# Building a Deck on Grade

## Helical piers and a trenched beam provide solid support for a curved ground-level deck

by Jim Finlay

Our customer's requirements were simple: Build an interesting deck and patio off the back of the house. The deck would be low enough to make rails unnecessary. We recommended curves, and the customer liked our simple, elegant design.

Building the patio was straightforward, but building the deck became challenging. Here in New England, we like to set the height of our decks one riser below the interior floor (a step down of 6 inches to 7½ inches), to help keep rain and snow out of the house. The area for this 15-foot-by-17-foot deck was mostly flat and about 14½ inches below the kitchen floor. Setting the top of the deck 6 inches below the floor would leave only 8½ inches for the deck framing.

### Post and Beam Construction

Fitting the entire structure of a curved deck within 8 ½ vertical inches is tricky, of course. Double-band construction, using joists attached with hangers to a double rim, would require the least height, but would pose several challenges.

To start with, the distance from the house to the girder at the front would be too great for 2x8 joists to span. So we would need to frame the deck with 2x10 joists; but those would not fit into our 8½-inch-high space unless we dug out and removed a few inches of soil over the entire area.

So, instead of a curved structural rim joist, we opted for post-and-beam framing with a carrying beam located about 2 feet back from the deck's front edge, under the joists. This configuration gave us two major advantages: First, it reduced the joist span so that 2x8 joists would be able to carry the load; and second, it allowed the joists to cantilever past the beam, which would make shaping the curve much easier.

Post and beam did impose one disadvantage, however: Because the structure

Figure 1. After digging a trench for the carrying beam, the crew used a hydraulic machine to drive helical piers into the soil until the required pier bearing strength was verified by the machine's on-board torque gauge (top). Adjustable-screw beam brackets set onto the steel-tube piers (above center) secure and support the built-up PT carrying beam (above).

Figure 2. The crew squared the end joists to the house and established the desired pitch for the deck, then used those joists for reference as they built up and set the PT carrying beam.

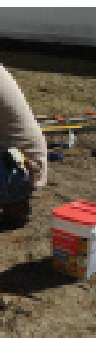


Figure 3. PT lumber rated for ground contact was used for the triple 2x8 carrying beam (above left), which had to be carefully cut into the stone patio (above), rather than rested on it. Crushed stone was placed around the beam to provide drainage (left).

of joists on top of a beam would occupy 16 1/2 vertical inches, the beam would need to be set into the ground, with its top just about at grade level. We'd have to dig a fairly deep trench to accommodate the beam, with a drainage space around it. But that work was worth doing, because it would separate the rough work of installing footings from the fussy work of finishing the precise, symmetric curve—we'd rather trim a half-inch off the end of a joist than have to adjust the location of a footing 4 feet deep in rocky ground.

We drew detailed structural plans and calculated weight loads so we could size the beam and joists properly. Although our building code (IRC 2009) requires a 40-pound-per-square-foot (psf) live load for decks, we build all our decks to 60 psf. I still remember when the extreme snow in February 2015 accumulated more than 4 feet deep in the Boston suburbs. That much snow can indeed weigh 60 pounds per square foot.

Our design imposes a load of 429 to 595 pounds per linear foot (plf) along the angled beams. Over the 6-foot-3-inch spans between footings, we could have used double 2x10 beams; but triple 2x8 beams could support even more weight and saved us 2 inches of digging.

Trenching a beam requires more than just digging a long hole. The beam needs space underneath to prevent frost from pushing it up in winter. Over time, dirt would fill in that space, so we over-dug the trench, lined it with landscape cloth, and surrounded our below-grade beam with loose, clean stones. Those stones drain well and will move aside if frost threatens the beam. The landscape cloth prevents soil from infilling the spaces between the small stones.

## Footings

For the deck footings, we used helical piles instead of concrete poured into Sonotube forms to avoid damage to the existing stone patio. Digging for piers would have been dangerous so close to the patio, and properly compacting the soil around the 4-foot-deep piers would not have been feasible: The soil would settle over time and cause the patio to sink.

