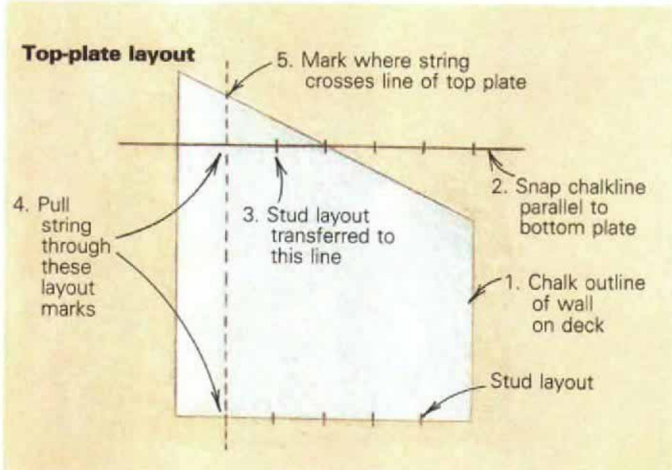
Balloon-Framing a Rake Wall

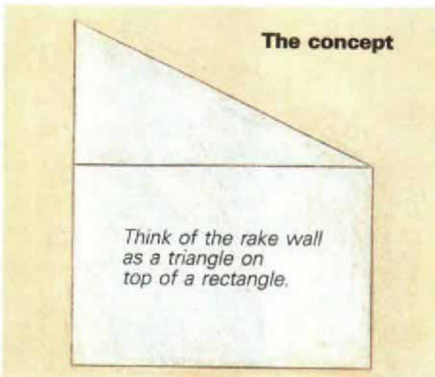
How one builder stiffens walls by running studs from floor to roofline

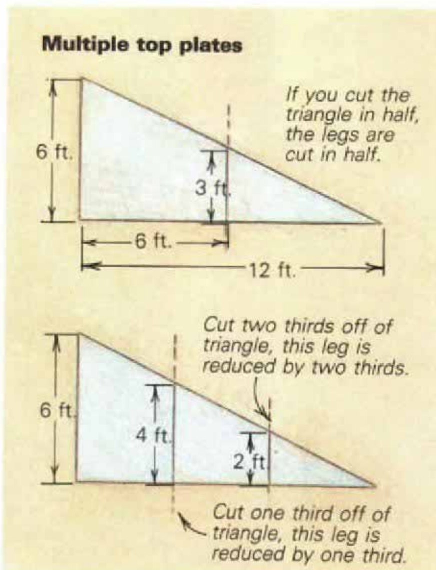
by Sean Sheehan

Here in Montana, the wind is something you can count on. The broad mountain valleys that grace this state are, among other things, nature's wind tunnels (the high plains are called windswept for good reason). A builder must contend with the wind during all phases of a project, and any building should be designed with the wind in mind.

One technique that our crew uses to increase the wind resistance of a rake wall (a wall whose top plate follows the incline of the roof) is balloon-framing. Whenever we can, we extend the rake-wall studs all the way from the floor to the roofline rather than frame a conventional wall and stand a truss on it or fill in above the wall with gable-end studs.







Balloon- vs. platform-framing—In balloon-framing, studs run continuously from foundation to roof. The second floor, if there is one, hangs from the studs. In platform-framing, which evolved from balloon-framing as a safer and more efficient form of construction, the second floor is built on top of the first-floor walls. Then the second-floor walls are framed on top of the platform (hence the name). With this system the top plates of the first-floor walls serve as firestops; in balloon-framing, firestops have to be added. Platform-framing also requires shorter studs, which are easier to handle, and provides a safe platform (the second floor) on which to work, rather than requiring the carpenter to build walls 16 ft. in the air.

Nonetheless, there are times when balloon-framing makes sense. I consider it essential when building a tall, window-filled rake wall in a home with high cathedral ceilings. Even when sheathed with plywood, the platform-framed version of this wall can literally billow in the wind. The top plates that divide a platform-framed wall from the rake-wall studs above it create a break line. When the wind pushes against such an arrangement and there is no interior structure (such as a second floor or a partition wall) to resist it, the wall flexes at the break line.

The structural integrity of balloon-framing can be undermined by careless placement of windows and doors. We try to ensure that studs in the center third of a rake wall are left intact. If this is impossible, we double up king studs, or sometimes triple-stud the center of a wall if there are windows on both sides of center. The object is a stiffer wall, so we leave enough of the studs in one piece to achieve this goal.

We use two basic methods to balloon-frame a rake wall. If we have the space, we build it on the first-floor deck. We usually divide a peaked wall into two wedge-shaped walls and nail them together after the walls are up. This provides more work space on the deck and puts *a* double stud in the center that runs to the peak. If we don't have room on the deck, then we build the wall in place, or "in the air," as we call it.

