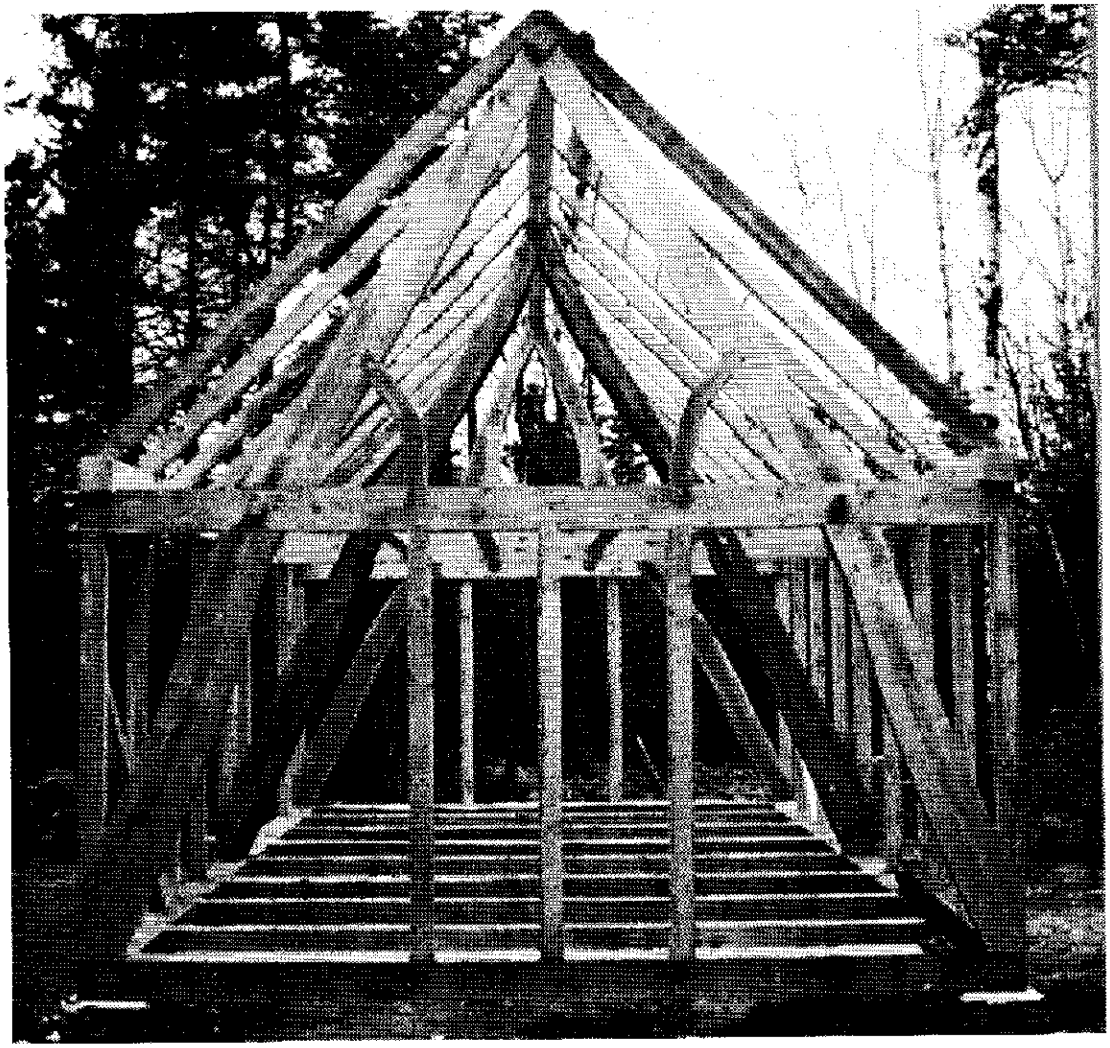


Cruck House

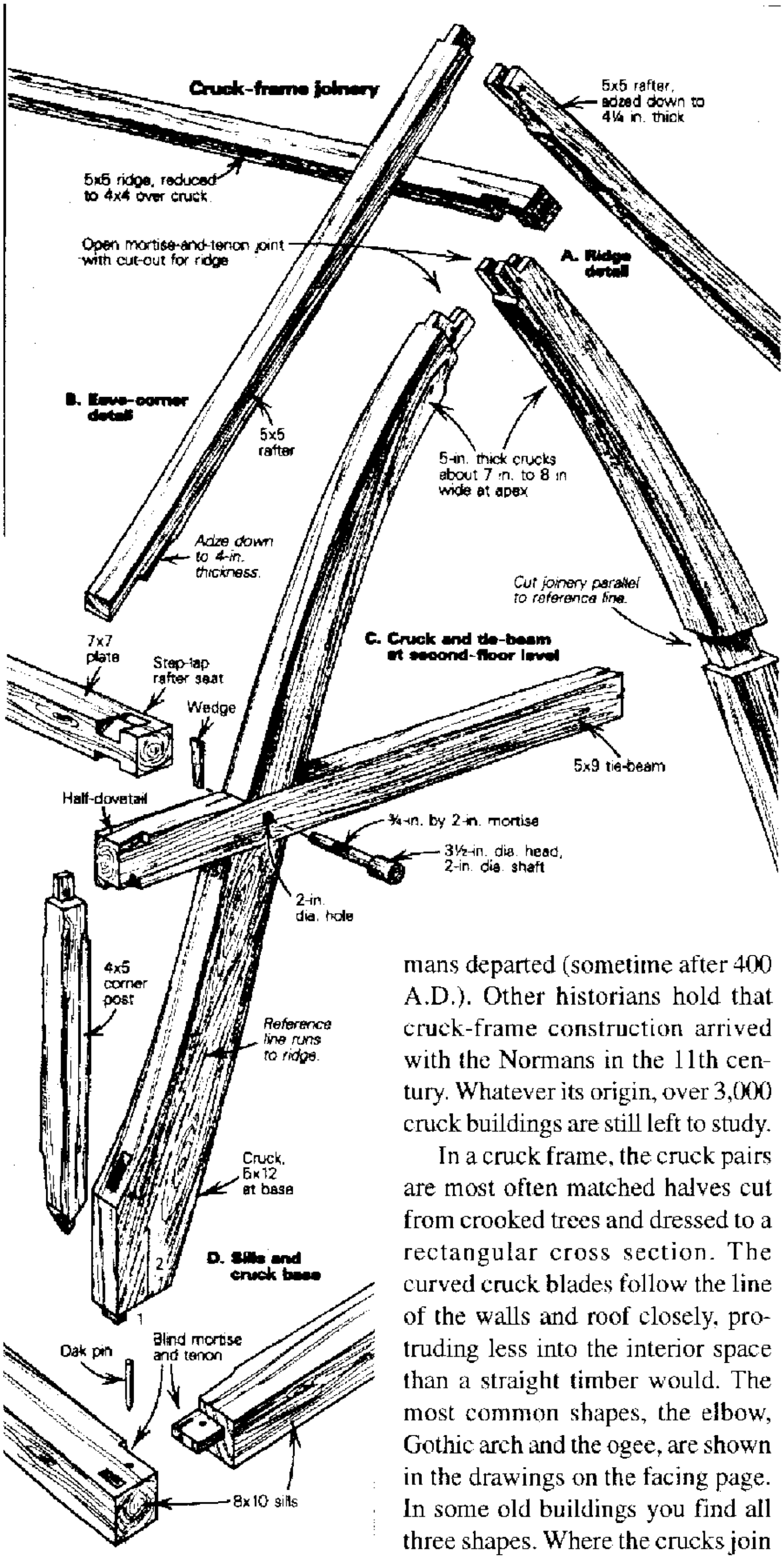
By Jack Sobon

WHEN MY FRIEND SUSAN GIRARD asked me to design and build a small house for her on land that she had purchased in Windsor, Mass., I immediately decided upon a cruck frame design. Though usually the needs of my client determine the layout and size of the house, the design of the timber frame is left to me. I had always wanted to build a cruck frame, and here was my opportunity.

