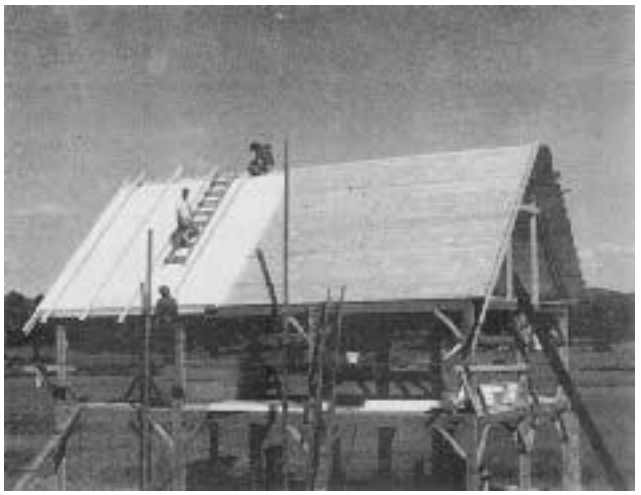


Kondor's hybrid roof system has 2-by nailers over 5 1/2 inches of foam over 1x8 T&G decking. The 2-by nailers create an ample ventilation space.

MYSTERY *of the* GHOST LINES

by T. Wayne Kondor

An innovative cure for buckled shingles

During four years of building post-and-beam houses in Vermont, I have been working with the technology of stressed-skin panels. In the early days, getting the system perfect the first time was unusual. Now, with 23 houses completed—all with stressed-skin paneling—it might be worthwhile to review the evolution of techniques we developed for using the panels.

The first house I ever built using panels was my own. Once I had constructed the foundation deck, I built the panels in the basement. The panels were 7/16-inch Aspenite with 5 1/2 inches of expanded polystyrene (EPS) foam and 1/2-inch drywall, all laminated with a water-resistant white glue. Within a month, a crew raised the frame, I installed the panels, and we were shingling the roof.

That was in November. The following spring, they first appeared—vertical lines of buckled shingles, not just randomly but every four feet. They were directly over each rafter and over each vertical panel joint. Although the roof did not leak, it looked like hell.

The Theories

I began to theorize the cause. The frame was constructed with the common-rafter system, with rafters four feet on center. My first theory was that water vapor was escaping through the joints where the panels met over each rafter. The spray foam we had used to seal the panels worked only about half the time because of the cold weather.

In making the panels for later houses, I switched from Aspenite to oriented-strand board (OSB), and began caulking all the joints on the roof with silicone sealer. The buckling of the shingles still occurred, only slightly less noticeably. My new theory was that water vapor leaking up between the panels was swelling the OSB and causing the shingles to buckle.

Now we come to the house that became a turning point.

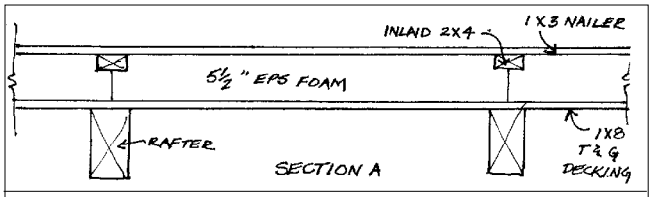
The specifications called for a cedar-shingle roof with ventilation under the shingles. A friend of mine had just finished putting a wood roof on a post-and-beam house. The way he vented it was interesting and worth copying.

Instead of using stressed-skin panels, he simply placed blocks of EPS foam on the roof over 2x6 tongue-and-groove boards nailed to the rafters (again, using the common-rafter system). To secure the foam, he inlaid a 2x4 into the foam over each rafter. The top of each 2x4 was flush with the foam. To secure it, a pole-barn nail was put through the 2x4, making the connection to the rafter. From there, 1x3 nailers were placed 5 inches on center, running horizontally across the roof, and nailed four feet on center into the inlaid 2x4. Gable venting was provided. (See Section A.)

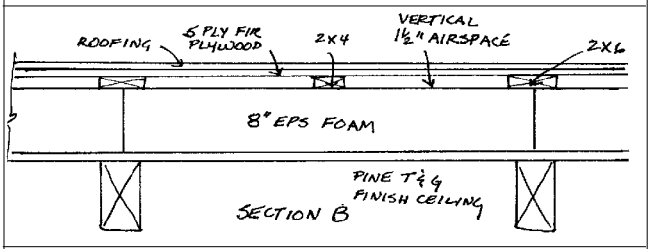
We were all set to try this when we encountered a classic construction occurrence: the owners changed their minds. They now wanted an asphalt roof, which meant we had to install solid decking over the 1x3s. We decided to lay the OSB horizontally this time. Unrelated to this, we wanted to see if the horizontally vented roof would solve the buckling problem by getting rid of any escaping moisture before the OSB could swell.

A remarkable thing happened. The shingle buckling still occurred—but now only eight feet on center. We had solved half the problem!

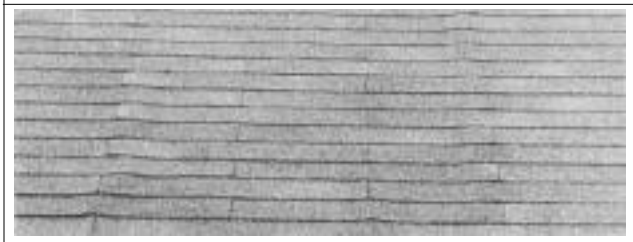
This completely confused us. We speculated that a horizontally vented roof was ineffectual, and the OSB was unstable. For subsequent houses, we eliminated the ventilation and switched to five-ply fir plywood for the panels. Although the plywood was much better to work with and there was a noticeable improvement in the shingle-buckling problem, the vertical lines were still visible.