First, the math—Usually, the eave height and the length of the wall are known, and I have to determine the peak height, the length of the top plate and the length of each stud. The peak height is determined by the pitch of the roof we're building. Let's assume a 6-in-12 pitch, a wall length of 12 ft. and an eave height of 8 ft. Over 12 ft., a 6-in-12 pitch will rise 6 ft. Add 6 ft. to the height of the eave for a peak height of 14 ft. To find the length of the top plate, it's helpful to think of the wall as a right triangle on top of a rectangle (center left drawing). The rectangle is 12 ft. by 8 ft. (the length of the wall by the height at the eave), and the right triangle is 6 ft. high and 12 ft. long with an unknown hypotenuse (the top plate). I use the Pythagorean theorem ($a^2 + b^2 = c^2$) to find the length of the top plate.

In this case, a = 6 (the length of one leg) and b = 12 (the length of the other leg). Plugging these numbers into the formula, you'll find that c^2 must be equal to 180. Now all you need is to find the square root of 180, which is 13.416 ft., or 13 ft. 5 in.

On the deck—Once I have the length of the top and bottom plates and the height of the wall at both ends, I chalkline a full-scale pattern of the wall on the deck, being careful to keep the pattern square.

To mark the stud locations on the top plate, another carpenter and I snap a line parallel to

Drawings: Michael Mandarano

the bottom plate that crosses the top plate somewhere near the middle (top drawing facing page). Next we transfer the bottom plate layout to this line. Then we pull a string through the stud layout of both the bottom plate and this line. We mark the points where the string crosses the line of the top plate.

Once the layout is accurately transferred to the top plate, it's a simple matter to measure stud lengths. We refer to the measurement as being to the "long side" or the "short side" to avoid confusion, and if we're building more than one wall from the pattern, we write the measurements on the deck below each stud.

In the air—When there is no deck on which to lay out the wall, we take a different approach. If the wall is short enough that the top plate can be cut from a single piece of lumber, we simply cut the plates and the end studs, nail these together and erect this frame. Once the frame is up and braced plumb, we lay out the studs on the bottom plate. If the wind isn't blowing, the layout can be transferred to the top plate with a plumb bob (photo right).

If the wind *is* blowing, we nail a 2x4 horizontally across the outside of the frame, level with the top of the shortest stud. We then transfer the stud layout onto this. Next we stretch a string from the bottom plate layout, through the layout on the 2x4, to the top plate and mark where the string crosses the top plate. If we don't trust the straightness of the top plate (and we never do), we pull a string along its top and use a temporary stud to correct the bow.

If the wall is long enough to require a two- or three-piece top plate, the wall can be equally divided. The lengths of the studs that will stand beneath the breaks in the top plate can be determined easily with a little math.

Let's return to the hypothetical wall: the length is 12 ft., the shortest stud is 8 ft., the longest stud is 14 ft., and the top plate is 13 ft. 5 in. If we were to break the top plate into two equal pieces 6 ft. 8½ in. long, the length of the stud that would stand under this break in the plate would be equal to half the difference between the length of the shortest and the longest stud, plus the length of the shortest stud, or 11 ft. Again, it helps to use the triangle/rectangle analogy. Simply put, if you cut the triangle in half, the legs will also be cut in half (bottom drawing, facing page). This works with any division.

