Framing the First-Floor Deck

The work goes faster if you use a laser, install anchor straps instead of anchor bolts, and measure as little as possible

by Tim Uhler

Our company builds a dozen or more houses a year. With a crew of only four carpenters, we can't afford to waste time, so we're always looking for systematic ways to approach the work.

In this article I'll describe our method for laying out and framing a first-floor deck. The techniques we've developed allow us to work quickly and accurately, and ensure that the rest of the framing goes well.

Getting Started

We typically split into two teams of two carpenters. One team rolls out tools and gets the floor framing material ready while the other lays out the sills. The goal is for the sill layout to be dead square and perfectly parallel.

Framing errors and compromises tend to accumulate and show up in the roof; if the sills aren't square and parallel, the walls will follow, making the roof harder to frame. The error might even be visible when the job is done.

Longest wall. The first thing we do is snap a line along the top of the longest wall, 5⅝ inches in from the outside face. This line represents the inside edge of the sill; its outside edge should be flush with the face of the wall. Sill stock is always a little bit wide, which is why we offset

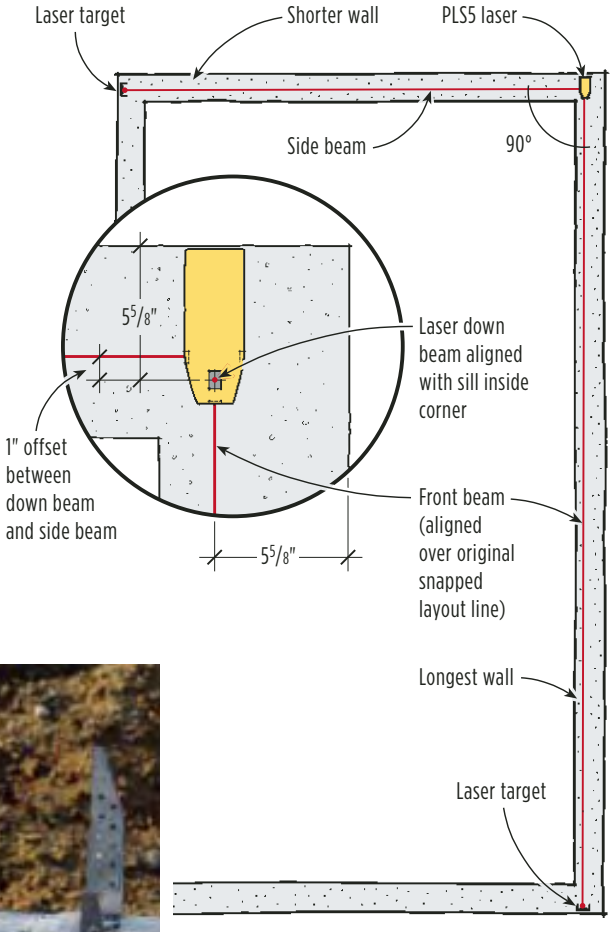

Figure 1. Crew members snap sill layout on the longest wall of the foundation (A), mark the inside corner, and align the laser over that point (B). Next, they place a target over the line at the far end of the wall and rotate the laser until the front beam hits the target dead center (C). Finally, they locate the perpendicular line by placing the target on the adjoining wall so that the side beam hits it dead center (D), mark that location, and measure in one inch to account for the offset between the down beam and side beam on the PLS5 laser. A line between this point to the inside corner will be square to the original line (E).

the line 5⅝ inches rather than 5½.

On a straight foundation wall, the sheathing usually ends up ½ inch beyond the face. If the foundation bows out in the middle more than ½ inch, we'll shift the line out until there is no place where the sheathing will not be at least flush to the face of the wall. This may change the size of the house slightly, but that's better than having the foundation touch the back of the siding.

Creating a Square Layout

Next, we snap a line square to the first line along the top of the longest intersecting 90-degree wall (see Figure 1, page 2).

In the past we located this line using the 3-4-5 method or by calculating the length of the hypotenuse between the far ends of these walls. Now we use a PLS5 laser (Pacific Laser Systems, 800/601-4500, www.plslaser.com), which projects reference lines that are perfectly straight and square. It's faster than drawing right triangles and there's no need to worry about inaccuracies caused by a sagging tape.

Using the laser, we can create square layout on a large foundation in a matter of minutes.

Aligning the beam. We begin by making a mark 5⅝ inches in from the end of the line we made on the longest wall. This represents the inside corner where two sills will meet.

Next, we place the laser on the wall, align the downward beam with the corner mark, and aim the main horizontal beam toward the far end of the wall.

Our goal is to position the horizontal beam directly over the line on the wall. To do this, we position the laser target on the far end of the wall so that the pointer lands on the line. Then we rotate the laser so it projects a dot on the centerline of the target.

Figure 2. To lay out sills on a stepped foundation, most carpenters stretch the tape horizontally and use a level to plumb down (left). A faster method is to stretch the tape, position the laser so the up beam hits the desired mark (above), then mark where the down beam hits the foundation.

