A Curved Porch
ON A GRAND SCALE

Full-scale layout with wood I-joists took the guesswork out of setting the columns

In 2003, my company built a large oceanfront home on Narragansett Bay in Rhode Island. A sheltered porch spanned the 96-foot-long east elevation, with each end of the porch topped by a conical roof. Seventeen round Tuscan-style columns supported those porch roofs. My associate, Mike Rand, supervised fabrication of the more complicated porch roof components in our shop. These included large, composite carrying beams for the porch rafters, the two conical roofs, and parapet wall surrounds for three second-floor balconies inset in the porch roof. The standard rafters would all be cut to fit on site.

by David Baud

Figure 1. Rather than individual pads, a continuous footing permitted unlimited side-to-side adjustment for precisely placing the pier forms.

Establishing Accurate Layout

We had plenty of I-joists on hand, so Mike used them to set up a full-size layout grid at the shop. The plan was to set up the grid on site — like a giant story stick — and eliminate the need for batter boards and string layout. I'll describe them in more detail later.

Rather than laying out individual footing pads for the porch columns, we poured a continuous wide footing (see Figure 1). After the concrete hardened, we shipped the I-joist grid to the site and assembled it, spacing it off the building with 2x8 spreaders. We shimmed it dead straight to a laser line and propped it up level on 2x4 legs above the footings (Figure 2, next page). The centerline of the I-joist determined the general center of the columns in parallel to the building. The underside of the I-joist also established the top of the concrete formwork that would support the columns.

Resisting Wind Uplift

The hollow DuraCast fiberglass columns we worked with (Dixie-Pacific, Gadsden, Ala.; 800/468-5993, www.dixie-pacific.com) are structural members with a stated load-bearing capacity of 22,000 pounds. On the other hand, wind uplift, especially under an open roof in an exposed location, is at least as great a concern as bearing capacity. Although the manufacturer suggests using small, through-bolted L-brackets as column anchors, that wasn't suitable for this application. Instead, we used pressure-treated 4x4 posts, concealed inside the columns and connected to a concrete pier with Simpson CB44 post base hold-down anchors.

Anchoring to concrete. Mike nailed 2x4 blocking to both sides of the 1/2-inch I-joist web at each column's center location, providing a properly sized block to hold the Simpson anchors. With the anchors held in precise position, we were able to

