FOUNDATIONS
ANCHORS

Foundation anchors play a key role in resisting uplift. They are required by code even if you're not building in a high-wind zone or in earthquake country.

CODE REQUIREMENTS

By code, all exterior sill plates must be anchored with minimum 1/2-in.-diameter anchor bolts.

Spacing

When casting foundations, place anchors at a maximum of 6 ft. o.c., and within 12 in. from the ends of each plate section.

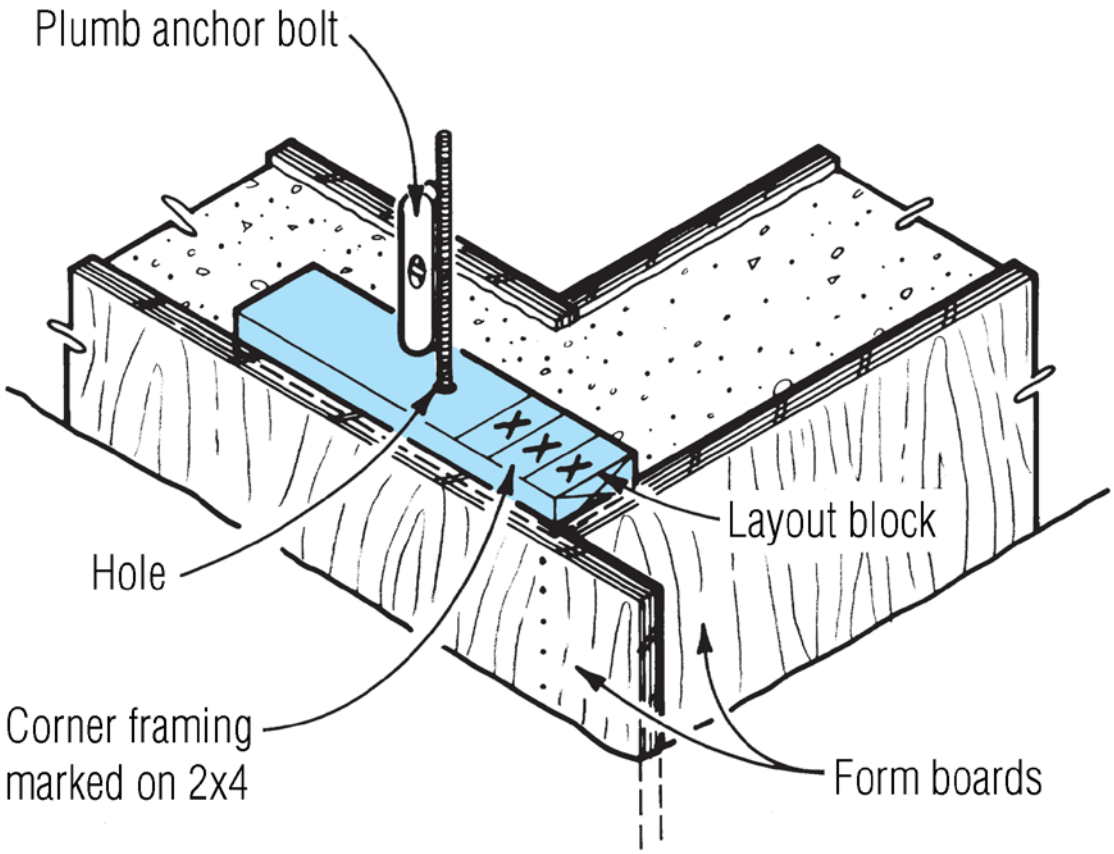
Embedment Depth

Foundation anchors must extend a minimum of 7 in. into concrete.

PLACING ANCHOR BOLTS

Where anchor posts attach to a corner stud or at one side of a wall opening, they must be located precisely. A layout jig can be very helpful (**below**). If possible, wire the anchor posts directly to the rebar.

