Taking a Load Off

Three basic shoring techniques for making structural repairs

by W. Whitie Gray

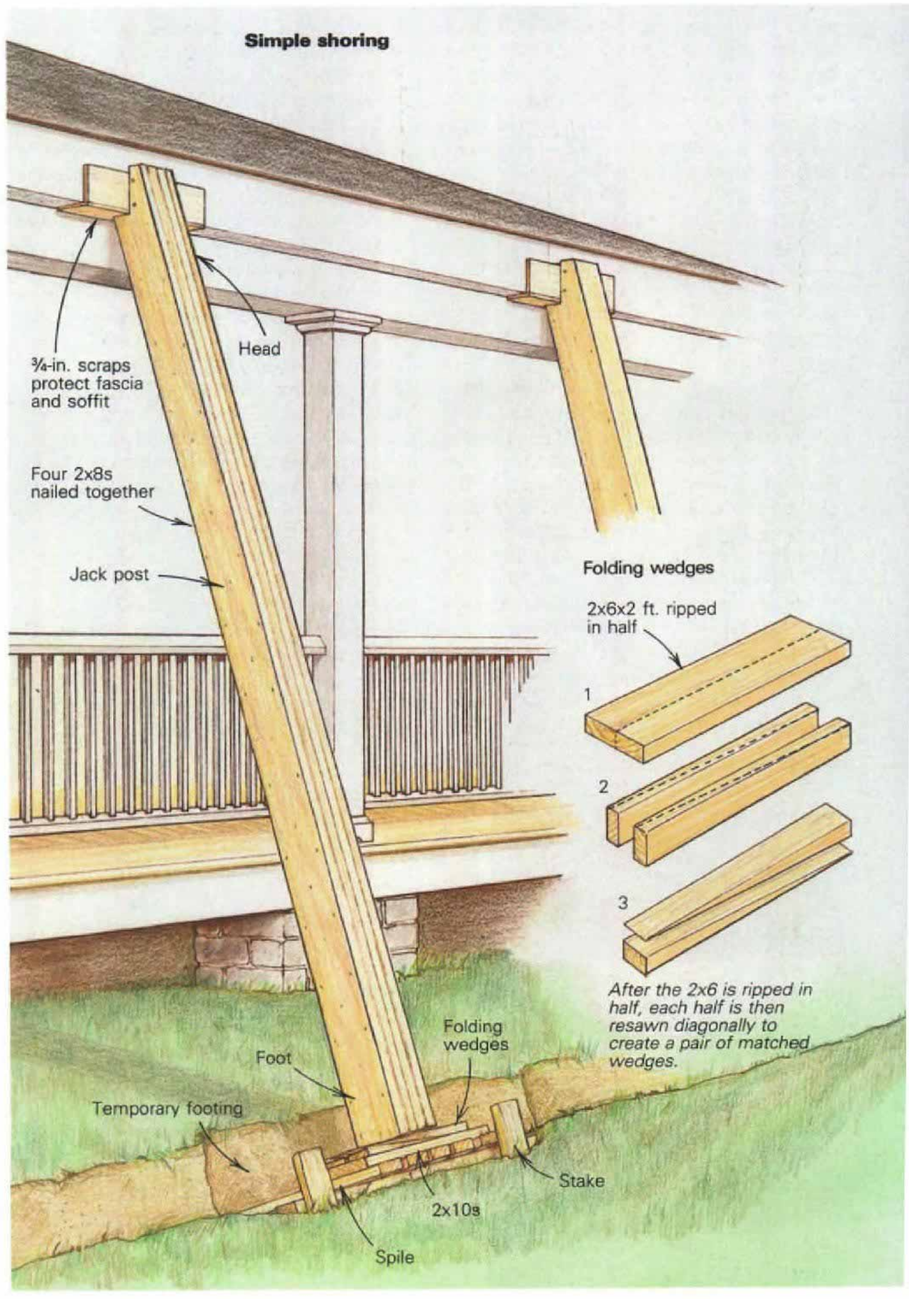
On my last three jobs the clients were more impressed by my shoring methods than by the repairs I made. Not that there was anything wrong with my work; they liked that well enough. But in each case, selling the clients on the shoring techniques convinced them I could do the job in the first place. In this article I'll describe the shoring techniques that I used on each of the three jobs. These methods are low-tech—they don't require much equipment—but they get the job done quickly and safely.