Laying Out Concrete Piers

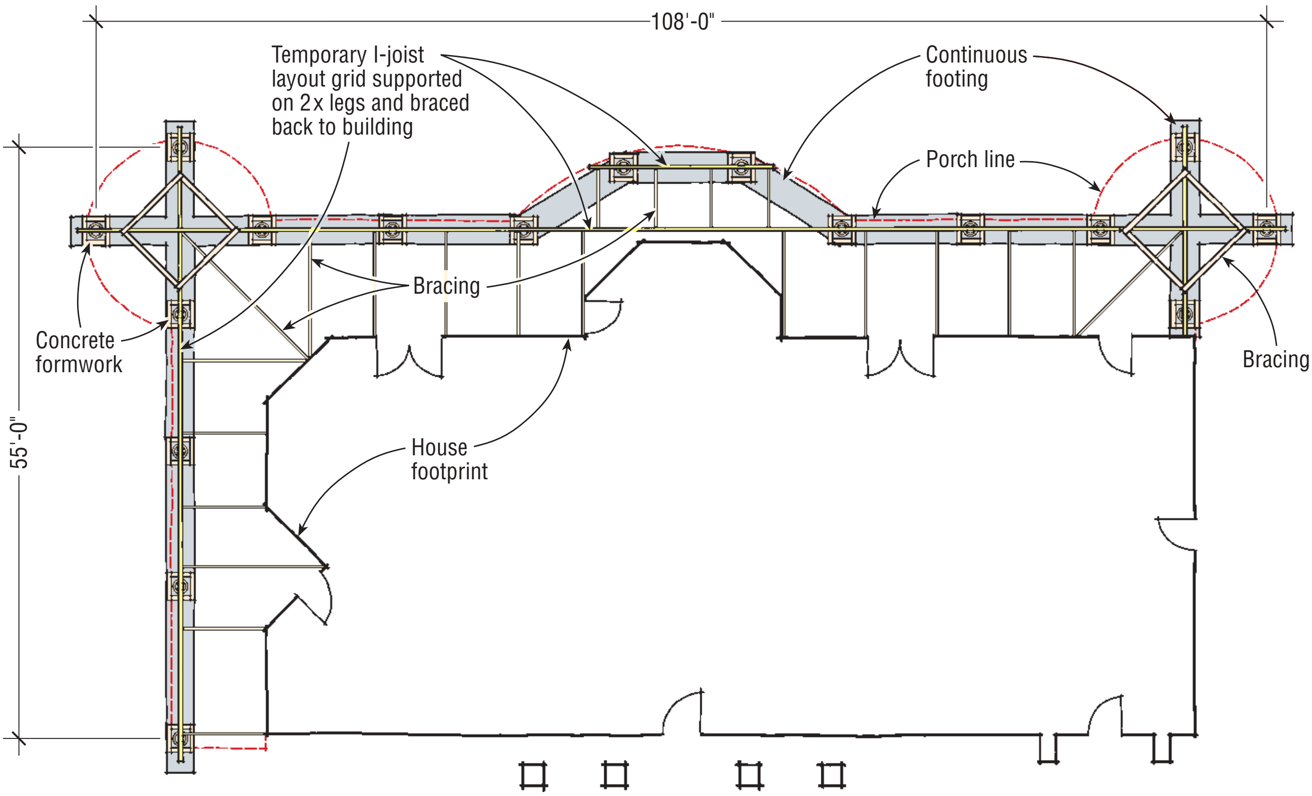

Figure 2. The author used I-joists instead of string for laying out the 17 porch columns, setting the bottom of the I-joists level with the top of the footings (left). This allowed the crew to accurately set the metal column anchors by tacking them to the I-joists. Spreaders, shimmed laser-straight off the building, set the center of the I-joist flange at the colonnade centerline. Two-by blocking tacked to both sides of the I-joist web at precise column locations established bull's-eye centers below which the pier forms could be set (right).

accurately place the pier forms below, on the footing. Each anchor was also encircled by a custom-made "nipple" form, made from bendable plywood (Figure 3). These were nailed directly to the underside of the I-joist flange. The resulting concrete nipple would fit inside the bottom of the fiberglass column and prevent lateral movement. Rebar, grouted into the footing inside each form, provided a positive mechanical connection for the pier.

We didn't leave any measuring for our concrete sub to do, so he was in and out in two days. We used a fairly stiff, 3,000-psi mix with 3/8-inch aggregate to fill the forms, and troweled the tops smooth.

After the concrete hardened and the inspector signed off on the work, we dismantled the layout grid and backfilled the area. We then installed the 4x4 posts using Simpson SDS screws in the base anchors. The 4x4s were 12 feet long, accounting for the combined heights of the column and the carrying beam, with some overage to be trimmed later. Setting the fiberglass columns followed immediately, so we didn't bother bracing the posts.

Columns 101

The classical formula for Tuscan column proportions states that the column's height must be equal to seven times its diameter, including the plinth and capital. So, technically speaking, a 16-inch-diameter column ought to stand 9 feet 4 inches overall. When designing with and specifying columns, this is a good rule of thumb to keep in mind to ensure a good appearance.

The column also features true "entasis," or an aesthetic tapering over its length. Ours measured 16 inches in diameter at the bottom and 13 1/2 inches at the top. The tapering occurs in the upper two-thirds of the column's length, and any necessary shortening is done at the bottom. These columns were 10 feet long in the rough and had to be cut to finished length before standing. We cut them about 1/4 inch short to allow for shimming and leveling.

Cutting. There's some kind of mineral component in the columns' fiberglass matrix that gives the material a stone-like appearance. You can effec-

Figure 3. Engineered post anchors were tacked to spacer blocks on the I-joist grid (top). The anchors were set to within 1/8 inch before any concrete was poured. Circular nipple forms created a pier insert to help center the bottom of each column (above). The nipple was 1/2 inch smaller in diameter than the column interior to allow for leveling the base.