FIGURE A: ANCHOR BOLT LAYOUT JIG

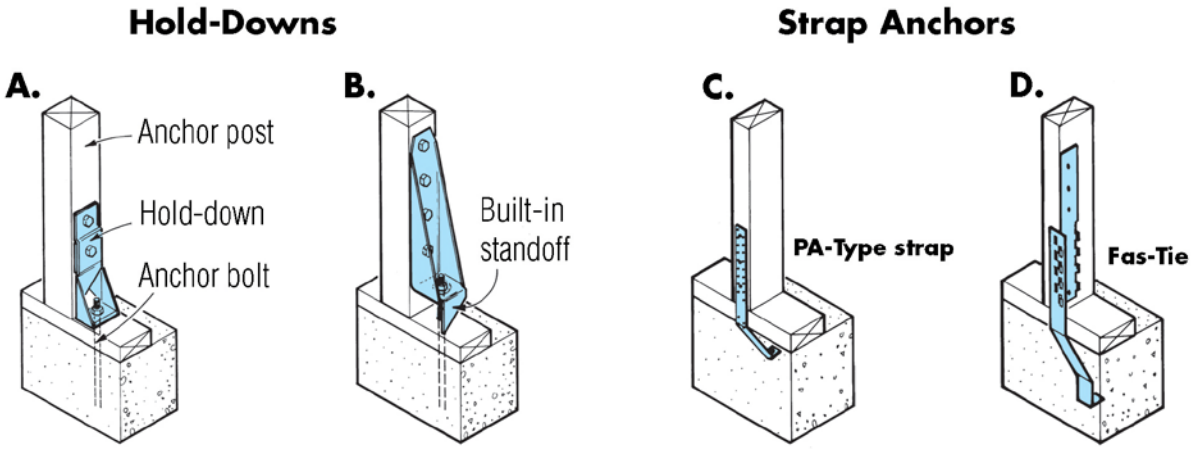


To ensure the exact position of an anchor bolt at corners or king posts (around openings), use a layout block attached to the form boards.

SEISMIC ANCHORS

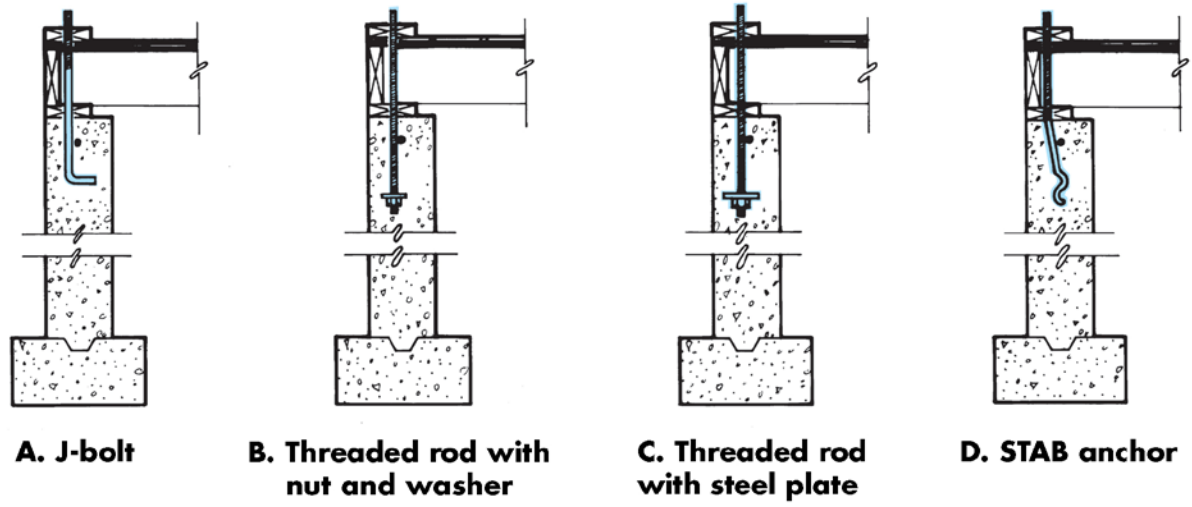
In seismic zones, all shear walls must be mechanically fastened to the foundation with metal hold-downs, metal straps, closed-space anchor bolts, or some combination of these (**Seismic Anchor Types**, below). Hold-downs require anchor bolts that extend up though the floor framing (**Hold-Down Anchor Bolts**, below).

FIGURE B: SEISMIC ANCHOR TYPES



Hold-downs either sit directly on the sill or bottom plate **(A)**, or have a built-in standoff that lifts them off the plate **(B)** so the bolt-holes won't split out the end of the post. **Strap anchors** nail either directly to the stud **(C)**, or through the sheathing into the stud. A two-part anchor **(D)** has two parts that lock together — one piece embedded in the concrete and a second piece nailed to the wide face of the stud.

FIGURE C: HOLD-DOWN ANCHOR BOLTS



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-in.-thick steel plate bolted to the end; and (D) a manufactured anchor bolt, such as Simpson Strong-Tie's STAB anchor.

