CASE IN POINT

How I Learned to Love Balloon Framing

by Paul Hanke

Several years ago I had occasion to help a young couple in nearby Peacham, Vt. design and build a house that taught me a valuable lesson about when to use balloon framing. During the design stages everything sent smoothly. Working from the owners' sketches and ideas we developed a plan for a modified saltbox-style house that was contemporary in feeling but reminiscent of traditional New England farmhouses. The final design was for a two-story house with a 1 1/2-story wall along most of the south side, and a one-story wall on the north, resulting in the desired semi-saltbox appearance when viewed from the gable end. A steep roof pitch and clapboard exterior added to the traditional feeling. Everyone was happy, and I retired to my drawing board to prepare construction drawings and work out structural details.

As I laid out the main structural section, I drew one-story walls for the first level, second-floor joists with a supporting beam at midspan, and a half-story kneewall on the south side to create the saltbox effect (see illustration). Two-by-twelve rafters would rest on top of the kneewall, rise at 45 degrees to the ridge, and then slope downwards to the edge of the second floor on the north side. Horizontal collar ties would be installed in the conventional location, about one-third of the way down from the peak, to prevent rafter spreading.

When the drawings were complete, a crew was formed of the owners, a contractor friend of theirs, a brother-in-law, and myself, and construction began. Perhaps I should have expected a major snafu somewhere along the line, since several events occurred which could have been read as omens. First I strained my back while framing the first floor and had to take a few days off to recuperate. Then, just before I was ready to return to work, I received an embarrassed phone call informing me that all the 2x6 first-floor walls had been framed on 16-inch centers instead of the 24 inches specified on the drawings. Oh well, the show must go on.

I returned to work in time to help frame the second floor. Once the plywood deck was in place it was time to erect the kneewall on the south side so that roof framing could begin. I brashly assumed responsibility for building the kneewall. A helper and I framed it in platform fashion on the deck, sheathed it, stood it up, plumbed it, and checked for straightness along the top plate with a taut string. After a few minor adjustments I was satisfied with the job, and roof framing could begin.

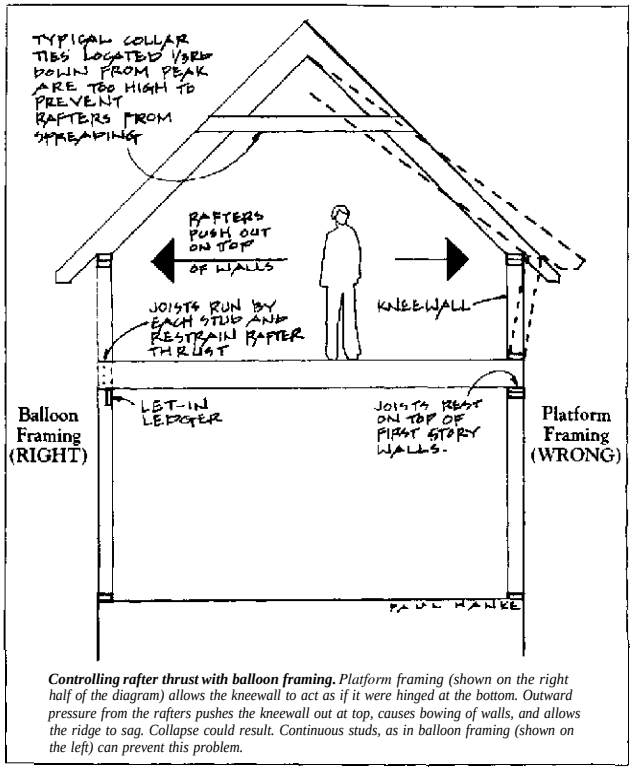
Instead of using a conventional ridge board, we cut all the rafter pairs, assembled them on the deck, nailed the collar ties in place, applied a glue/nailed plywood splice plate at the peak, and then lifted each set up onto the kneewall. The completed assemblies were heavy and awkward, requiring all-hands-on-deck for lifting. We all agreed we'd never do it that way again. By the end of the day all the rafters were raised, but not in place, and darkness was drawing near, along with gathering storm clouds. For overnight security we slid all the rafters to one end, leaned them against an end wall, and lashed the tops together with a rope. Needless to say, the endwall curved outwards noticeably at the top from the weight of the leaning rafters, which was another sign that I ignored. A few temporary braces to a lower story roof reinforced the end wall, and we all retired for the evening, hoping the rafters would still be there in the morning. They were.

