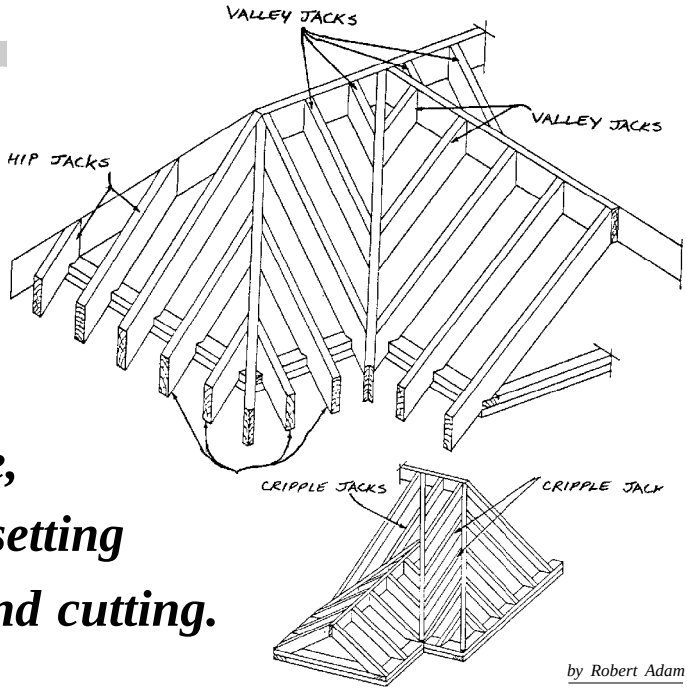
CUTTING JACK RAFTERS



After figuring the first one, it's as easy as measuring, setting your saw to 45 degrees, and cutting.

by Robert Adam

Roof framing is, for most carpenters, a mysterious joining of rafters that—with a little luck—fit the first time. For some, it is a nightmare of frustration. Most of us have no problem with common rafters or an occasional hip or valley rafter, but jacks often seem mind-boggling.

The key to understanding all rafters is to think of them in terms of horizontal and vertical coordinates (lengths of run and rise) rather than as the diagonal lengths they really are. They should also be visualized in plan and elevation views. If thought of in these ways, all rafters are quite easily understood.

Jack rafters are simply shortened commons that intersect with a hip or valley or both. Hip jacks run from the top plate to the hip; valley jacks from the ridge to the valley; and cripple jacks between hips and valleys. Since they are shortened versions of commons, it makes sense to view them as types of commons.

To follow this discussion, you'll need some familiarity with the use of a framing square. I use a Stanley AR 100 aluminum framing square. It has the most complete set of scales and tables available, is easy to read, and because it is aluminum it will not rust. I also use "stair gauges," moveable clamp-on fixtures that allow the user to represent the units of rise and run on the tongue and blade (body) of the square. (I use Starett #111 stair gauges because they offer greater accuracy than General's brass "stair buttons.") I also lay out my plumb and level lines with a sharp #2 or #3 pencil, not a carpenter's pencil.

Laying Out a Hip Roof

Before we get into laying out and cutting jack rafters, let's review how a hip roof is laid out. For the system illustrated, the span is 20 feet, so the run of the common rafters is 10 feet.

Starting at the outside of each corner, measure in 10 feet (the length of the run) along the top plates and mark these points. These marks show the centerline position of the first and last common rafters, and the two end commons.

Next, lay out the centerlines of each common rafter, starting with the first common and marking the top plates at the appropriate distance (every 16 or 24 inches) on center. Following that, mark the commons on the opposite plate. Since each mark is for the center of the rafter, you'll need to square a line 3/4 inch off each centerline for the edge of each rafter. These marks can be transferred from the plates to the ridge.

Now you're ready to mark the hip jacks. These should be measured from the first commons, last commons, and end commons—working your way into the four corners. Keep the same on-center intervals.