Figure 4. A simple plywood cradle held the columns at a comfortable height for cutting to length. The crew found that carbide-tipped blades dulled quickly, but that abrasive diamond blades worked well.

Figure 5. Instead of strap ties, the author used 4x4 posts running through the columns as hold-downs for the box beam on top. Square holes in the top and bottom flanges of the box beam allowed the beams to drop over the 4x4s. Square notches in the ends of the beams fit around the posts, allowing the sections to be fastened together. After the beam was fastened to the posts with bolts, the protruding tops (bottom) were cut off. ▼

tively cut one or two columns with a carbide-tipped blade, but the teeth quickly dull. Instead, we used an abrasive diamond chip masonry blade in a circular saw, resting the columns in a basic cradle to hold them at a comfortable cutting height (Figure 4). One worker did the cutting while another slowly rotated the column.

Lifting and setting. A single column of this size weighs about 200 pounds. We looped a nylon choker strap around the top of each column in turn and used a Lull to lower them over the 4x4 posts. After each column was set, a worker slid the one-piece cast polyurethane plinths and capitals over the top. We set all 17 posts, including the 4x4s, in about six hours. Although we'd anticipated having to brace the columns after standing, that proved unnecessary. Thanks in no small part to careful cutting and pier preparation, as well as the columns' own mass, they stood nearly plumb all on their own.

Carrying Beams

The roof's straight carrying beams were a series of composite box beams, built in sections to bear on three or more columns each and butting over column centers (Figure 5).

A $3^1/2$-inch-square opening cut through the top and bottom plates of the beam on layout captured each post. A worker on a ladder guided the 4x4s into their pockets as the crane operator lowered each beam into place.

For the two circular beams, Mike laminated two 4-inch-thick ring beams from 16 layers of 1/4-inch lauan plywood, bonded with West System epoxy. The rafters were set in pockets cut into the rings' inner face. Below the ring beams, he constructed an open framework of plywood plates and 2x4 struts to continue the 28-inch-wide entablature band around the circular porch sections.

Fastening the Columns

The beam rested directly on the fiberglass columns, which we'd modified at the tops with four pieces of 2x blocking, screwed and urethane-glued to the interior circumference (Figure 6). The blocks allowed us to screw directly down through the bottom plate of the beam into the tops of the columns, drawing them up tight to the beam. We used steel shims under the column on the concrete pier to raise the column and beam to final height, checking level with a dot laser. Once the entire beam was leveled, we secured it with three 1/2-inch carriage bolts passed through the post and flange. To plumb the columns, we'd left about 1/2 inch of play between the concrete nipple and the columns' interior diameter. Using a stick level held against a straightedge equipped with standoff blocks to compensate for the column's taper, we nudged the bottom around until the column stood plumb in all directions. Later, we grouted the shim gaps at the pier with cement mortar, leaving weep holes to allow any condensation inside the columns to drain.

Finishing Up

We left the cast plinths and capitals loose on the columns, wedged partway up the columns, out of the way of the framing and finish work (Figure 7, next page). We framed the porch floor on independent supports, with the column piers buried below the framing line. The 1x4 tropical Ipe decking was fitted around the columns, then

