Flat Roof Framing Options

by Don Gordon

These shortcuts create good drainage without a lot of complicated framing

Although there are several ways to frame a "flat" roof, none of them result in a truly flat roof. Even in mostly dry Southern California, where I have been production framing for over 15 years, you have to create a slight slope to get rid of rain water from the heavy, sudden storms we get. Otherwise, the water will pond and eventually cause leaks.

To give the illusion of a perfectly flat roof, many designers add a low parapet around the perimeter of the roof, which conceals the slightly pitched roof behind. The roof surface is designed to direct water to one or more drains behind the parapet wall.

Designers in my area commonly use two approaches to rooftop drainage (see Figure 1). One method is to use a two-part roof drain with a lower main drain and a higher backup drain, in case the low drain gets clogged. The other approach is to use a single drain with scuppers in the parapet as a backup.

Rip Strips for Tapered Rafters

On very simple, short-span roofs (over entryways, for example) where the rafter's strength isn't an issue, we rip a 1/8-inch-per-foot taper on the tops of the rafters to create the slope. As the span gets longer, we set the rafters flat, then attach long tapered "rip strips" to the top of the rafters to create the slope. A roof built with rip strips on top is quick and easy to frame because the ceiling underneath is flat, the wall plates are all one height, and the strips can be installed from above. We use a site-built jig to cut the rip strips with a circular saw (see "Rip-Strip Jig").

Sometimes the plans call for two layers of plywood, one applied directly to the flat roof rafters, followed by rip strips and a second layer of plywood applied over them. With the approval of the engineer, however, we're sometimes able to apply the strips directly to the rafters and save one layer of plywood. Because we build in a seismically active area, the engineer has to be sure that there is adequate transfer of lateral forces from the shear walls to the roof diaphragm. Full-depth blocking over shear walls, anchored with Simpson A-35 clips, can often solve the problem (Figure 2).

Single-Slope Roofs

The simplest roofs have full-length rip strips nailed directly to the rafters to create a single slope (Figure 3). We try

Figure 1. *A low parapet wall (left) conceals the slightly pitched roof behind, giving the impression that the roof is perfectly flat. A two-part drain provides for runoff. The main drain, protected by a leaf screen, is plumbed into the home's main waste line; the smaller drain will have an extension to provide backup drainage in case the main drain clogs. The author sometimes places a "cricket" in a corner, to direct ponding water back toward the drain (right).*

to limit the high end of the taper to 3 1/2 inches — the width of a 2x4. Tapering a 2x4 at 1/4-inch-per-foot slope allows a 14-foot run. We occasionally use 2x6s for slightly longer spans, but if the roof span gets much wider we'll create a low-pitched gable running to two sides of the roof, or a hip, which directs water to all four sides (more on hips below).

Other options for single slopes. Another way to frame a slope on a flat roof is to sister a sloping roof rafter onto each flat ceiling joist. This works fine for small roofs, but on large spaces, sistering wastes lumber and takes more time than ripping strips.

It's also possible to get custom tapered I-joists and trusses. We've used these on everything from small decks to large buildings. The only drawback with these is that they must be ordered way in advance, which makes careful job planning very important. If you are one joist short, it can cost you weeks of production.

Figure 2. *The plans often call for a fully sheathed flat roof to be covered with a second, sloping layer of sheathing (above). On smaller roofs, it is sometimes possible to save the second layer of plywood by nailing the rip strips directly to the rafters. In this case, the engineer may specify full-depth blocking and metal clips over shear walls to ensure transfer of shear forces into the roof diaphragm (left).*

The Rip-Strip Hip

Using rip strips, we can create a hip effect over a flat roof deck, directing water in four directions. With careful layout, the rip strips can even be installed before the roof joists are installed. Here's how we do it:

The outside rafter is installed flush with the outside face of the wall and has no rip strips attached (Figure 3, bottom). The second rafter gets a short piece of rip strip — 15 1/4 inches for 16-inch on-center framing — tacked on each end, the second joist gets a 31 1/4-inch piece at each end, and so on. We then measure the height of the rip strips at their high ends and fill in with continuous flat strips ripped to that dimension.

We sheathe this low hip roof as if it were flat. Where the plywood crosses a hip, we snap a line and cut along the hip. The waste piece falls into place on the other side of the cut.

