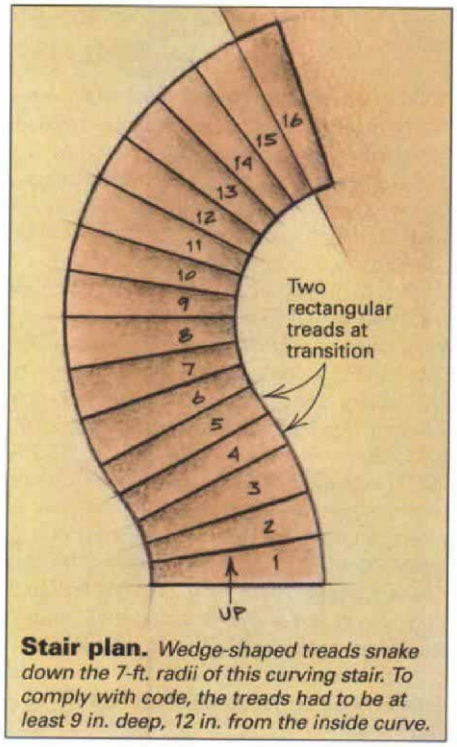
Inside the staircase. Assembly of the stair (far left) starts with a plywood and stud armature. A pair of plywood patterns defines the plan of the stair (drawing below). Pairs of studs (left) carry 2x12 cross ties that serve as risers for the stair. Blue tape (below) shows where the cuts were made to remove everything that's not part of the finished stair.

Building a Curved Stair on Site

A stick-framed stair lifts the eye upward while keeping the costs under control

by Russell O. Bessonette



Stair plan. *Wedge-shaped treads snake down the 7-ft. radii of this curving stair. To comply with code, the treads had to be at least 9 in. deep, 12 in. from the inside curve.*

Working feverishly with Super Glue, I completed the model of this stair at 3 o'clock in the morning on Dec. 24. Later that day, I showed the model to a skeptical building inspector. He studied it, mulled it over and then said, "Go ahead and build it. Merry Christmas."

Because stairways take up a lot of space, finding room for them in remodels is always a problem. And that was certainly the case when we added a second-story addition to a house in Seascape, a development a few miles south of Santa Cruz, California. The plans showed a staircase all right, but it was clear to all of us that the proposed stair, which included two landings, would have overwhelmed the living room.

Unsure of how to proceed, we went ahead and built the addition and periodically pondered the stair. As the roofers were applying the shingles to the new roof, we were still pondering. And, I might add, we were tired of getting to the second floor by way of a 10-ft. stepladder.

Standing atop the new second floor and looking down at the recently laid hardwood floor in the living room, I began to envision a winding stairway. A winding stair would eliminate the two landings shown in the working drawings, and it would introduce a bold, sculptural element into the living room (photo facing page). Unfortunately, curves cost money. A winding stair undoubtedly would exceed the portion of our bid that had been allotted to the stair. But I couldn't get the image of that curved stair out of my mind. I knew it was the right solution, so I asked our boss, contractor Dennis Dyrdahl, if I could take on the responsibility of designing and building the stair. With Dennis' blessing, I began my work by studying a back issue of *Fine Homebuilding*.