Make a Pattern

Now select a straight and defect-free piece of rafter stock to make a pattern. Calculate and lay out the length of a common rafter on the pattern piece—complete with crow's foot (bird's mouth), and rafter tail. Cut and install all the commons and the ridge. But don't use the pattern for a common rafter, since it will also be a pattern for the jacks.

Next, lay out one of the hip rafters, cut it and test it, then use it as a pattern for the rest. Be sure to adjust the depth of the crow's foot on the hip rafters so that the top edges of the hip lie down in the same plane as the common rafters.

Most of us can get to this point in the framing process without too much difficulty. But now the jacks must be cut. In Figure 1, you can see there are six jacks at 16 inches on center. In the plan view, each is shorter by the same amount: 16 inches. That's because the hips are always at 45 degrees to the commons and jacks.

Laying Out the Jacks

The easiest way to figure the lengths of the jacks is to calculate and lay out their length on the common-rafter pattern. To do this, first find the "difference in lengths of jacks" on your framing square for the roof pitch and rafter spacing you are using. In this case (Figure 2), for a 9-in-12 pitch at 16 inches on center, the difference is 20 inches shorter than the previous one. The longest jack—measured on its centerline—will be 20 inches shorter than the common rafters.

The trickiest part here is finding the length of the first hip jack. Start by measuring along the top edge of your pattern piece, extending the hook of the tape past the end of the rafter to the theoretical center of the ridge. (This is easily done by nailing a piece of 3/4-inch scrap to the end of the rafter as in Figure 3a). Make a mark at 20 inches—the difference in length found in the rafter table—and square it across the top edge of the rafter.

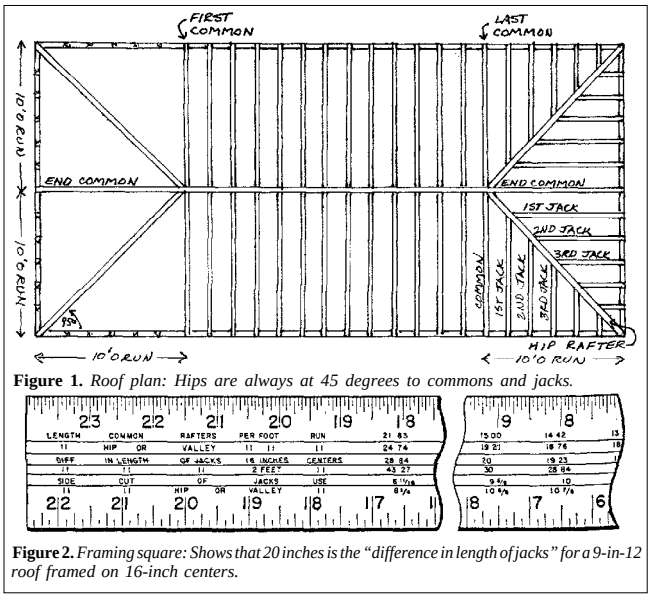


Figure 1. *Roof plan: Hips are always at 45 degrees to commons and jacks.*

Figure 2. *Framing square: Shows that 20 inches is the "difference in length of jacks" for a 9-in-12 roof framed on 16-inch centers.*

Now you have to adjust for the thick, ness of the hip rafter. To do this, make a second mark 1-1/16 inches past the first—measured on the horizontal. (You'll do this by dropping a plumb line down the face of the rafter, and measuring over to a second plumb line. One and one-sixteenth inches is half the diagonal thickness of the hip rafter, based on nominal 2x lumber.) Now square this second plumb line across the top edge of the pattern rafter (Figure 3b). Put an X where this line crosses the centerline of the rafter.

The next step is to mark the so-called side cuts. To do this; go back to the framing-square tables and find the number called "side cuts of jacks" under the appropriate pitch. Under 9 (for 9-in-12 pitch) we find the side cut is 9 5/8.

