



The blue AnchorMate bolt holders (1) simplify the placement of anchor bolts and ensure consistency (2) that in turn simplifies the alignment of the mudsill later.

Anchoring Mudsill

BY TIM UHLER

Mudsill, or sill plates, makes the transition from concrete work to wood framing and anchors the house to the foundation. When I started coming to the jobsite as a teenager in the early 1990s, we anchored our mudsill with 1/2-inch cast-in-place anchor bolts placed 8 feet on-center. Only a standard washer and nut was required to attach it. That changed for us in the early 2000s, when building codes in our area were updated to meet seismic zone requirements and began to require anchor bolts spaced 60 inches on-center with 3x3x1/4-inch plate washers. Since then, several other options have been recognized in the code, and we've tried them all to figure out what is most efficient for us.

ALTERNATIVES TO ANCHOR BOLTS

The basic prescriptive requirements of R403.1.6 in the 2015 and 2018 International Residential Codes (IRC), call for minimum 1/2-inch-diameter anchor bolts. These bolts must extend 7 inches into the concrete and be spaced no more than 6 feet on-center. In seismic zones, these basic requirements apply with the addition of 3-inch-square plate washers. However, in all cases, the building code also allows for the use of "approved anchors or anchor straps spaced as required to provide equivalent anchorage to 1/2-inch-diameter anchor bolts."

For a number of years, we used Simpson Strong-Tie MASAP mudsill anchors, which qualify as an approved substitution for anchor bolts with 3-inch-square plate washers. These seemed like a good alternative to having to adjust the layout for joists that landed on bolts. They attached easily to panelized concrete forms, and we didn't have to worry about the joist layout. The MASAP is located at the edge of the foundation wall and wraps over the edge of the mudsill. This placement has the advantage that we could set the mudsill right on our snapped layout lines—a welcome change from aligning anchor bolts, which takes time to do accurately. Allowable holes for the anchor bolts in mudsill can't be oversized more than 1/16 inch, and so we often would end up having to move the mudsill slightly to accommodate the anchor bolts, and the mudsill would end up off the line.

With MASAP straps, we used a Hilti powder-actuated tool to secure the mudsill to the concrete on our chalk lines. This held it in place until we nailed off the straps.

Photos by Tim Uhler



MASAP anchors are code-approved replacements for anchor bolts and 3-inch-square washers. They attach to the edge of the form **(3)** and wrap over the mudsill **(4, 6)**. Note that these strap anchors secure the mudsill, but they are not a substitute for shear wall hold-downs, such as the threaded bolts used for HDU anchors, that were required on this foundation **(5)**.

We used MASAP straps for nearly 10 years, nailing them off either with a positive placement gun or by hand-nailing. Frankly, this was tedious, and we needed to pin the plates in place with the Hilti to keep them from moving around when we nailed off the anchors. Another disadvantage is that the MASAPs created a gap between the mudsill and the rim joist that bears on top of it. All things considered, we ultimately went back to the anchor bolts, feeling they were cleaner and simpler to use.

MAKING ANCHOR BOLTS WORK

We sometimes sub out our foundation work, but typically we form and pour foundations ourselves. I lay out the location of the bolts prior to placing concrete, and my focus is to eliminate any framing landing on bolts or plate washers. Much of our framing is 24 inches on-center, so the bolt placement is 48 inches on-center and lands between joists or studs. I use Simpson Strong-Tie's AnchorMates to hold the bolts in place. These bolt holders are made



To align mudsill with anchor bolts, the author places the board against the bolts and marks each one (7), then pulls the board back to his chalk line, measures the distance, and drills the holes (8). Working in a D2 seismic zone, the author is required to use 3-inch-square plate washers on anchor bolts. To save time, he tightens the nuts with an impact ratchet (9), being careful not to overdrive the nuts, as that can crack the concrete around the bolt. The rule is to seat the nut, then tighten it one half-turn.

of nylon plastic and hold up well over time so they more than pay for themselves. (We have been using the same set for the last two years.) Though not required, the bright blue holders also give the inspector something to see, and overall they make for one less thing for us to deal with during the pour.

Aligning the mudsill can be a challenge, but over the years we have worked out some good processes. The most important part is getting the foundation right to begin with. I have outlined our foundation process in a two-part series, “Building Stem Wall Foundations,” Feb/13, and we cover it regularly on LinkedIn at @awesomeframers.