Editor's Note: This article, reprinted with permission from The Taunton Press, describes in detail the raising of a modern reconstruction of the cruck house. It is from the book "Fine Homebuilding: Great Houses: Timber Frame Houses," *©1992 ($24.95), which also details a wonderful timber framed house and a cobblestone cottage. Do **not** build a timber frame house until you have read this book. To order, call Taunton at 1-800-888-8286, operator 77 (and tell them where you heard about the book!)*

A Brief History—The cruck frame is different from the box frame, or braced frame. Instead of vertical posts, pairs of inclined crucks, a so called "curved tree principals," rise from the base of the sidewalls to meet at and support the roof at the ridge (photo facing page). The cruck pairs form rigid triangles at each bay interval, stiffening the structure in the transverse direction.

The origins of this unusual structural system date back to medieval England. B. Bunker, author of *Cruck Buildings,* maintains that crucks were brought to England by Anglian settlers who arrived after the Ro-



mans departed (sometime after 400 A.D.). Other historians hold that cruck-frame construction arrived with the Normans in the 11th century. Whatever its origin, over 3,000 cruck buildings are still left to study.

In a cruck frame, the cruck pairs are most often matched halves cut from crooked trees and dressed to a rectangular cross section. The curved cruck blades follow the line of the walls and roof closely, protruding less into the interior space than a straight timber would. The most common shapes, the elbow, Gothic arch and the ogee, are shown in the drawings on the facing page. In some old buildings you find all three shapes. Where the crucks join at the ridge, they might be half-lapped and notched to form a cradle for the ridge beam. In some old cruck-frame buildings, one or more cruck pairs weren't long enough to reach the peak. To solve this problem, the tops of the short crucks were joined with a collar beam that supported a king post which rose to support the ridge beam. Building widths are commonly 14 ft. to 18 ft., with as many as seven bays. The largest existing cruck building is the Leigh Court Barn, Hereford and Worcester, England, with an interior cruck span of 33½ ft.

Making the Crucks: For the Girard house, I had planned to find and cut the crucks at the wooded six-acre site. This proved to be more difficult than I had anticipated. Because of the 2,000-ft. elevation, most of the forest was red spruce and balsam fir, with a few mixed hardwoods. Spruces naturally grow straight. A more southerly forest with its oaks and other hardwoods would more likely harbor some potential cruck blades.

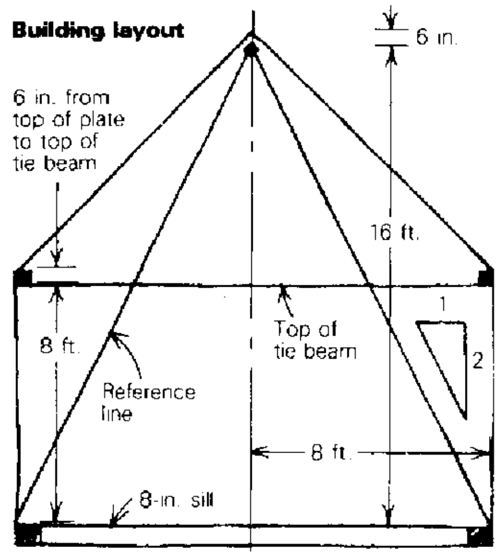
A thorough search of Susan Girard's property turned up three trees that were large enough and curved in only one place. Two of them were black cherry; the third was quaking aspen. Each would render two cruck blades of matched curvature. The aspen was an elbow shape; one cherry was an ogee, the other was curved like an ox yoke The maximum length available was 18 ft. This, along with structural considerations, limited the width of the building to about 16 ft.