On a long wall, adjusting the laser takes very little movement; for fine adjustments, we tap lightly on the side of the laser. When the beam hits the target's centerline, we know it's aligned with the chalk line.

Projecting a perpendicular line. The next step is to project a second line at a perfect 90-degree angle to the first and mark it on the adjoining wall.

The PLS5 projects three horizontal beams, two of which are perpendicular to the main horizontal beam. The main beam is already aligned with the line on the foundation, so to create a square layout we just have to determine where the side beam passes over the intersecting wall.

We do this by taking the target to the far end of the intersecting wall and positioning it so that the side beam hits it dead center. Then we mark where the pointer lands on the concrete.

With the PLS5, the side beams project at a one-inch offset from the vertical beam (in this case, one inch too close to the outer face of the wall), so we measure over an inch and use the new mark to snap a line back to the corner where the two sills will meet.

Laying Out the Remaining Walls

Now that we have two lines that are perfectly square to each other, laying out the rest of the walls is simply a matter of measuring off the first two lines. Difficulties arise only in places where the foundation walls step up and down or where we need to drop our layout onto a basement floor slab.

The traditional way to handle these areas is to stretch a tape horizontally and then use a plumb bob or level to carry the layout down. We find it faster and easier to stretch the tape and use the laser's up and down beams (the plumb beams) to carry the layout down (Figure 2).

Installing Mudsills

Once layout is snapped, we gang up on the mudsill. If the sill is to be attached with anchor bolts, three framers mark bolt locations while one carpenter drills holes.

Anchor bolts. To locate the holes, we place the sill against the bolts, align a square with a bolt, and scribe a line across the sill at that location. We then measure the distance between the layout line (on the foundation) and the center of the bolt and make a mark that far in from the edge of the sill on the line we just scribed (Figure 3). The mark will be the center of our hole. It's important to do this accurately because the hole should not be greatly oversized.

We have tried using a specialized marking tool, the Bolt-Hole Marker (Big Foot Tools, 702/565-9954, www.bigfoottools.com), but found it difficult to balance a 2x6 plate on the stem wall while making the marks. This tool is much better suited for marking plates for slab foundations.

Once we're about halfway through marking and drilling, one framer breaks off from marking and begins to fasten the sills with nuts and washers. We tighten the nuts with an electric impact wrench, taking care not to overtighten them.

Straps are faster. Not long ago, we stopped using anchor bolts and started using a type of cast-in strap that wraps over the sill and is fastened to it with nails. We happen to use Simpson's MA6 anchors, but USP makes something similar, the ST1-TZ.

On our crew, one carpenter cuts and places sill stock on the foundation, a second follows behind and tacks the sill on layout with a powder-actuated tool, and a third makes the structural connection by bending the straps over the sill and fastening them with a metal connector nailer. We tack down the sills to prevent them from moving while the straps are being nailed (Figure 4, page 5).

Using straps is much faster than using anchor bolts because there is no need to lay out and drill holes. Another advantage to using straps is that we never have to move a joist off layout because a bolt is in the way; since straps are thin, you can run joists and rim boards right over them.

To avoid having to use galvanized or stainless steel fasteners, we use borate-treated lumber for the sills (see "Fasteners for ACQ Plates," *Q&A,* 1/06). We frame quickly so that the sills are not exposed to the weather long enough for the borate to leach out.

Figure 3. A carpenter butts sill stock to the bolts, squares in from them (right), then measures the distance between each bolt and the layout line (far right, top). After marking that distance on the stock, he drills the bolt holes (far right, bottom).

Using Girders to Break Up Spans

Most of the homes in our area are built over crawlspaces, so we install rows of girders 8 or 9 feet apart to break up long floor spans and pick up point loads. This makes for a stiffer floor and eliminates the need for a stem wall at the center of the house.

We don't do this with basements, however, because that would require too many posts. Instead, we use larger joists, and — when necessary — break up the spans with bearing walls.

The tops of the girders should be flush to the tops of the sills. On large houses we install the sills that are perpendicular to girders first; that way, part of the crew can set girders while the rest of the sills are being installed.

We start by scattering the girder stock

Figure 4. Fastening sills with cast-in strap anchors (above left) is faster than using anchor bolts. The carpenters place the sill stock on layout, tack it in place with a powder-actuated fastener (above), then fasten it by nailing on the strap (left).

Figure 5. With a crawlspace foundation, the author uses girders to break up the floor span. Instead of measuring, the crew lays the girder stock in rough position (above) and cuts the pieces so the joints land over footing pads (above right). The girders are supported by posts that land on pieces of rubber membrane and are tied to the footings with cast-in straps (right).

so we can cut the pieces where they go. The ends of the girders will be supported by posts that land on ribbon footings (long thin footings) or footing pads (Figure 5, page 5).

The footing pads vary in elevation, so each post has to be cut to a slightly different length to keep the girder level. To quickly measure post length, we stretch a string very tightly from sill to sill where each run of girders will be, measure up to it from the footing, and deduct the height of the girder.