Simple shoring—The first job involved simply raising the ceiling and roof of a 70-ft. long veranda so that, among other things, new porch columns could be put in place. For this job, I used a simple shoring technique (drawing right).

My crew and I were restoring Helmwood Hall, a 150-year-old house in Shelby County, Kentucky, that's on the National Historical Register. Everything had to go up evenly, smoothly and gently. We didn't use hydraulic or screw jacks to raise the roof because they would have been in the way of our work. Also, with hydraulics it's easy to pump one time too many and break something, and these were brittle timbers we were dealing with.

Because the porch was a trabeated structure—that is, designed to transfer the weight of the structure to the foundation down each column—and because we had to lift this weight to make our repairs, we dug 2-ft. wide holes for temporary footings about 4 ft. in front of the porch. Then we built wood footings, using a layer of 2x10s. The 2x10s bear on a series of spiles driven into the ground at an angle so that the bottoms of the jack posts could be cut square. Spiles are long stakes that we make from 2x4s or 2x6s and sharpen by cutting a taper on one edge at an acute angle of 15° or 20°. When driven into the ground with the tapered edge up, spiles compact the soil beneath them.

We notched the tops of the jack posts with a cut like a bird's-mouth cut to engage the bottom corner of the fascia at the juncture of a ceiling joist and a rafter; we positioned them at such an angle that we could work conveniently under and around them. The jack-post angle can vary, and the safest angles are those that are closest to plumb—the farther away from plumb, the greater the hazard. Of course,



all shoring methods are potentially dangerous, and safety is the most important consideration. Sizes of timbers must be designed with a large safety factor in mind.

The jack posts were designed to be strong enough to lift the weight without distorting. We laminated them out of four 2x8s nailed together so the posts would have a wide foot to stand on. Leonardo Da Vinci long ago discovered that a bundle of saplings bound together would support more than a solid post of the same diameter.

Folding wedges—Wedges used in opposing pairs, called folding wedges, are the key to all of our shoring methods. In this case, we inserted them under the feet of the jack posts and used them to raise the roof. The wedges are sawn from yellow pine 2x6s at least 2 ft. long (detail drawing, previous page). We rip the 2x6s in half giving us two pieces of wood 2¾ in. wide. Each of these is then resawn diagonally, which gives us a 2¾-in. wide wedge with a long slope and a low rise.

The wedges are cut and used in pairs. This pairing assures that the lifting occurs evenly. The wedges are made so they can be hammered in or out (at some point we trim them blunt on the thin end) and are held in place by gravity and friction. They must be removed as carefully as they are inserted.

After the heads of the jack posts were put in place (we use duplex nails to hold them temporarily) and the feet set on wedges and footings, we were all set to raise the roof. This was done by driving the opposing wedges into each other (depending on the load, we'll drive wedges with anything from a 22-oz. framing hammer to a 10-lb. sledge). We did this at each jack-post location, raising the entire roof a little at a time and monitoring the progress by measuring with rule, story pole and stringlines. We only wanted to clear the new columns by ½ in. As each new column was placed we simply backed out the wedges and allowed the weight to settle.

