Framing a Radius Stair

Get the layout right — and the framing of this curved stair is easy

BY ROBERT THOMPSON

I'm a construction supervisor for a large framing contractor in New Mexico. Our ten crews frame about 15 custom homes each month, most of them high end, with 3,000 or more square feet of floor space. In this niche, radius stairs — curved stairs that arc as much as 180 degrees around a single point — are quite common. I've framed 40 or 50 of them in the last nine years and have developed a method that's both fast and accurate. In fact, the stair I'm about to describe took only 16 hours to frame.

Code Requirements

As with any stairway, the first order of business was to verify that the stair would meet code. A crucial dimension with curved stairs is tread width at the inside of the radius. The Uniform Building Code specifies a minimum inside tread width of 6 inches. Stairs that don't conform must be redesigned, which usually means laying them out with a longer radius. Fortunately this design met all codes, with an inside tread width of 8 3/8 inches and an outside width of 16 1/4 inches.

Planning

The structure consisted of a series of 3 1/2-foot-long "pony walls," framed like little stud walls. Each pony wall was 7 1/8 inches higher than the previous one, and each supported a tread. In general, the process involved lining up the pony walls to form steps, then fanning them out along two concentric arcs. The outside arc of this particular stair also defined a curved bearing wall for the second-story floor system; the inside arc followed the rise of the stairs and was left open for handrail installation by the finish carpenters.

This stair would also enclose a closet which meant that five of the pony walls, instead of being framed with studs, had headers to span the closet opening. The last three treads were framed in yet another way, which I'll describe later.

Layout

How smoothly a curved stair project goes depends on how carefully you do the layout. Working from the plans, I first snapped a line that I knew was square and parallel to the exterior walls of the house and that ran through the radius point for the stairway (see Figure 1). I sank a nail at my radius point, hooked the end of my tape measure over it, then drew four concentric arcs that began and ended at the reference line I had snapped on the floor. The arcs had the following radiuses:

- Arc 1: 4 feet (the short radius)
- Arc 2: 4 feet 3 1/2 inches (the short radius plus 3 1/2 inches)
- Arc 3: 7 feet 6 inches (the long radius)
- Arc 4: 7 feet 9 1/2 inches (the long radius plus 3 1/2 inches)

I now had two 3 1/2-inch-wide arcs on which to align my curved floor plates. The total distance between the innermost and outermost edges was 3 feet 9 1/2 inches — 3 1/2 inches wider than the stair width — to allow for the curved bearing wall over the outside arc. The final stair width would be 3 feet 6 inches.

Rise and run. The next step was to calculate the unit rise and run. The stair had a total rise of 121 1/8 inches. That worked out to 17 rises at 7 1/8 inches each. The plans showed the stairs forming a 160-degree arc. I had 16 treads to place in this area, so I had to space them 10 degrees apart.

Next, I drew a tread layout on the slab. I placed a 12-inch speed square at the radius point, lined one leg up with my reference line, and marked off each 10-degree interval. I then snapped lines from the center of the arc through each 10-degree mark, extending the lines across the floor to arc number four. It took some work to get consistent treads. Having the 10-degree marks so close to the radius point meant that I had to constantly adjust my tread widths as I went along to make sure each matched the others.

Curved plates. For bottom plates, I used a double layer of 3/4-inch plywood. I cut the curve with a Skil wormdrive saw, setting the blade 1/2 inch deeper for every pass. This required three passes for each cut of the radius. After cutting all the plates, I placed them in position on the floor and transferred my tread lines across them. But I didn't fasten them until I had finished all the framing, to leave room for adjustment. I planned the curved wall so that a stud would fall just forward of each stair riser. This provided solid nailing to tie the stairs into later.

This elegant curved stair conceals a frame structure (above) consisting of a series of stepped walls fanned out along an arc and tied together by plywood treads and risers.

Building the Frame

We were now ready to build the stairs. Before framing a house, I typically spend several hours with the plans, and it pays off. When I hit the job I know exactly what needs to be done, with detailed cut lists for most of the house's components. On a curved stairway this includes dimensions for pony walls, headers, treads, and risers. With a good cut list, my crew can quickly build the pony walls and cut the rough treads and risers.