The next day we laid out 16-inch centers along the floor edge and top plate of the kneewall. Then we delicately walked each rafter assembly out to its proper position, toenailed it in place, and installed temporary braces.

I'm not exactly sure when we first noticed the bow in the kneewall, but it was sometime after the rafters were in place and before we got too far with the plywood roof decking. At that time the pressure exerted by the massive rafter assemblies alone had caused the kneewall to deflect out in the middle of the wall by about 3/4 inch, with no sign that it would stop there. Only the end walls were keeping the whole wall from toppling over until we could devise some first aid to keep it from getting any worse, and then work out a long term cure.

Soon the entire crew had stopped work and gathered around to gaze at the problem and discuss possible solutions. First aid materialized in the form of a come-along, which one crew member fortunately had in his tool collection. We looped a chain around the top plate at the center of the kneewall, attached the other end of the come-along cable to the north wall below one of the rafter tails, and cautiously began ratcheting. Ever so slowly, the kneewall began to come back in to where it belonged, accompanied by much creaking and groaning of lumber. The double top plate was stiff enough to permit us to straighten the whole wall by pulling in the center, which was lucky, since we only had one come-along.

Once the wall was pulled back into place and stabilized, we had some breathing space to think of a permanent solution, but there was still some tension (pardon the pun) in the air. About that time the old farmer who lived up the road came along, as he often did in the afternoon, to see how we were doing. After silently watching the scene for a few minutes, the asked in typical Vermont fashion, "What'cha doing?" After we explained the problem and the proposed solutions to him, he thought for a minute and said, "Well,. . . I've seen that problem (bowing walls) on old houses before, but I've never seen it on a new one."



Controlling rafter thrust with balloon framing. *Platform framing (shown on the right half of the diagram) allows the kneewall to act as if it were hinged at the bottom. Outward pressure from the rafters pushes the kneewall out at top, causes bowing of walls, and allows the ridge to sag. Collapse could result. Continuous studs, as in balloon framing (shown on the left) can prevent this problem.*

Preassembled rafter pairs lean on the gable-end wall and await final positioning. After they were set in place, the kneewall bowed out 1/2 inch in the center and might have kept going without the aid of a come-along and a strategically placed brace.

After a good laugh, we turned our attention to permanently bracing the framing. With the wall more or less back to where it belonged, we simply attached a diagonal brace from the top of a stud near the center of the kneewall, running downward through the floor where we secured it to a floor list. One brace seemed to be enough, since no further movement was noticeable after we released the come-along. Fortunately an interior partition was planned for that location, so the brace would be concealed with a wall.

The whole problem, of course, was caused by unrestrained outward thrust due to the pressure of the rafters leaning on each other. The situation was complicated by the fact that the kneewall acted just as if it were hinged at the bottom, which in effect it was. Normally attic joists would tie rafters together at the tops of second-floor walls and prevent the problem from occurring. In our situation, and many others which I have seen since then, such horizontal restraint is impossible, since horizontal ties would be so low that they would go directly through living space. In such cases balloon framing is the solution of first choice. A balloon-framed wall with continuous 12-foot studs from plate to plate (instead of an 8-foot wall with a kneewall on top) would have been securely tied to the opposite wall by the second-floor joists.

In retrospect it seems ironic that I designed the problem into the house in the first place. I was aware of the problem of outward thrust, and of balloon framing techniques, but never really connected the two at the time I did the drawings, relying instead on my erroneous faith in collar ties. To make my embarrassment worse, the upstairs of my own house was built (by someone else) by adding a kneewall above an existing one-story garage. In the middle of each kneewall are two diagonal braces which protrude prominently into the floorspace, despite the fact that the roof also has collar ties near the peak. Every day, I worked on the drawings in my office, in full view of the braces and vaguely aware of their purpose. Unfortunately it never occurred to me that I would soon need to use them myself unless I took advantage of balloon framing. Live and learn. I'm pleased to say that I've never made that particular mistake again, and I hope you won't either.■

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