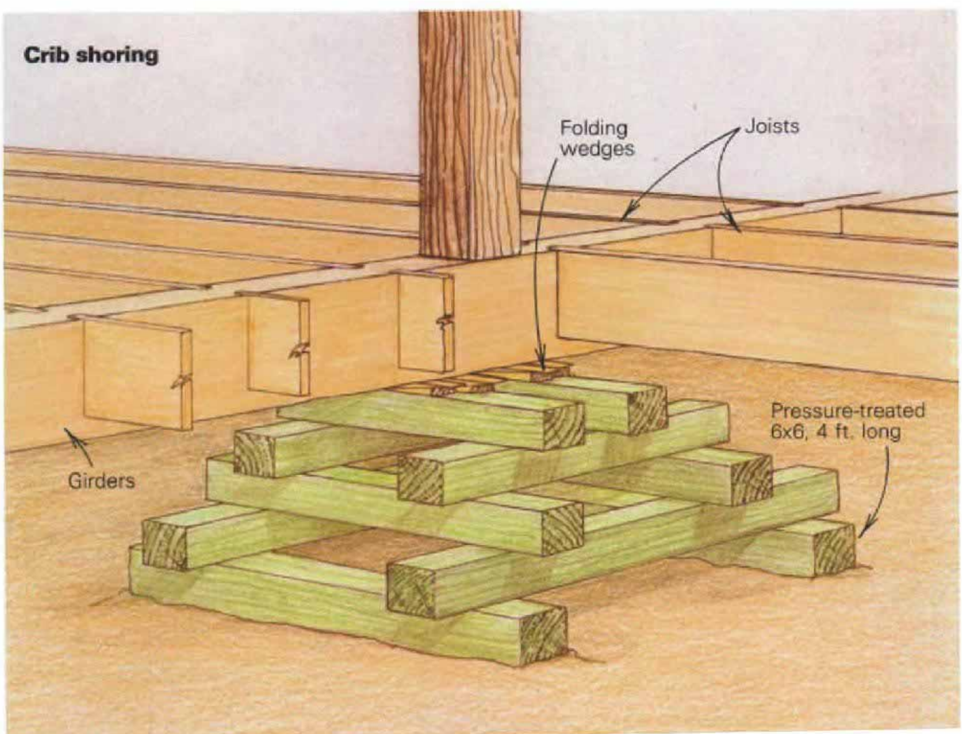
Crib shoring—On my next job I had to raise and level the interior floors of the oldest house in Eminence, Kentucky. Inside this 150-year-old structure, doors wouldn't close, plaster was cracked and furniture wouldn't stay put.

Under the house was a crawl space and a tiny hand-dug basement. Walnut sills, girders, and sleepers supported 2-in. by 12-in. roughsawn poplar joists (girders that carried other girders were called sleepers). The dirt within the rock foundation was powder dry and very fine.

I decided to raise the floor with crib shoring (drawing below) and leave it in place permanently. I had seen my engineer father employ this same method to shore up floors under heavy equipment in an old mill. Crib shoring, which involves layers of crisscrossed timbers, works on the same principle as snowshoes; it distributes weight over a larger area, thus sustaining a big load on a soft surface.

On this particular job we used pressure-treated 6x6s to make cribs (sometimes we use 4x4s or landscape timbers). Crib design and timber sizes are custom-fitted to the job. Here the bottom timbers were 4 ft. long, and those in each successive tier were about 6 in. shorter than the previous ones. As each crib was assembled, we toenailed the timbers together. Under the house, we moved the timbers about easily with rope and a small sled called a stone boat. Made of two 2x4 runners about 4 ft. long and two 2x10 crosspieces about 2 ft. long, we used the sled to move all manner of tools and materials in the tight spaces.

After all the cribs were strategically located under the sagging timbers, we used 2-ft. folding wedges to raise the floor. Wedges were nailed to hold them in place, but nailed sparingly so additional repairs could be made in the years ahead. In this case the girders and sleepers were laid out in a grid of 12-ft. squares, and the joists changed directions at every grid. But it was easy to see where the girders had failed: generally in the center of their span. This is where we placed a crib. In places, we used two or more cribs with a beam between them.



When we collected our pay, all the door locks worked again and the floors were level, flat and stable.