Code Requirements in Seismic Zones

In addition to following the anchor spacing requirements described above, code specifies:

- A minimum anchor spacing of 4 ft. o.c. for two-story buildings
- Anchors located within 12 in. of the ends of each plate section for all interior bearing walls and interior braced wall lines, as well as all exterior walls
- Plate washers measuring at least 2x2x3/16 in.

RETROFIT FOUNDATION ANCHORS

A variety of foundation anchors can be used to retrofit a missing anchor bolt or fasten framing into foundation materials (**Typical Retrofit Concrete Anchors**, below). While many of these anchors are more expensive than shields or drop-in anchors, they don't require laborious spotting, which is difficult and time-consuming.

Selecting Retrofit Anchors

Follow the guidelines shown **below** when retrofitting concrete anchors.

FIGURE D: TYPICAL RETROFIT CONCRETE ANCHORS

Type	Size (in.)	Minimum Embedment Depth (in.)	Pullout Strengths (lbs.)[1]
Hammer (sleeve type)	1/4 X 2	3/4	800
Hammer (nail type)	1/4 X 2 1/4	1 1/4	1,100
PAF	.140 X 2 1/2	1 1/4	1,400
Concrete screw	1/4 X 2 3/4	1 1/2	1,500
Sleeve	3/8 X 3	1 5/8	<2,400/td>
Wedge	3/8 X 4	3	4,000 - 5,000[2]
Epoxy (dispenser type)	3/8 X 4	3 1/2	5,000 - 7,000[2]
Epoxy (capsule type)	3/8 X 4	3 1/2	5,000 - 7,000[2]

Notes: 1: 3,000-psi concrete except as noted. **2:** 4,000-psi concrete

The sizes shown are typical for the type of fastener, although other sizes are available. Valves are typical only for the size -listed and should be checked for the specific fastener and substrate. Values listed are "ultimate" pullout strength. In actual design, a safety factor of 4:1 to 8:1 is typically used.

Tips for Placing Concrete Anchors

Usually the most important detail in installing any type of mechanical or epoxy anchor is drilling the hole according to the manufacturer's specs.

Do not drill too close to a concrete or masonry edge, or the anchor is likely to break out the substrate when inserted, and holding power may be compromised.

If the diameter of the hole is too large, concrete screws won't tap and hold properly, while sleeve and wedge anchors may spin in the hole.

Concrete screws will require a hole 1/4 in. deeper than the screw to leave room for displaced material, and drop-in anchors may fail if not placed in holes drilled to a required depth.

Overtightening may compromise the holding power of sleeve and wedge anchors. Take care to torque them down to manufacturer's specifications. Some anchors are also sensitive to the depth of the hole.

Retrofit Anchors in Unstable Substrates

For best results, place anchors in stable concrete. If you are uncertain if the concrete or masonry is stable, choose an epoxy anchor, which will help bind the base material together. Check with the manufacturer or catalog for the appropriate embedment depth and design load of each -fastener — especially for any structural connections.

Selecting and Placing Concrete Anchors

Sill plate for bearing wall. If you've left out one or two anchor bolts, a few powder-actuated fasteners (PAFs) should do the job. If the slab is uneven and you need to draw the plate down, use a sleeve anchor. If you've left out all the anchor bolts for a bearing wall, use sleeve, wedge, or epoxy anchors.

Sole plate to slab for nonloadbearing partition. A PAF is the fastest way to connect interior partition plates (wood or steel) to a slab. Hammer anchors are a good alternative.

Steel column to a slab. To secure the bearing plate of a structural post to a concrete slab, use a wedge or epoxy anchor. If the concrete is at all soft, an epoxy anchor is more reliable.

Ledger for exterior deck or porch. To attach a framing ledger to a poured concrete or masonry wall, use a wedge anchor for strength. You may want to use a PAF to hold the ledger level while you're drilling for the wedge anchors.

Stair stringer in concrete bulkhead. A PAF is sufficient if you can fasten every 16 in. or so along the stringer. If you have to hang the stairs from one end of the stairwell, you're better off depending on a sleeve or wedge anchor.

Sleepers for wood flooring over a slab. A PAF will work well, unless the slab is way out of level (if it slopes towards a drain, for example). In this case, with shims beneath the sleepers, you may exceed the length of a PAF and need to use a wedge or sleeve anchor in the deepest areas.

Wood frame around basement openings. To box out a door or window with pressure-treated wood, PAFs are the quickest option; concrete screws or hammer anchors will also work.

Strapping to foundation wall. When fastening nailers for drywall or siding to a poured concrete or masonry wall, PAFs are the fastest method. Drive the pin into the horizontal mortar joint of a masonry wall. Concrete screws or hammer anchors are an alternative.