If the run is more than 25 feet long, we add 3/16 inch to the height of the center posts to account for the sag in the string.

We have used a rotary laser to determine the height of posts, but that approach is slower than using a string. The laser is more accurate, but our primary objective is for the tops of the girders to be in a straight line between the sills. We don't care if a run of girders is slightly out of level — say, within 1/4 inch from end to end. (If the stem walls are off by more than that, we shim the mudsills.)

We cut the posts, stand them over a piece of PVC membrane, and install girders on top. The posts are fastened to the footings with cast-in straps and to the girders with nailed 2x4 gussets. We sight the girders before nailing them off; if there is excessive crown, we'll cut the girder over an intermediate post.

The girders normally stop short of the stem walls, so it doesn't matter that they aren't treated. If the ends are less than an inch from the concrete, we cover them with PVC membrane.

Figure 6. After the girders are in, the crew installs rim boards (top), then places the joists in rough position (above).

Laying Out and Installing Joists

Once the girders have been installed, we clean out the crawlspace and lay out the locations of joists and beams on the sills and girders. To minimize errors, only one carpenter does layout; the rest of the crew scatters the joists and sets beams.

I-joists. We use I-joists about half the time. Our supplier provides a "precut" package based on the plans, so we have to pay close attention to the lengths the manufacturer sends. The joists come several inches long and we trim them on site.

We like to scatter the longest joists first, just to get them out of the way. While one framer installs rim, another uses a forklift to boom the joists over the foundation so that the other two guys can unload them (Figure 6). With the forklift, it takes only about 30 minutes to scatter all the joists for a 1,500-square-foot floor.

If the joists are less than 25 feet long, our preferred method is to use a chain

Figure 7. Rather than measuring each joist, a carpenter butts them all to the opposite rim, snaps a line where the inner face of the rim will be (far left), and then cuts them in place with a circular saw (left).

saw to cut them while they're still banded together; if they're longer than that, they'll bend too much and throw off the measurement.

When the joists are more than 25 feet long, we leave off one of the rims, butt them to the opposite rim, snap a line for the cut, and cut them in place with a circular saw (Figure 7). We then install the last of the rim and begin to roll and fasten the joists.

Nailing. We follow the I-joist manufacturer's recommendation for nailing. We use RFPI Joists (Roseburg Forest Products, 800/347-7260, www.rfpco.com), which require one 8-penny nail through the rim into each flange and two 8-penny nails through the bottom flange (one on each side) into the rim (Figure 8). With solid-sawn joists, we use 10-penny nails to fasten every 1½ inches through the rim into the joists as well as to toenail the joists to the sill.

If we're using I-joists, the manufacturer supplies precut I-joist blocking, or LVL blocking when the engineer says it's necessary. With solid-sawn joists, we use solid lumber blocking.

Sometimes we're required to install double blocking under shear walls, in

Figure 8. To finish the frame, the author nails joists to the rim (top left) and sill (top right), then installs the required blocking (above).

Figure 9. When installing the subfloor, everyone has a particular job: One carpenter does nothing but glue, two carpenters cut and place the sheets and beat them together, and one just nails.

which case we make the blocks out of cutoffs from the 4-by girder material.

Inspection

The building inspector needs to inspect the frame before we install subflooring. Framing the floor normally takes us five or six hours, so we schedule an inspection for the afternoon, and unless there are major problems we can sheathe the floor as soon as he leaves.

If the inspector asks for anything, it's usually that we add a few more pieces of framing hardware to tie the rim to the sill or that we add some extra anchor bolts to the foundation. When we need to add anchor bolts, we use ½-inch Kwik Bolts (Hilti, 800/879-8000, www.hilti.com), a type of wedge anchor.

If at all possible, we sheathe the floor and snap out the walls on the same day. That way, we can start framing the walls first thing the next morning. If we aren't finished when the inspector comes out, we have to call in for another inspection and we lose the next day on the job.

Laying the Floor Sheathing

When we install subflooring, everyone sticks to a particular task until the floor is done. Since there are four of us, the first carpenter applies the glue, and a second packs material and beats the sheets together so that the T&G joints will close (Figure 9). A third packs material and cuts, and a fourth does nothing but nail.

We trade off on every house so that no one has to do the same thing all the time.

Gluing is the weakest link in the process. Even with a pneumatic glue gun — which is way faster than operating a gun by hand — the guy doing the gluing has to hustle to stay ahead of the rest of the crew.

We're very production-oriented about this; on a recent project we installed the subfloor on a 3,000-square-foot single-story home (95 sheets) in a little less than two hours, including trimming the edges.

During the drier months of the year, we sheathe floors with LP's midlevel OSB product, TopNotch Orange Plus (888/820-0325, www.lpcorp.com).

But during the rainy winter months, we'll spend the extra $3 to $4 per sheet it costs to get AdvanTech (Huber Engineered Woods, 800/933-9220, www.huberwood.com), which is less likely to swell when it gets wet.

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