Section A. *Vented horizontally between the 1x3s. This detail inexplicably cured half the buckling problem—every other row!*



Section B. *The new roof detail with vertical went spaces eliminated all problems with buckled shingles.*



The buckled shingles formed unsightly lines 4 feet on center—lining up with the rafters and vertical panel joints. The cause is still unknown.

I heard an interesting theory recently [see last month's *NEB]* that blamed the wrinkling roof shingles on the lengthwise shrinkage of roof timbers. Initially, this seemed to make sense. It certainly could explain the strange effects of laying the OSB horizontally instead of vertically. If the beams spanning the length of the house shrank collectively—say, an inch or more over a distance of 40 feet—this might cause the panels (and, in turn, the shingles) to buckle.

Looking for additional evidence to support this theory, I revisited a number of the houses with problem roofs. The theory did not hold up. In talking with the owners, and in observing my own roof, the consensus was that the shingles rose and fell with varying levels of sun intensity or temperature, although we were never able to predict the occurrence. Sometimes the bulges were barely visible; at other times they were obvious. I also expected to see distortions at the inside and out-

side corners where the panels met, but I did not.

The Solution

We never did figure out why the shingles buckled, but we solved the problem. In the process of building another house with a cedar-shingle roof, we designed a system that allowed a vertical air channel between the EPS foam and the shingles, utilizing full-length soffit and ridge vents.

We decided to try this system on roofs that were to receive asphalt shingles. We laid down a roof deck of 1x8 T&G pine, on top of which we laid out the blocks of foam. This time, instead of inlaying the 2x4 into the EPS foam, we laid a 2x6 vertically up the roof on top of the foam over each rafter, spiking through the 2x6 into the rafters. Next we glued a 2x4 flat on the foam two feet on center between each 2x6. We then sheathed the entire roof with five-ply fir plywood (instead of the 1x3 nailers) using H-clips to help in spacing. This created a clear 1 1/2-inch vertical air space. (See Section B.)

Although this may seem labor-intensive, it proceeds quickly because of the light weight of the individual components. And it has proved to be cost-competitive. But best of all, we never saw the shingles buckle again!

It also created other tangible benefits. On roofs where there had been considerable ice buildup, we never saw even one icicle on the drip edge. Additionally, the structure we created to support the finish soffit and fascia trim boards was more than adequate to support gutters. (See Section C.)

One last digression: My apprenticeship in college involved my reprogramming a local company's accounts-payable computer system. Three weeks into the project, I encountered a software bug. Although I found—and eventually corrected—the bug, I never completed the project because I ate up valuable time as a conscientious academic trying to solve a problem I could have worked around. Yet I learned a valuable economic lesson: First make it work, then figure out on your own time what went wrong.

Still, as we bask in the success of a roofing system we consider second to none, I would love to know why those shingles buckled. If anyone ever figures it out... ■

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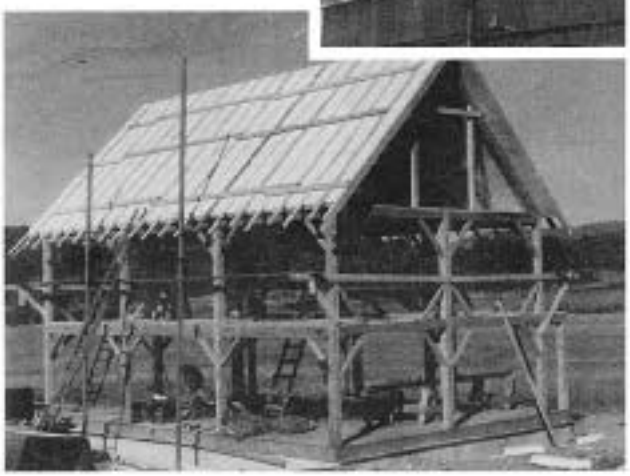
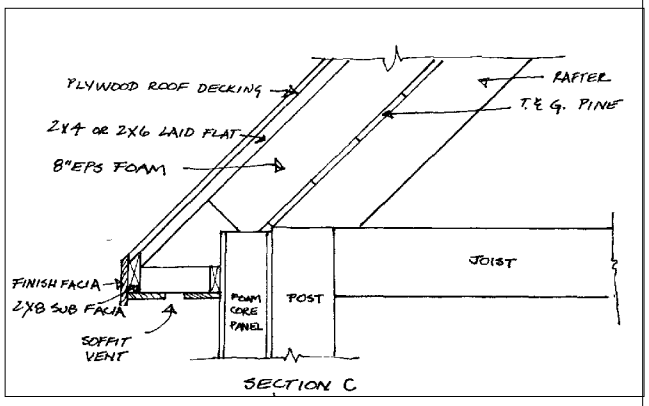


The roof (above), ready for sheathing, had 2x6 nailers over the rafters and 2x4 nailers in between. The eave (inset) is sturdy enough to support gutters.



Section C: *The new roof section provides good thermal integrity, full ventilation, and a solid eave.*