Pony walls. The first eight pony walls consisted of four studs, framed 16 inches on-center. As Figure 2 shows, the 2x4 bottom plate fit between the two curved plywood arcs; the top plate spanned the distance between the inside and outside of the same two arcs.

The 7 1/8-inch unit rise meant that the first pony wall would be 6 1/8 inches tall (adding a 1-inch-thick plywood tread would bring it up to 7 1/8 inches), the second 13 1/4 inches tall, and so forth. Each wall was fastened to the floor behind a 10-degree layout line. To support the back of the treads (the edge at the bottom of the next riser), we also nailed a ledger 7 1/8 inches below the top of each wall.

Closet headers. The ninth tread was the first clear span over the closet. Starting here, we cut four trimmers (two to a side) and a king stud for each tread, then bridged the distance between them with a double 2x6 header. The header was capped with a 2x6 plate which, in turn, was at the correct height to support the front of the tread.

Short stringers. The last three treads on this stair posed yet another problem. Because they extended above the closet door, they couldn't have a supporting wall beneath them.

Finish Work

With the framing complete, the project was handed over to John Sullivan at Albuquerque Stair Company. John and his crew spent close to 130 hours — a four-day job for four people — fabricating and installing the red oak stair parts. Even so, the job was relatively simple compared with other curved stairways. Instead of full-width treads and risers, this stair was mostly carpeted, with exposed oak treads and risers only along the inside edge.

Also, Sullivan chose not to use a finish skirt on the inside radius, instead dressing the exposed ends of the treads and risers with moldings. He simplified installation of the outer radius skirtboard by using 1/4-inch oak plywood backed up with 1/4-inch fir plywood instead of solid oak laminations.

The most challenging part of the job was the curved railing. Sullivan's crew created the profile by sandwiching seven red oak strips between two premolded edges, then carefully laminating the assembly around a bending form. They made the rail in several sections, staggering the ends of the laminations to weave the sections together. But despite the care that went into lining everything up, the railing still required a good deal of hand-dressing after installation.

— JLC

Our solution was to frame them like a conventional stair, using three short 2x12 stringers, as shown in Figure 3.

Using the closet door header for support at the bottom, we measured and cut one stringer so that it came tangent to arc number two at the middle tread. It had a unit run of 8 3/8 inches, which equaled the stair's *inside* tread width. We then cut a second stringer to form a chord of arc number three. This stringer had a unit run of 16 1/4 inches, which equaled the stair's *outside* tread width. With the inside and outside stringers in place, we used strings to lay out a third stringer for the midspan.

With the basic stair structure complete, we cut our rough treads and risers, using plywood templates to keep them consistent. We then glued and nailed them to our stair structure. To prevent squeaks, we glued *and* nailed every framing joint as we went along, including the one between the bottom plates and the floor. As extra insurance, I also ran an additional bead of adhesive around all completed joints. ■

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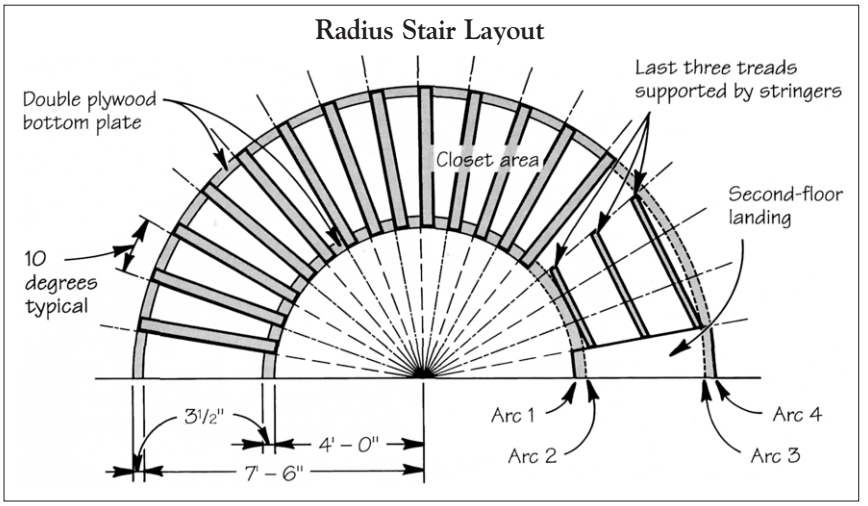