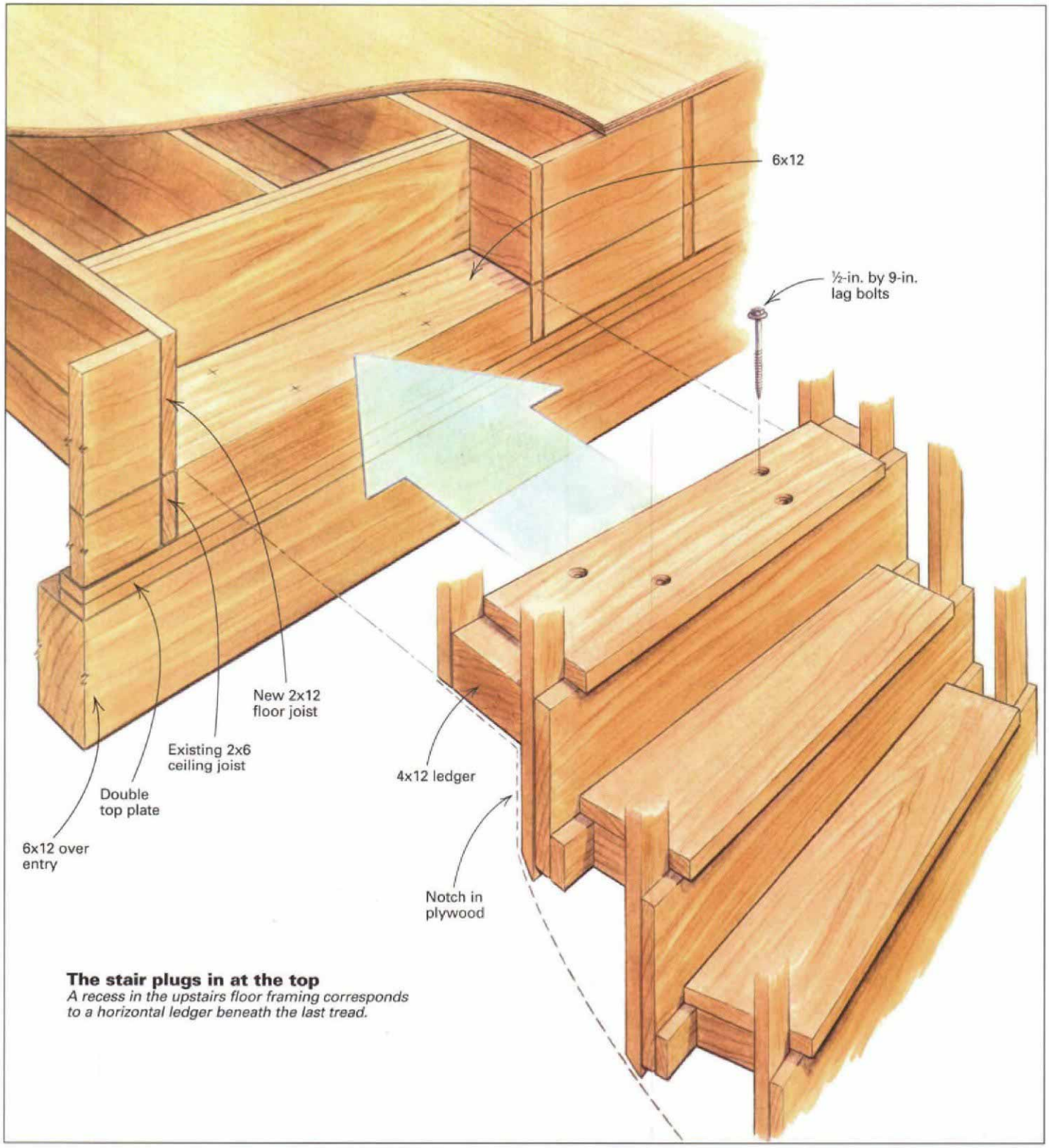
Convincing the inspector and the clients. Back in 1989, David Stark Wilson built a spiral stair by defining the stair shape with floor-to-ceiling 2x6 framing lumber, wrapping it with plywood and then cutting away the un-needed portion of the assembly, thereby leaving a pair of helical plywood box beams to serve as the stair stringers (*FHB* #51, p. 61). I wanted to use the same construction method, but instead of a spiral stair, I wanted to build one that was mostly an arc in plan, with a recurve at the first-floor landing (drawing left).

I began with a scale drawing of the floor plan at 1/2-in.: 1-ft. scale. Then I drew a number of stair plans with outside radii varying from 6 ft. to 9 ft., and tread widths of 36 in., 38 in. and 40 in. I cal-

Drawings: Dan Thornton

Turning a problem into an asset. As the only access to a 900-sq. ft. second-story addition, this stairway had to make an aesthetic contribution to the living room while not intruding into the floor plan. Curving the stair did the trick.