Old cruck blades are mostly 6 in. to 8 in. thick and as much as 24 in. wide at the butt. Our crucks were small in comparison, 5 in. thick and about 12 in. wide at the base, tapering to about 7 in. at the ridge. In the old days, a matching pair of crucks could be sawn out of a curved tree, or split out and then hewn square. My partner Dave Carlon and I chose a more modern method, using a portable chainsaw mill from Sperber Tool Works (Box 1224, West Caldwell, N. J. 07007). While a regular sawyer would have a difficult time positioning a boomerang-shaped log on his carriage, this sort of cut is no problem for the Sperber mill.

After felling the tree and levering the log up onto short cross log supports, we began laying out for the first cut, which would halve the log. We used Will Malloff's approach (from *Chainsaw Lumbermaking,* published by The Taunton Press). The log was positioned with the curve lying level in a horizontal plane. Then 2x4 or 2x6 blocks were nailed on each end with their top edges both level and equidistant from the proposed cutting plane. Checking these with a level ensured a cruck free from winding problems. Two strings were stretched across the 2xs as a reference. Then ¼-in lag bolts were screwed into the log until their heads were just below the strings. At a spacing of 3 ft. or 4 ft., these lag-bolt heads would support the guide plank that is used with the mill. Of course, the bolts were not so long as to pierce the cutting plane and catch the saw teeth. After one last check, the strings were removed and the guide plank was set on the log. Our guide plank was a 2xl4, 14 ft. long. It had to be moved halfway through the cut. After the first, or halving cut, the bolts and planks were removed, since the fresh-cut surface provided a guide for the mill to complete the slabbing cut.

Because these 8-in. slabs were still too heavy and awkward to carry out of the woods, we hewed off the wane with an ax, following the natural curve of the piece. This surface was later planed or spokeshaved to form a continuous, attractive curve. We checked the curves the way you might check the straightness of a board, by sighting down the edge. Abrupt changes were quite noticeable, and we took them out with a hand plane. But even with the reduced weight, Dave and I barely managed to shoulder the cruck blades and carry them out of the woods to the work site near where the house would stand.

The black cherry was a delight to work with, and its color and aroma added to our pleasure. The aspen, however, gave us no end of trouble. First of all, the tree was leaning severely, and though Dave and I are experienced tree fellers, the aspen tore a section of its stump right out of the ground as it came down, splitting partway up the butt. This necessitated cutting off part of the butt, wasting some of the tree. The lean of the tree and its elbow shape had caused it to develop lots of reaction wood As we finished sawing through the heart, stresses in the log were released, and the slab ends



Above: Photo and diagram of the house built by the author.
Right: Cruck house reconstruction at Plymouth Plantation.

sprang apart with great force, almost catching me on the chin.

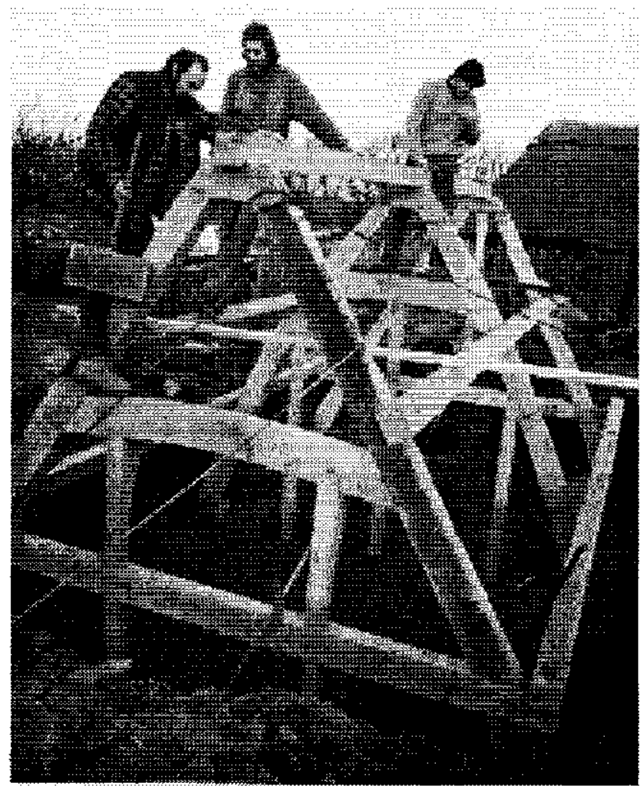
Handling the aspen cruck blades was equally unnerving. Not only were they elbow-shaped, but they were also warped. These pieces would not sit flat on our shoulders, or on sawhorses. On several occasions an aspen cruck started to roll off its sawhorses with no help whatever. After hitting the ground, it seemed to flop about like a fish out of water. All I could do was get out of its way until it came to rest. These pieces seemed to be full of energy until we framed them into the house.