A big advantage of the helical piles is that they can be screwed into the ground by a compact hydraulic machine without disturbing the surrounding soil, and the machine's torque gauge tells us exactly when the required bearing capacity has been achieved. We twisted each 7-foot helical footing into the ground below the frostline, and cut the end off once it exceeded the required bearing capacity. We then attached adjustable brackets to support our beam (**Figure 1**).

## Framing

The initial deck framing was fairly conventional (**Figure 2**). After leveling our two reference joists, we inserted the beam below. The helical-pile footing bracket adjusts easily on its screw, so setting the beam height was simple. Once the beam was set, we flushed the top of each joist even with our carefully leveled house ledger, shot nails to temporarily fasten the joist, then installed joist hangers (**Figure 3**).

An interesting issue arose on the left side of the deck. Our design called for the deck to extend a few inches over the patio to hide its edge and provide a clean look. We could not let the side joist merely rest on the patio, because the patio is not a structure and is subject to frost. We had to support that side joist like all the other joists. Thus we had to extend our beam into the patio.

The solution was obvious, but somewhat tedious: We carefully notched the patio stones and reset them around the beam. It's too bad the finished deck hides this craftsmanship.

## Cutting the Curve

Since we had separated the beam structure from the edge of the deck, building a smooth, evenly curved rim became easy. We marked the curve on the joists using a string-and-pencil compass and cut the joists to length, finishing each cut near the ground with a recip saw (**Figure 4**).

Carefully selecting and scoring the rim joist was crucial to creating an evenly curved deck (**Figure 5**). The rim joist could have no large knots, and a smooth curve demanded evenly spaced relief cuts. But the long radius (11 feet 6 inches) allowed our rim joist to easily bend into shape. Clamps on the ends and two screws in the middle held the curved rim in place. Leaving the joists loose over the beam allowed us to adjust any joist left or right until it tightly contacted the rim. We then aligned the height and nailed the rim to each joist.

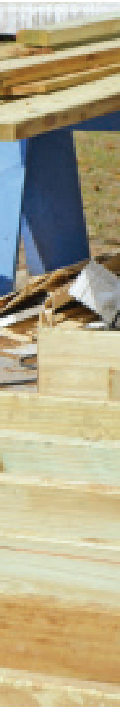
## The Safety Bench

As planned, the step down from the deck to the patio was about 8½ inches, but sloping ground on the right side increased that drop to almost 16 inches, making the deck on that side far too tall to comfortably or safely step down from. We addressed this hazard by building a bench along that edge of the deck (**Figure 6**).

A standard bench with pairs of legs might have looked too massive for this small deck. We opted instead for a "floating bench," which employs single 4x4 legs that extend down into the deck frame. The key to making the bench solid and stable is to through-bolt each leg between two joists below and between pairs of cross supports on the upper frame. We clad the bench frame with Fiberon's synthetic ProTect fascia, ripped to height, and softened the bench edges to improve sitting comfort by holding the trim ¼ inch below the seat.

Treated wood shrinks considerably as it dries during the first months of its exposure, and the initially tight joints in our bench may become loose and wobbly in six or nine months. Fortunately,

**Figure 4. After the joists were installed, a simple string-and-pencil compass was used to lay out the deck's curved edge (top). Workers then cut the joists to length with a circular saw (bottom), finishing the cuts with a recip saw where space was tight.**