Photo this page: Charles Miller

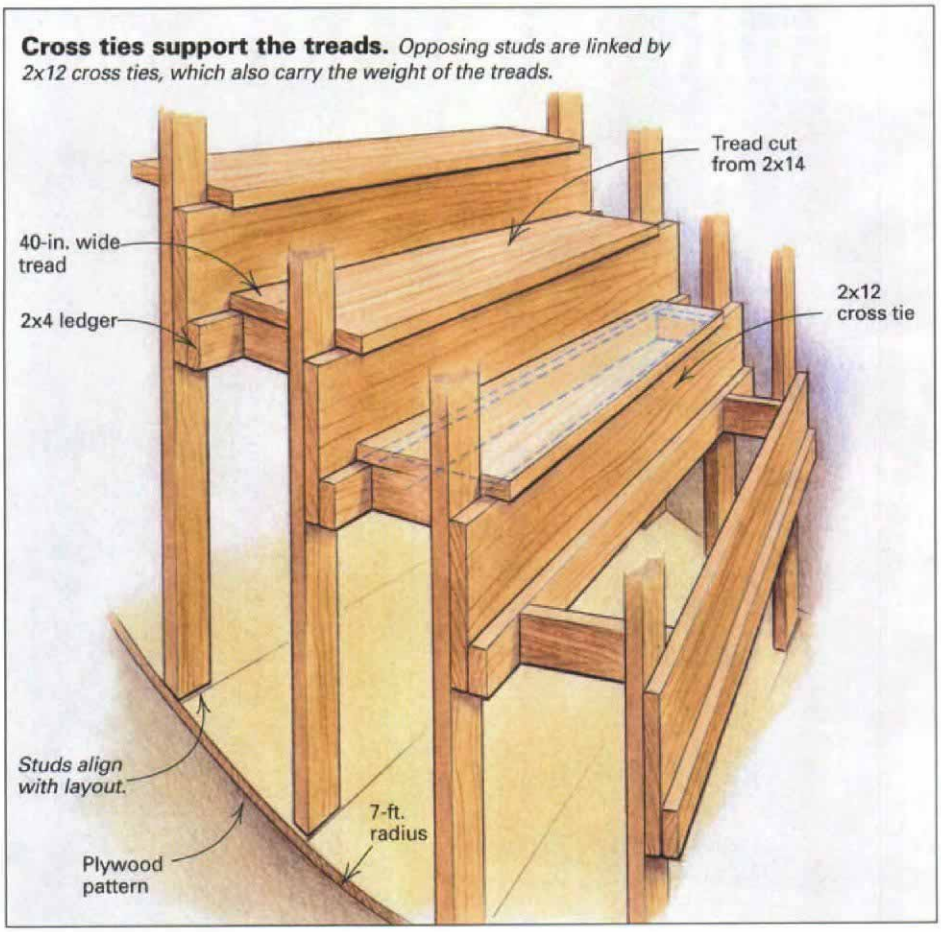


The stair plugs in at the top
A recess in the upstairs floor framing corresponds to a horizontal ledger beneath the last tread.

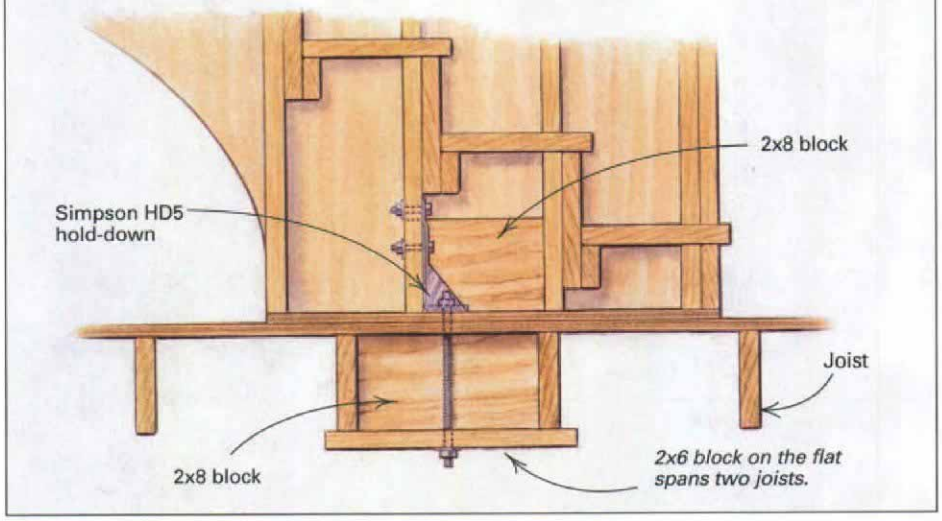
culated the number of steps needed and turned the last five steps in the opposite direction to achieve a pleasing S-shape.

The building inspector's main concern was with the tread-depth requirement. The treads had to be at least 9 in. deep when measured 12 in. from the inside radius of the stair. My drawings revealed that a 7-ft. radius stair with 40-in. wide treads satisfied the codebook. But I still had to convince everybody that the scheme was sound. That's why I decided to built a balsa wood and cardboard model of the assembly that showed how everything went together. The model proved essential in convincing the clients and the building inspector of the project's feasibility.