Adjust your framing-square stair gauges to 9 5/8 on the tongue (16-inch leg), and 12 inches on the blade (24-inch leg). Hold the square to the edge of the pattern and mark on the blade side a line through the X you just made. This diagonal line is your side cut (Figure 3c).

Finally, extend a line down the side of the rafter from the side cut to make your plumb cut (Figure 3d). This plumb cut now represents the length of the longest jack to its long mitered point. The second longest is 20 inches shorter, and so on.

If you were going to use this pattern as your first jack rafter, you would set your circular saw to 45 degrees and cut along the plumb line. But to use it as a pattern, you should instead cut it square along the plumb line, so it can be used to mark both left and right jack rafters.

A Pair of Jacks

All the same-length jacks should be cut together to ensure uniformity and accuracy. Begin with the longest and

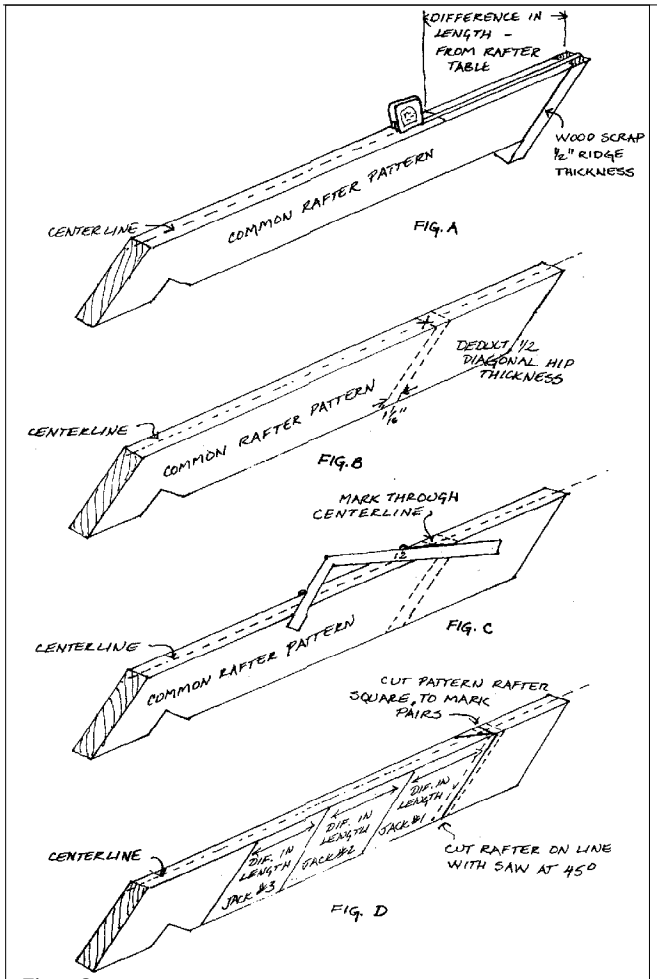


Figure 3. *Laying out hip jacks: Starting with the common-rafter pattern (a) mark difference-in-length-of-jacks. Next, subtract half the diagonal thickness of the ridge (b). Third, mark the appropriate sidecut angle (c), and cut on the plumb line (d) with the saw set at 45 degrees. (Or cut square on the plumb to make a jack-rafter pattern to mark left and right jack.)*

shorten the pattern by 20 inches for each successive jack. All pieces of each length should be in matching pairs, cut plumb at 45 degrees, and have the same crow's foot and rafter tail as the common rafters.

It's best to try the first pair of jacks of each length before cutting the rest. Jacks, like all rafters, should be installed by first nailing the crow's foot into the plate. But be certain to do them in pairs so that their upper ends line up at the hip directly opposite each other. This will automatically straighten the hip. The upper ends of the jacks should be nailed through the cheek into the hip.

Valley Jacks

Valley jacks are easier to lay out, because the cut is measured directly from the plumb cut at the crow's foot on your common pattern. There are no hips or ridges to adjust for.