Figure 1. *After locating the radius point of the stair, the author laid out four concentric arcs, marking the bottom plates of the stair structure. Arcs 1 and 2 mark the inside, open wall of the stair. Arcs 3 and 4 mark the floor-to-ceiling bearing wall on the outside.*

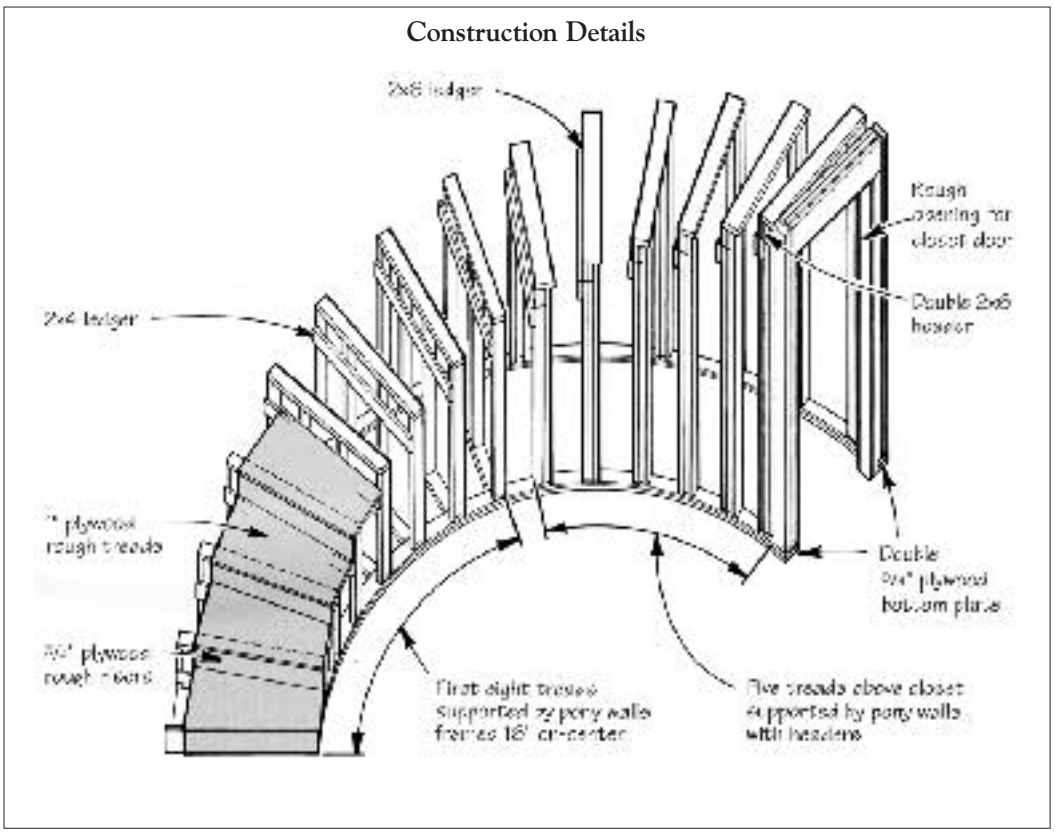

Figure 2. *Simple pony walls, framed 16 inches on-center, support the first eight treads of the stair. The next five pony walls include a header to span the closet opening. A 2x ledger fastened 6 1/8 inches below the top of each wall supports the back of each tread.*

Figure 3. *The author supported the last three treads with short 2x12 stringers to leave room for the closet door and a passageway beneath.*