Double-Pitched Roof

We often build garage roofs that slope to a roof drain in one corner of the roof. To build the roof so it slopes to one corner, the trick is to first cut and set the

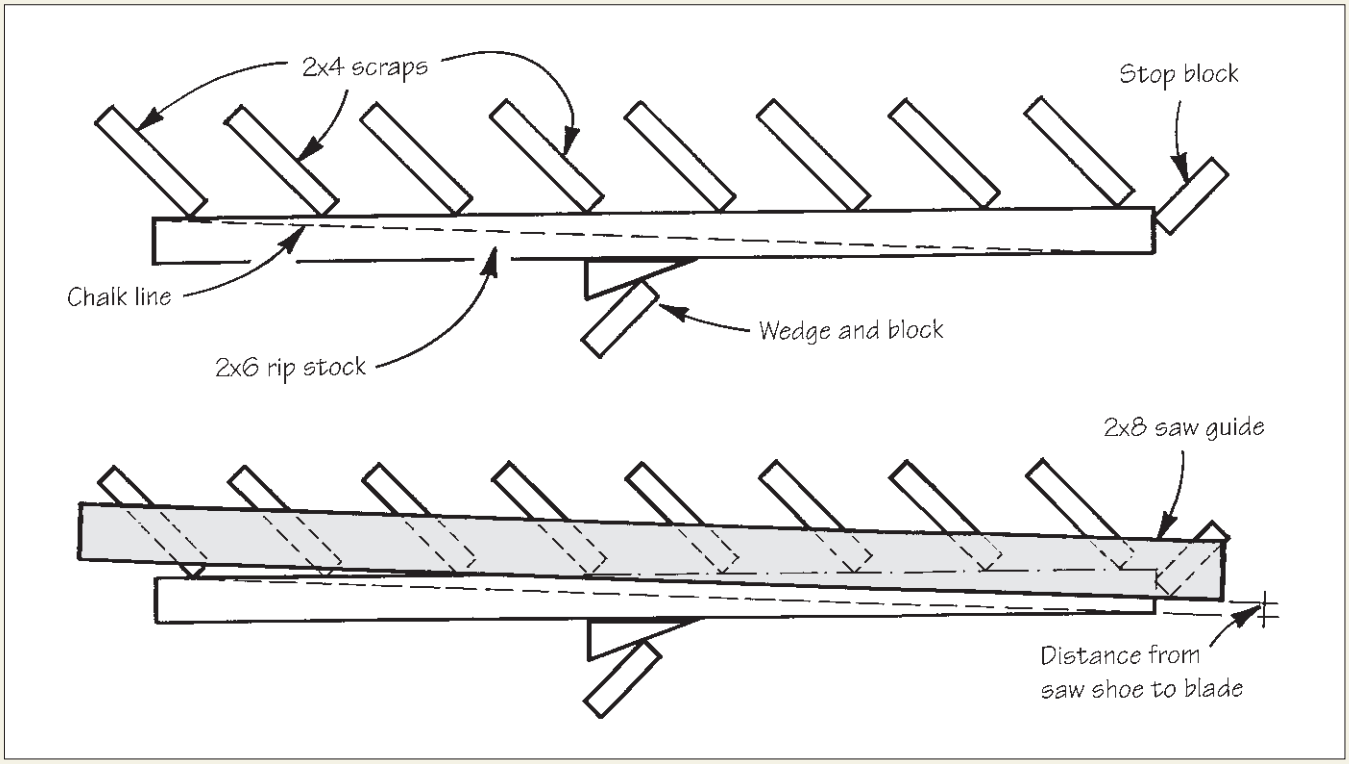
Quick Rip-Strip Jig

Measuring, snapping lines, and cutting rip strips one at a time is too time-consuming, so we devised a site-built jig that allows us to cut tapers quickly and accurately. Young guys can work right off the roof deck, but when we have a lot of ripping to do we usually work from a 2x12 set on sawhorses. Here's how to do it:

- Temporarily tack a straight 14-foot 2x6 to the work surface.
- Nail short scraps of 2x4 to the work surface at a 45-degree angle to the 2x6, with one corner touching the 2x6. This holds the material being ripped while preventing sawdust buildup.
- Nail a block at one end of the work surface to act as stop.
- Find a straight 2x6 and snap a line diagonally from corner to corner along its length.
- Nail another block to the work surface, this time spaced far enough away from the rip stock to allow for easy removal and replacement of rip stock. Cut a wedge that fits between this block and the rip stock. This secures the work and also removes any crown from the stock.
- With the chalked 2x6 wedged in place, nail a straight 2x8 on top of the 2x4 blocks to act as a saw guide. Set the 2x8 so the edge of the saw shoe will ride against it while the blade cuts the chalk line. (Put a couple layers of scrap building paper between the 2x4s and the 2x8; this acts as a spacer to allow the rip stock to slide easily under the 2x8.)
- To use the jig, rip the chalk line on the original 2x6. Remove the wedge, remove the two rips (which both taper from 0 to 5 1/2 inches in 14 feet), wedge a new 2x6 into place, and have at it.

— *D.G.*

A carpenter rips a long taper using the site-built jig.



This site-built jig speeds up the process of cutting multiple rip strips. The scrap 2x4 stop blocks are set at an angle to allow sawdust to clear.