Rake shoring—The third job that I'll describe was the most difficult and required the most sophisticated use of low-tech shoring methods. I was asked about a problem wall by a client living in a manor house built in 1864. The walls were solid brick, which had been molded and fired on the site. On the south side of the two-story house a brick pilaster had shifted about 1 inch on the cut-stone foundation, thus allowing the weight of the brick wall to break the limestone lintels over two windows.

To compound the problem, the soft inner brick of the three-layer wall had crumbled and settled. This caused two things to go wrong simultaneously. The outside of the wall bulged 6 in., and indoors the sculptured plaster ceilings, with pierced leaf molding, were beginning to break and fall. The inner layer of brick was all that held the ceiling up and the wall in place. It too had moved about ¾ in.

Two architects and one engineer had diagnosed the illness as terminal and could only recommend razing the wall and rebuilding it. I convinced the owners that it could be saved and corrected with rake shoring (photo facing page) at less than one tenth the cost of rebuilding.

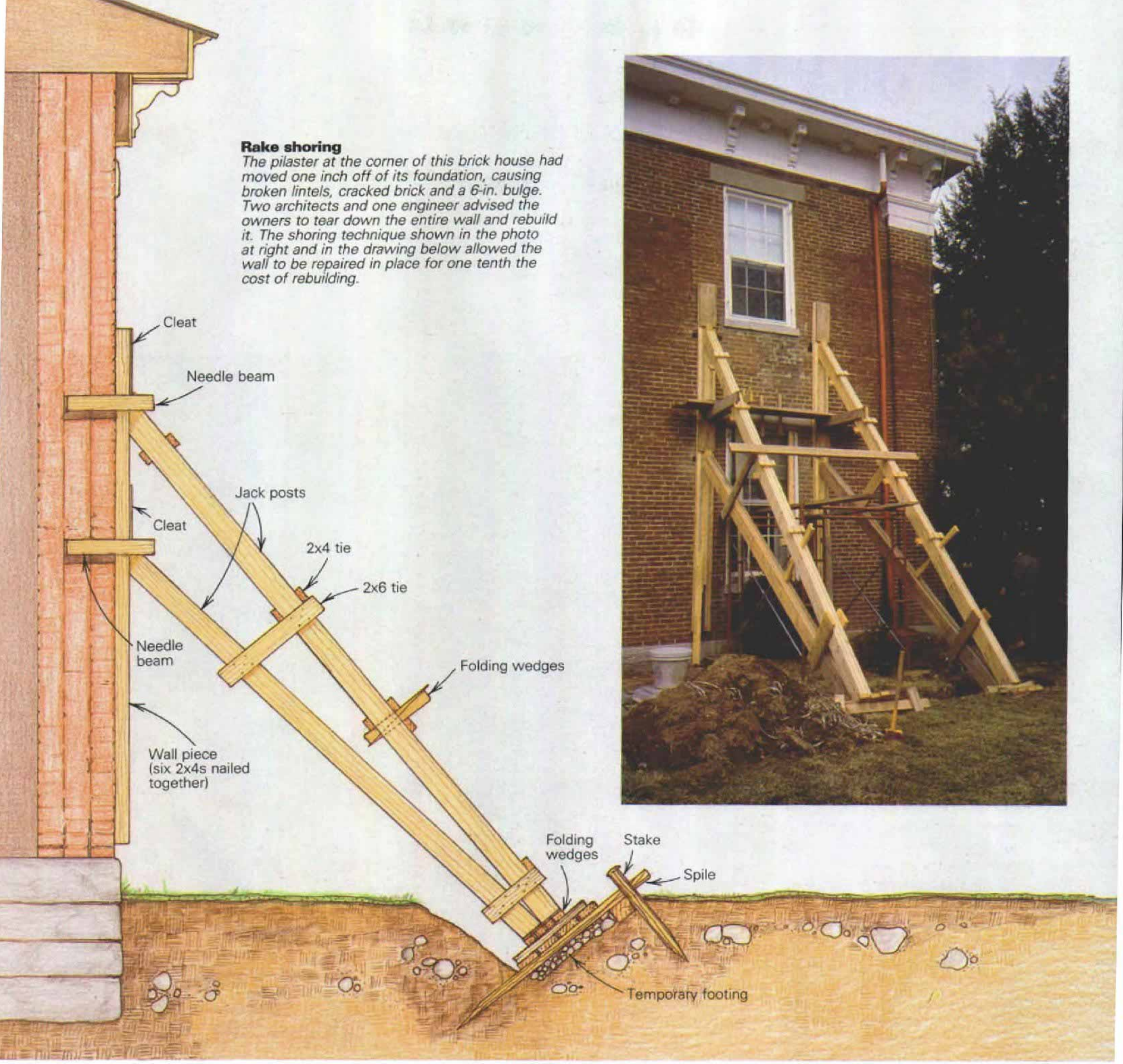
The procedure was similar to the simple shoring mentioned previously, but with a few important differences. Our temporary footings were dug and ditched so they would drain after a rain. They were placed at a distance from the house that gave the jack posts an angle to the grade of about 60° (drawing facing page). This angle was critical because we were trying both to lift and push the wall at the same time.