Cruck Joinery – After hand planing both sides, we laid out the joinery on each cruck blade from a single chalkline snapped on it. This reference line represented an imaginary line from the peak of the roof diagonally down to the top outside edge of the sill beam. The building was 16 ft. wide by 16 ft. to the ridge, so the angle formed between the line on the cruck and the horizontal read as 16/8 or 2/1 on the framing square. All angles were laid out with a framing square from the line, and all measurements were made on the line. Thus all the joinery could be cut without scribe fitting.

Ridge, plates and sills are all continuous in, this house. To gain some extra strength, I extended the ridge and plates an additional 3½ in. past the ends of the building. These protrusions are buried in the finished thickness of the exterior wall.

Crossing each cruck pair at second-floor height is a single horizontal 5x9 tie-beam that extends to the edges of the frame and supports a pair of horizontal 7x7 plates. Vertical posts, mortised into the tie-beam, also provide support along the sidewalls. Where the second-floor level tie beams crossed the crucks, we used a lap-type joint that Charles Hayward (*Woodwork Joints*, Sterling Publishing Co, ©1979) calls a "strengthened halving." It provided additional bearing for the tie beam and allowed us to cut the walls of the lap at exactly a 2/1 angle, regardless of the actual angle of the curve at that point on the cruck blade. The only variable was the distance of the lap from the chalkline.

Traditionally, this halving joint was secured by boring multiple peg holes at opposing angles to prevent withdrawal of the joint. We made use of a more elaborate but stronger fastening design – large wooden forelock pegs, turned on a treadle lathe at nearby Hancock Shaker Village. Each had a 3½-in. dia. head, a 2-in dia. shaft and a mortise for a ¾-in. thick wedge to draw the joint tight and allow for some adjustment after sea-



soning. We used an assortment of woods for the bolts and wedges including oak, hickory, maple, elm, beech, cherry, walnut and shadbush. The heads of the pegs on the exterior cruck pairs would be buried in the thickness of the wall in the finished house.

An open mortise-and-tenon joint (sometimes called a tongue-and-fork joint) was used to join the crucks at their apex, with a 4x4 notch cut out for the continuous 5x5 ridge beam. The ridge not only ties the cruck pairs together but also supports the open mortise-and-tenon rafter pairs. The rafter-to-plate connection is a step-lap seat. When pegged, this is an extremely strong joint.

The Girard house rafters span from the ridge to the plate, though in many traditional cruck frames, intermediate purlins framed into the top side of the crucks would support them at midspan. Bracing from the purlins to the cruck blades would stiffen the frame longitudinally. Because our frame had no purlins or purlin braces, we added let-in braces at two opposite corners to provide longitudinal bracing.

In the eastern end wall, two short raking struts connect the tie beams and crucks. These black cherry pieces, once short curved branches in a fallen tree, were handhewn and planed, provided with lap-dovetail tenons, and inserted into the assembled bents in just two hours. ■