Column Installation

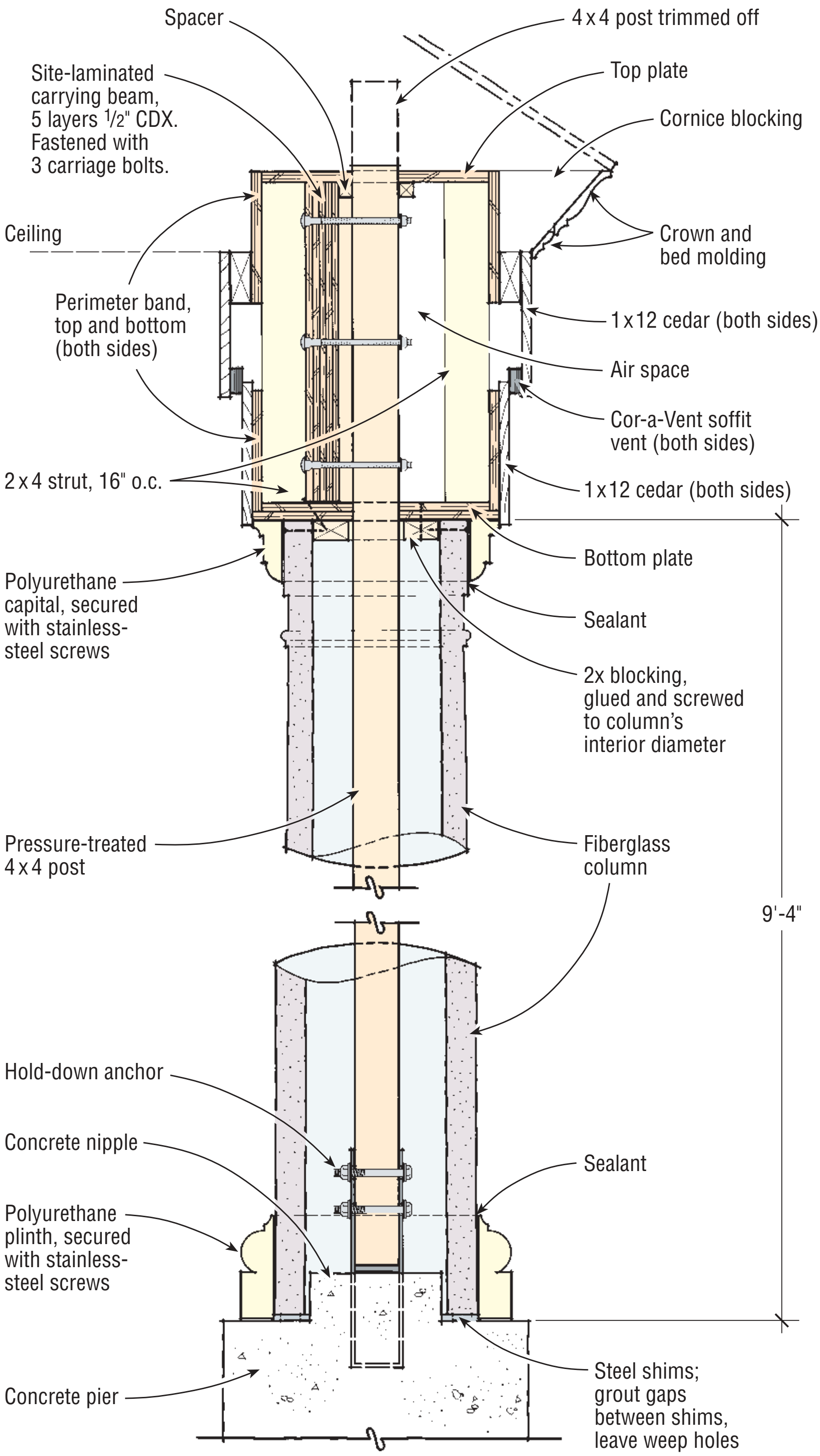

Figure 6. The composite beams were built around a glue-laminated plywood web, 2 1/2 inches thick by 28 inches high. The overall 19-inch width of the beam accommodated the columns' square capitals. Four pieces of wood blocking, shaped, glued, and screwed to the top interior of each column, provide an attachment for wood screws driven down through the beam's bottom flange.

Figure 7. A nonstructural frame under the circular roof (top) aligns with the box beam entablature. The circular roof loads are carried to the columns by a site-laminated round top plate. Note how the plinth and capitals are wedged safely out of the way during construction (above).

covered by lowering the plinth. The beam trim was cut around the tops of the columns; then the capitals were slid up into place. We secured the castings to the columns with Excel XPress polyurethane glue (AmBel, Cottonport, La.; 800/779-3935, www.excelglue.com) and a couple of countersunk stainless-steel screws. The countersinks were capped with epoxy filler and sanded to disappear. The columns arrived with rough-ground molding seams that required top-dressing with thickened epoxy (using West's 401 filler additive), followed by sanding to produce a uniform smooth surface before painting. The completed assemblies were sprayed with latex primer, caulked, and finished with high-quality exterior-grade latex trim paint.

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