Paper templates and plywood patterns—The living-room floor, protected by several layers of kraft paper, became my workspace for a couple of weeks. First, I made a full-size paper template of the stair plan. I taped enough kraft paper together to form a 16-ft. square. Then I used trammels and straightedges to mark the arcs on the big worksheet and to draw the placement of the wedge-shaped treads. I cut out this template, set it aside and arranged two layers of ½-in. plywood to accommodate the template. I ran the layers in opposite directions so that they would overlap, and I screwed them together to make a single sheet of plywood. Then I used my paper tem-



Cross ties support the treads. *Opposing studs are linked by 2x12 cross ties, which also carry the weight of the treads.*



Hold-downs at the landing. *A pair of steel anchors attached to the stair's framing is connected to the floor by way of threaded rods.*

plate to transfer the outline of the stair to the plywood, and I cut it out.

I made two plywood patterns and marked the positions of the treads on their corresponding faces. Then I connected the patterns with 14-ft. 2x4s and tilted the whole thing vertically (left photo, p. 62). To ensure that the top and bottom patterns stayed plumb during construction, I had drilled two reference points at the opposite end of the plywood patterns when they were stacked atop one another. Once the stair was upright and spread apart, I dropped a plumb bob between these points and diagonally braced the 2x4s with plywood to make sure no racking occurred. I kept the armature in the center of the living room so that I would have easy access to both sides.

As shown in the drawing (above, top), I put a 2x4 on each of the tread layout lines top and bottom. With the help of a story pole, I next marked the heights of the treads onto the 2x4s. Then I used construction adhesive and screws to secure 2x12 cross ties to the 2x4s. The cross ties act as risers and carry the leading edge of each tread. Also, 2x4 ledgers affixed to the bottoms of the cross ties carry the back edges of treads. Once I had the cross ties and ledgers installed, I screwed and glued the treads in place (center photo, p. 62). I cut them from 2x14 framing lumber.

Wrap the frame with plywood—I used three layers of ⅜-in. CDX plywood on both sides of the 2x4s to skin the armature. I put the plywood on the inside faces first, alternating grain directions with each subsequent layer. For the first layer, I applied copious amounts of construction adhesive to the studs before I screwed on the plywood. Both the second and third layers were coated with white glue before I affixed them with progressively longer screws arranged in a random, overkill pattern of 6 in. o. c. I didn't bother to notch the plywood around the treads for the first two layers—it would have been just too tedious. But I did notch the third layer to provide backing for the drywall to come.

Louvered lights let into the inside rails of the stair had helped sway the inspector that this stairway would be safe. So before proceeding with the outer layers of plywood, we ran the wires and did the other electrical work for the lighting.

I secured the three layers of plywood to the outside of the stair in the same manner, and then I marked the cutline on the rails with blue masking tape. I left a couple of 2x4s in place to act as temporary posts, and then sculpted the curving plywood walls with a reciprocating saw into the rough shape of the stair (right photo, p. 62).

Bolt the stair, then drywall and plaster. Dennis and I used a pair of come-alongs to coax the stair into position. The stair connects to the second floor by way of a horizontal ledger that nests in a corresponding recess in the floor framing (drawing facing page). Four ½-in. by 9-in. lag bolts hold the assembly together. A pair of Simpson HD5 hold-downs anchors the rails to the floor framing (drawing below left).

The curved sides of the stair were easy enough to cover with drywall, but the compound curves formed by the underside of the stair required another solution. We used the leftover ½-in. plywood from the patterns to make 2-in. wide strips of lath. Then we screwed the strips to the bottoms of the cross ties until we had a solid backing for expanded metal lath.

We finally found a drywall crew that wasn't afraid of curves or rounded edges. They refined the curves atop the railing, filling in any angular lines that might have added facets to the curve of the stair. A rough, sandy texture unites the look of the drywall sides and the plaster bottom.

I'm still amazed at how easy it was to build this stair. It took about two weeks of my time. Altogether, it cost about $3,500. We figure that amount to be $2,000 more than the two-landing stair that we decided not to build. □

Russell O. Bessonette is a carpenter in Grass Valley, California. Photos by the author except where noted.