After the footings were done, we nailed together wall pieces to lie vertically against the house and distribute the horizontal thrust of the jack posts. These wall pieces were made up from six 2x4s on edge.

We planned to push and lift the wall at two locations above and below the second-floor joists. We left holes in our wall pieces at these levels and made corresponding holes in the outer brick, so we could penetrate the wall with short needle beams. Each needle beam acts as a chock for the upward force where the jack posts meet the brick wall.

We used two pairs of jack posts—each pair consisting of an upper and lower post—positioned on either side of the windows with the broken lintels. We connected the upper and lower jack posts with 2x6s.

In this case, the upper jack posts were made of three 2x8s sandwiched so that the center 2x8 could slide between the two outer 2x8s. The two outside pieces were connected with 2x4 ties top and bottom every 3 ft. In addition to lifting the entire jack post with folding wedges placed on the footing, we inserted another set of wedges at a joint in the center 2x8, about 4 ft. up from the footing. Only the



Rake shoring
The pilaster at the corner of this brick house had moved one inch off of its foundation, causing broken lintels, cracked brick and a 6-in. bulge. Two architects and one engineer advised the owners to tear down the entire wall and rebuild it. The shoring technique shown in the photo at right and in the drawing below allowed the wall to be repaired in place for one tenth the cost of rebuilding.

center 2x8 raises the needle beam. The side 2x8s push against the wall piece and, with wedges and blocking, hold what is gained by the center 2x8. When all was at the ready we tightened the wedges to hold the wall and prevent any more movement.

Repairing the wall—With the shoring taking up the load of the wall, the next task was to put the brick pilaster back in place on the stone foundation. This we accomplished by building a bulkhead 4 ft. from the house. Then we placed two 25-ton screw jacks and short 6x6 posts between the bulkhead and the brick to push the pilaster back into place.

To keep the foundation from shifting again we excavated the dirt beside it and poured a concrete buttress against the pier, just below the finish grade line. We wanted no evidence of tampering with the original foundation. We gave the concrete a weekend to cure and then began the serious work of pushing the wall back plumb.

There had been a few periods of rain as work progressed, and we had tightened the wedges in our shoring after each rain to compensate for the softening of the earth at the temporary footings. When we checked the wall and ceiling inside they were back in place, and only one 6-in. piece of leaf molding had fallen.

The next days were spent removing lintels and rebuilding the brick wall in rake or stair-step fashion. Instead of using limestone lintels, we cast new lintels from portland cement and sand, reinforced with ½-in. rebar. To duplicate the marks on sawn limestone, we stroked the green concrete with a rubbing stone.

All the bricks were tuckpointed to a depth of 1½ in. After raking the mortar joints, there was nothing left to be done but remove the shoring, replace the brick where the needle beams had been and repair the earth. When we left, the owners were pleased, we were pleased, and the architects coming by to view the results were dumbfounded. □

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