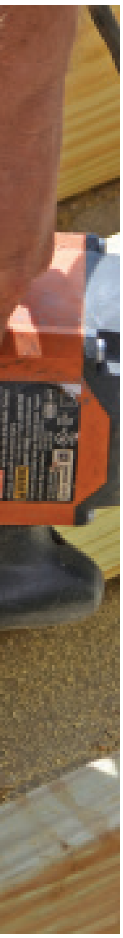
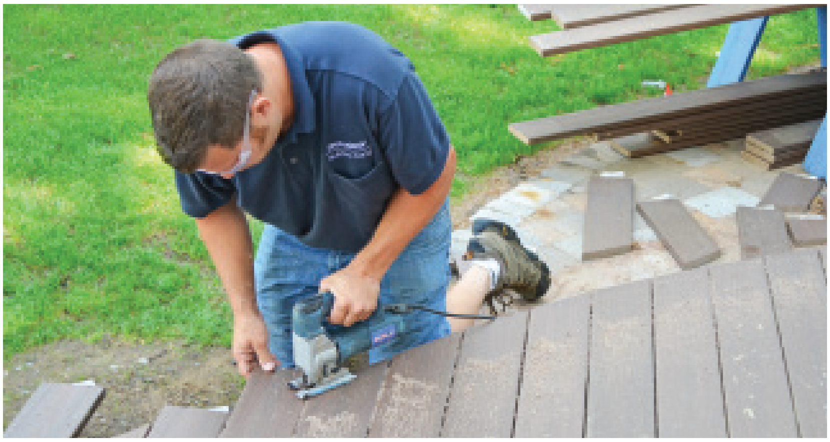


Figure 5. The band joist was framed with a pressure-treated 2x8 that was kerfed to allow it to bend and follow the curve of the deck (below left). With the joists resting loosely on the carrying beam, the crew clamped the band joist into position (below right) and nailed it to the joist ends before finally fastening the joists to the carrying beam (bottom right).


Figure 6. Along the high side of the deck, 4x4 posts support a bench, which serves a safety function in addition to providing seating (top left). After the posts were plumbed and fastened to the deck frame with ThruLok screws (top right), a ladder-framed bench structure was fastened to the post ends (above left). The bench was finished using the same Fiberon material used for decking and deck trim (above right).



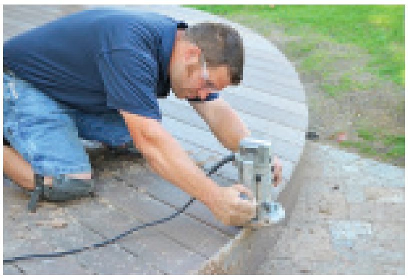


Figure 7. A worker laid out the curved portion of the decking, then carefully cut to the line with a jigsaw (top). Next, he smoothed the edge with a router equipped with a flush-cut bearing bit (above left), then covered the exposed end cuts with a second trim piece (above right).

Figure 8. The clean and simple deck nicely matches the adjacent patio.

this shrinkage eventually stops and the wood remains moderately stable thereafter. So we'll return within a year and tighten our connections.

## Trimming the Deck

To hide the framing, we covered the rim and side joists with more Fiberon trim material. At 3⁄4 inch, it was thin enough to easily follow our curved rim joist.

For decking, we used grooved Fiberon ProTect Advantage 5⁄4x6, fastened with hidden clips. We ran the deck boards diagonally and left them long, hanging past the trimmed rim. Cutting the decking straight along the side trim was easy using a circular saw.

Cutting the decking around the curve took two steps. We first used a jigsaw to roughly cut each board about 1⁄4 inch beyond the trim (**Figure 7**). We finished the curve with a router and a 1⁄2-inch-diameter flush trim bit. The bit's bearing ran smoothly along the curved deck trim and guided the blades to create a flush, even edge.

To cover the exposed ends of the decking, we installed a second trim piece, flush with the top of the decking. We ripped a piece of the same fascia material to 2 1⁄2 inches and fastened it with stainless steel trim nails through the lower trim, and with clear silicone and stainless steel pin nails into the ends of the decking above.

The layout of the diagonal decking left one small sliver that demanded some care (and an extra face screw), but the results were worth that effort.

The completed deck looks quite simple (**Figure 8**). But making it solid, flat, and quiet, and ensuring that its curve was smooth and even, took some craftsmanship. ❖

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