A centerline is not necessary. Just mark the "difference in length," square the mark across the top edge, then draw the plumb cut down from the face (Figure 4). This line marks the long point of the miter. You can mark the side cut, as you did before, using the framing square and stair gauges. But if you are cutting with a power saw, it's not really necessary to mark the side cut. Just set your saw to 45 degrees and cut along the plumb cut.

As with the hip jacks, the pattern should be cut square (on the plumb line) to mark lefts and rights. Then the next shorter valley jacks are successively marked and pattern-cut.

Cripple Jacks

Finally, on a complicated roof you might encounter cripple jacks, which connect a hip and a valley. Cripple jacks are laid out similarly to valley jacks. Start with the last, longest valley jack (Figure 5) and use its plumb cut at the ridge as the long point of the side cut on the upper end of the cripple. If the intersecting roofs are the same pitch, cripples are of the same length. Unequally pitched roofs are another subject.

Jacks are not difficult to cut and install when using this method. All calculations and layouts are done only once on a pattern, and the first pair for each length is checked for accurate fit. The only tricky part is finding the length of the first hip rafter. This takes a little thought, but it guarantees proper on-center spacing from the full-length commons to the last jack. You'll appreciate that when sheathing and insulating—and particularly if the plan calls for exposed rafter tails. ■

Robert Adam is a member of the Association for Preservation Technology (APT)—an organization of contractors, architects, and others working in the field of preservation and restoration. APT has meetings and publications that help contractors improve their skills and knowledge of construction crafts. For more information, write Marylee MacDonald, SHC-BRC, One East St. Mary's Rd., Champaign, IL 61820.

Figure 4. *Valley jacks: Simply start with the common-rafter pattern, mark the difference-in-length segments, and cut with the saw set at 45 degrees.*

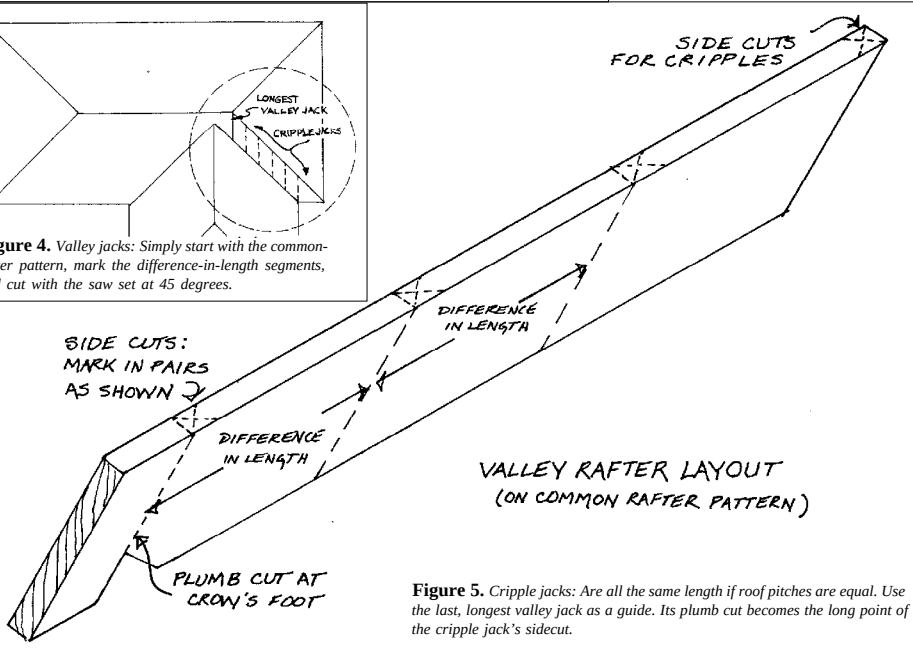


Figure 5. *Cripple jacks: Are all the same length if roof pitches are equal. Use the last, longest valley jack as a guide. Its plumb cut becomes the long point of the cripple jack's sidecut.*