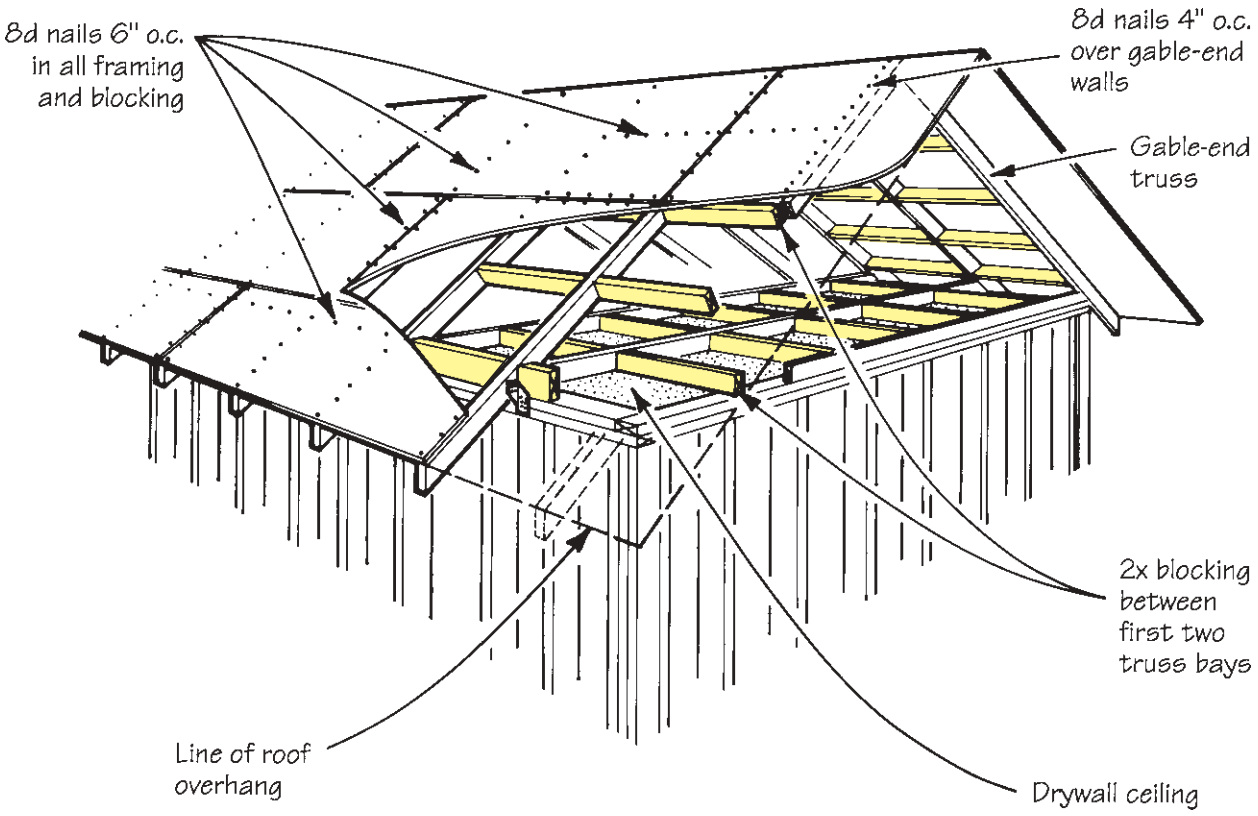
Wood-to-Wood



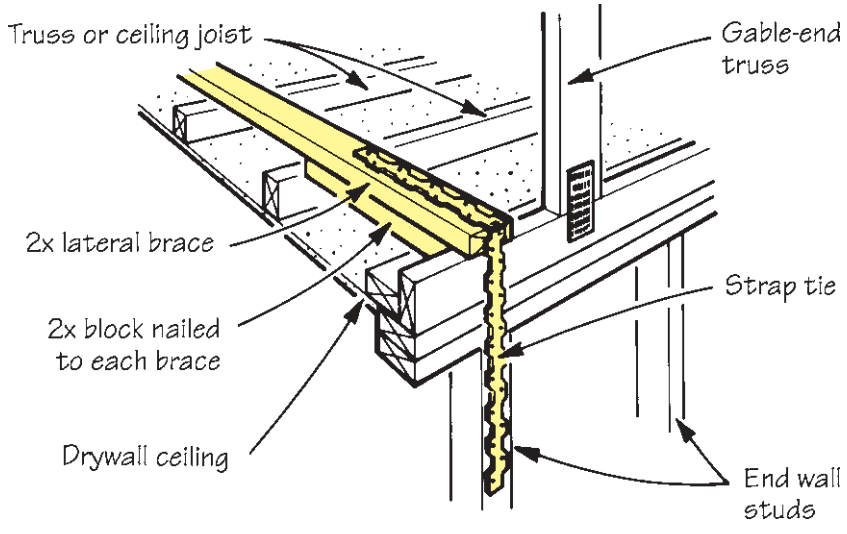
Wood-to-Masonry

Gable ends were a common source of truss roof failure in Hurricane Andrew, because of weak connections between gable-end trusses and the walls below. Engineers are recommending the use of metal framing connectors, properly spaced and nailed, to prevent the problem from recurring. ("After the Storm: Hard-Won Lessons," 8/93)

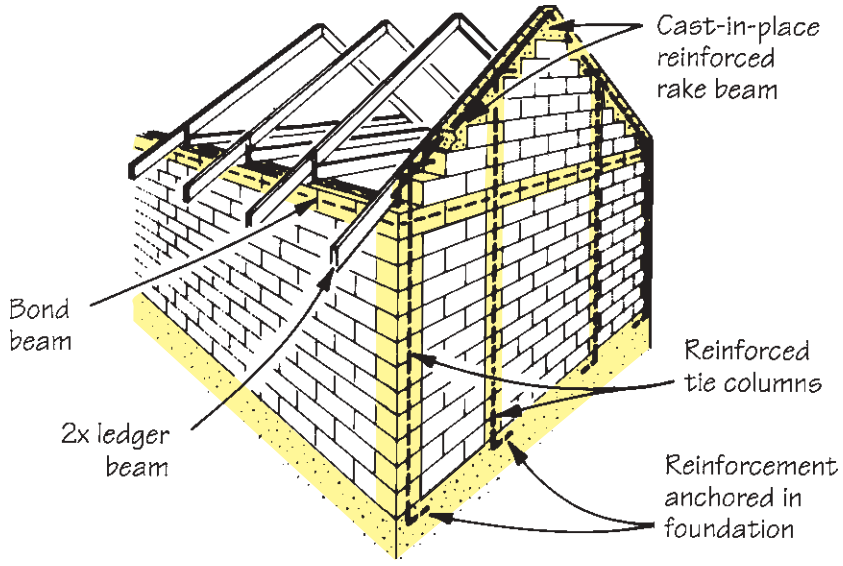
Strengthening the Roof Diaphragm



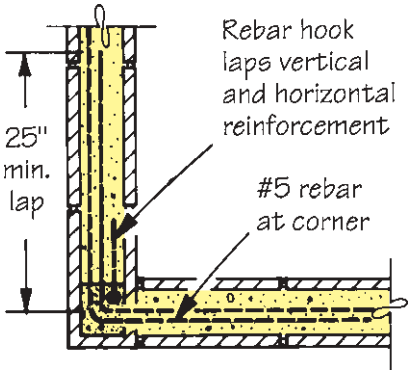
To strengthen the diaphragm action of the roof sheathing and ceiling, future codes may require blocking along the top and bottom chords of trusses (above). An alternate detail, from the National Forest Products Association, transfers loads to the ceiling diaphragm through 2x4 lateral braces (right). ("After the Storm: Hard-Won Lessons," 8/93)



Masonry Bond Beams and Tie Columns



Bond Beam Corner Detail



Unreinforced masonry walls did not fare well in Hurricane Andrew — many collapsed. Fully grouted tie columns should be located at every building corner and at least every 20 feet along walls. Rebar splices in tie columns and bond beams should lap by at least 25 inches. ("After the Storm: Hard-Won Lessons," 8/93)