To align the mudsill with our chalk lines, we place the sill board next to the anchor bolts, center a square with the bolt, and mark a line across the board. The bolts are not always perfectly vertical,

so you have to eyeball the base of the bolt. When the locations are marked, we slide the board back to the chalk line and measure the distance from the base of the bolt to the edge of the board. We then mark this distance on the board and drill our holes. The largest hole we can drill for a $\frac{5}{8}$ -inch-diameter bolt is $\frac{11}{16}$ inch.

THE CASE FOR DRILLING

A few of us framers on Instagram have been talking about ditching anchor bolts completely and drilling them in after the concrete is poured. There are a few options available that work for this in our seismic zone: Simpson’s Strong-Bolt 2 wedge anchors (or similar from other manufacturers) and Titen HD screw anchors are two that we’ve used. Both are allowed as alternatives to cast-in-place anchor bolts, but there are some caveats.

The idea of drilling after the fact might seem on its face a slower method, but there are some definite advantages:

- Drilling after the fact means we never have to move a framing member or notch it. Many foundation subs don't think about the framing; they just set bolts to the spacing called out on the plans. This means that when we sub out our foundation, we sometimes end up cutting anchor bolts off and drilling for Titans anyway.
- We don't have to even think about laying out bolt locations while forming the foundation.
- Mudsill can be set perfectly on the line and no holes will be oversized since the size of the hole for the anchor is exactly the same size as the anchor.

There are a few cons to drilling after the fact, though:

- The AHJ (authority having jurisdiction) might not allow it as the sole attachment method.
- Even if code allows the anchors on paper, inspection of the length can be an issue. The Strong-Bolt 2 has the length stamped on the end, but Titans don't. Additionally, the Strong-Bolt 2 has a torque requirement for the nut, which the inspector might want to verify.
- You can hit rebar when drilling. Rebar can be time consuming to drill, even if you use my favorite rebar-cutting bit (the Diablo Rebar Demon).
- Even if you don't hit rebar, it's slower to drill 8 inches into the concrete than it is to drill through the mudsill alone.

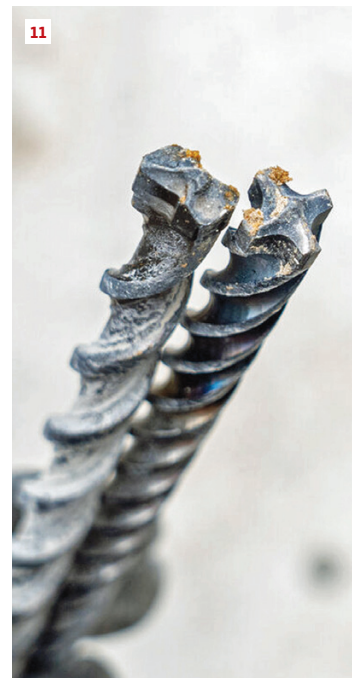
Of course, the big factor is cost:

- A non-galvanized $\frac{5}{8}$ -in. x 10-in. anchor bolt costs me about \$1.50, or \$15 for 10.
- Ten $\frac{5}{8}$ -in. x 10-in. Strong-Bolt 2 wedge anchors purchased online run about \$30 (fastenersplus.com).
- Ten $\frac{5}{8}$ -in. x 10-in. Titans run \$60 online (also from FastenersPlus).

Given this cost, what works best for us are $\frac{5}{8}$ -inch cast-in-place anchor bolts placed at 48 inches on-center for our crawlspace walls. For garage walls, we use Strong-Bolt 2 wedge anchors. The reason for the difference is that we frame our garage walls on the floor and then drop them into place with the forklift. Trying to get them onto a cast-in-place anchor bolt is a huge hassle when we can oversize our hole only $\frac{1}{16}$ inch.

If I built only on slab, I would switch entirely to wedge anchors. Using them would allow us to sheathe all walls before standing them up, and still be able to perfectly land them on the foundation before installing the anchors. That would save us a huge amount of ladder work.

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Drilling for wedge or screw anchors, such as the Titan HD (12), simplifies both the concrete work and the installation of mudsill. But drill-in anchors depend on your being able to efficiently predrill through concrete and rebar. The author used to use a rebar bit—a small core drill (10). That meant first using a standard concrete bit (11, at left). As soon as he hit rebar, he'd switch to the core bit, and then switch back to the concrete bit as soon as he was clear of the rebar. The process is much faster with the Diablo Rebar Demon (11, at right), which efficiently drills through both concrete and rebar, so there's no need to switch bits.