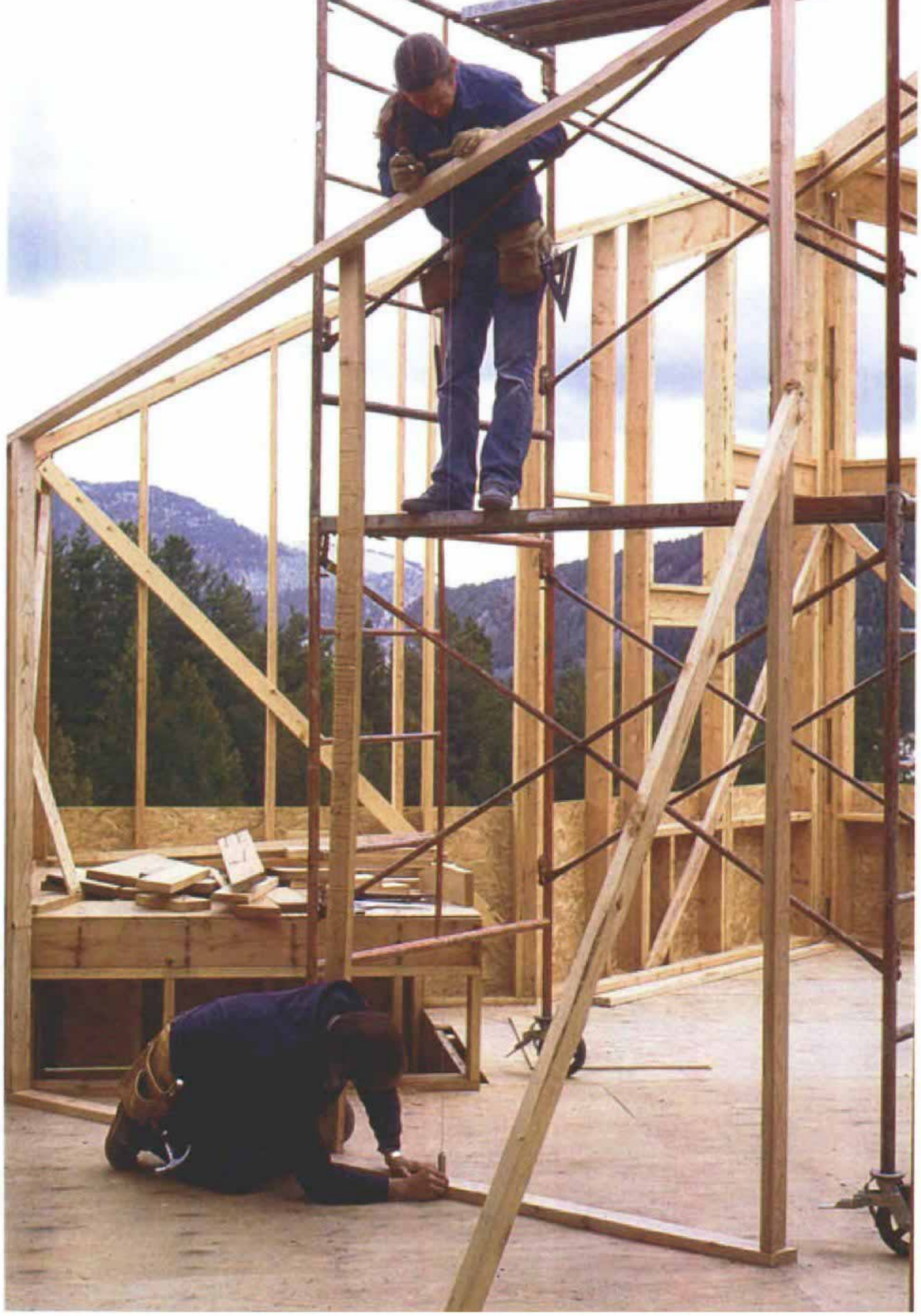
When this method is used, the wall usually ends up with an extra stud in the center because the layout almost never coincides with the exact center of the wall. Sometimes the center stud interferes with the installation of another stud, but still doesn't fall on the layout. In this case, we simply add another stud onto the side of the center stud closest to the layout. Keep in mind that if you want the break to fall in the center of the stud, the measurement you arrive at mathematically will be to the center of the angled cut at the top of the stud. This is the only time we deal with a measurement that is neither the "long side" nor the "short side."

Opposite sides of a peaked wall should be identical, and when building "in the air," measurements can be transferred from the top plate on one side to the top plate of the other. If things start coming out "a little off," find out why. Geometry is an exact science, and if the studs that fit on one side are suddenly ¼ in. too long on the other, resist the temptation to just squeeze them in, or push them over and figure it's close enough. Chances are good that ¼ in. isn't nearly close enough.

It's very important to maintain close tolerances when balloon-framing. Particularly on steep pitches, an error in stud length of ⅛ in. can cause a considerable bow in the top plate. This is also true with regard to placing studs on center, and to a lesser extent, it holds true with top plate length. An error of ½ in. can really throw things out of whack. Double-check your math to be sure the figures are right. Once the wall is up, we usually tack the bottom plate in a few places, brace it and immediately plumb it. When the ends are plumb, we run a quick check on each stud with a 5-ft, level.

Finally, when the wall is permanently nailed and braced, we snap a line the length of the wall at 8 ft. from the floor to serve as an installation reference for the fire blocking. In the event of fire, this will prevent a wall cavity from behaving like a chimney and increasing both the rate of spread and intensity of the conflagration. We position the blocks in an alternate pattern: one above the line, the next below, so we can nail through the studs and into the blocks. There is a danger of bowing the studs with overdimension blocks, so here again, we maintain a high standard of accuracy.

Sean Sheehan is a builder in Basin, Montana. All photos by the author.



When there isn't room on the deck, Sheehan's crew builds rake walls "in the air," standing up the basic frame, then filling in the studs. After laying out the bottom plate, they use a plumb bob to transfer the layout to the top plate, provided the wind isn't blowing too hard.