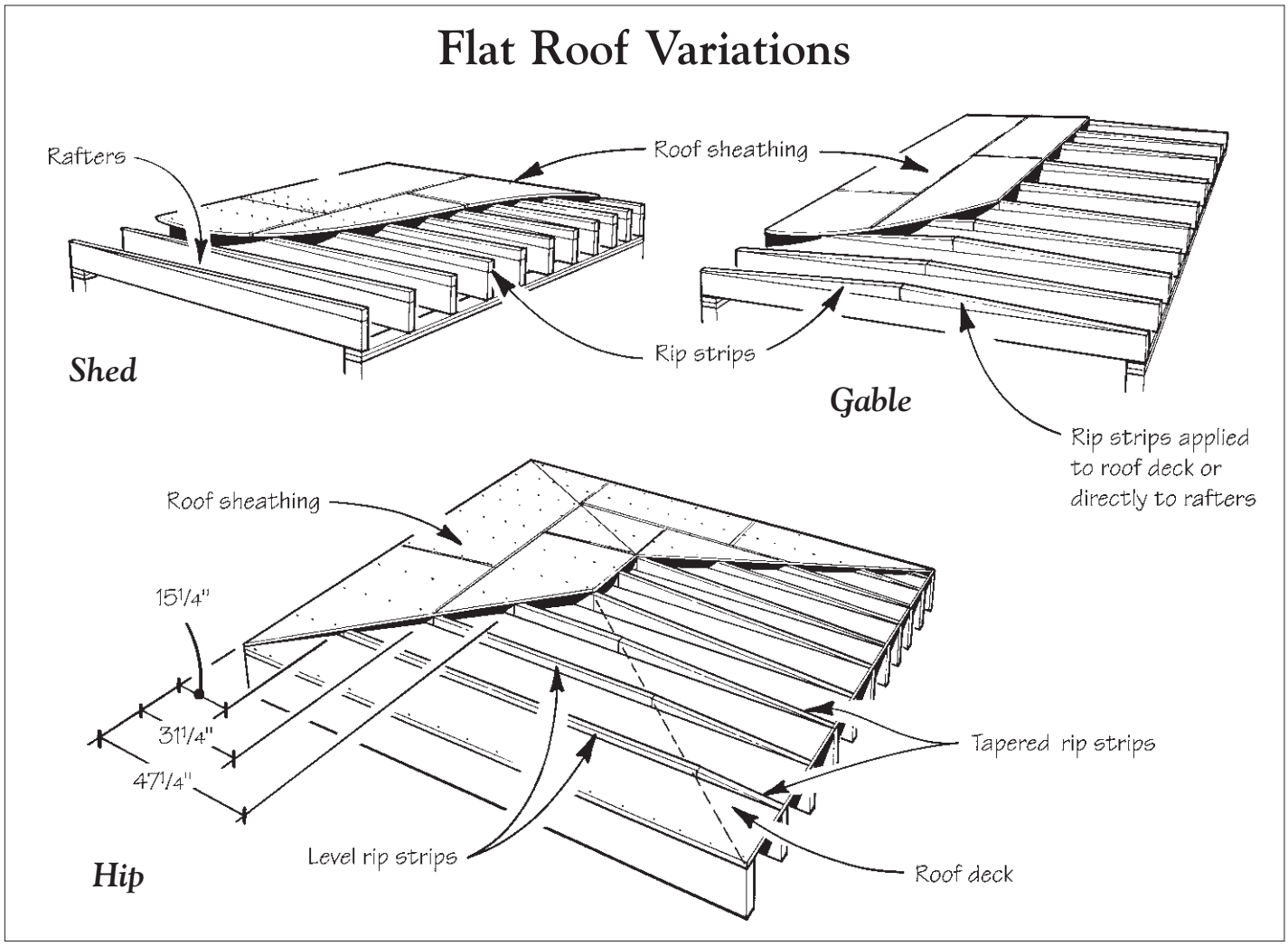


Figure 3. *On narrower flat roofs, the author applies rip strips to create a single-pitch shed roof, or a gable slope (top). On large flat roofs, a hip profile (above) often works better to direct water to multiple roof drains. Since there are no hip rafters with a rip-strip hip, all the rafters run in the same direction, and the plywood can be laid as if the roof were flat.*

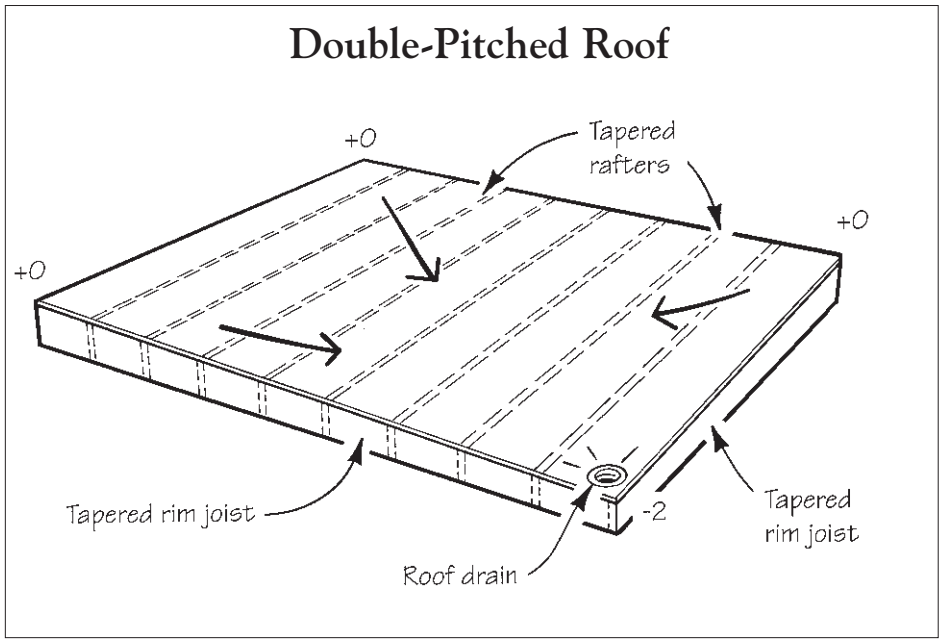


Figure 4. *For garages and other lightly loaded small flat-roof areas, the author sometimes frames a roof that pitches toward one corner. He begins by installing two full-size and two tapered rim boards, then scribes the rafters to one of the tapered rims. This results in a roof that pitches from all sides toward the corner drain.*

four outside rim joists to form the slope, and then custom taper each rafter to fit inside the rim boards (Figure 4).

The two rim boards opposite the drain are set level and kept at full depth. The other two rim joists start out at full depth but taper toward the corner drain at the rate of 1/4 inch per foot. The tapered joists are laid out by simply measuring the height of the tapered band joist at the layout marks, snapping a sloping chalk line on each joist and cutting the taper.

When you lay the sheathing on a roof like this, don't be surprised if the plywood doesn't want to lay perfectly flat: The double slope creates a slight bow in the roof surface, but with a little weight, the plywood will conform. ■

Don Gordon has specialized in production roof framing for the last nine years. He is a principal of Gordon Fiano, which builds custom homes in Santa Barbara, Calif.