

A Nearly Perfect Cathedral Ceiling

by Richard Harrington

Cathedral ceilings are an increasingly popular design option, because they provide a feeling of spaciousness that flat ceilings cannot. But to the designer and builder, cathedral ceilings pose several problems, including moisture control, providing adequate ventilation, and meeting minimum insulation requirements.

The design offered here — I call it a “no-fault” cathedral ceiling — meets those challenges while also providing a space for mechanicals, an inside and outside radiant barrier, and the long-spanning advantage of wood I-joists (see Figure 1).

Construction Details

I tried out the design on an addition for my own home. I used 9½-inch I-joists, as required for the span, and an LVL ridge beam. I cut the rigid insulation — foil-faced polyisocyanurate — on the table saw, ripping each piece ⅛ inch undersize. There’s very little waste, as the web of the wooden I-joist provides just enough thickness to make up for the saw blade kerf. (A standard 48-inch-wide foam board will provide two pieces for 24-inch rafter spacing, or three pieces for 16-inch on-center rafters.) The foam board required a plumb cut at the ridge board, which was quite easy to make with a handsaw.

I used 3-inch- and 2-inch-thick foam board, based upon availability at my local lumberyard and the R-value I was trying to achieve. I used two methods to get the foam board in place. The first was to slide the pieces in from the soffit (Figure 2, page 62). One person pushes from the outside while another person on the inside maneuvers them into final position. The second method was to insert the boards from the inside, which was accomplished by using a spreader stick to splay the bottoms of the wooden I-joists slightly (about ½ inch) and then tilting the boards into the rafter

cavity diagonally.

After getting the upper layer of foam into place, I taped the joints between the pieces with sheathing tape (oriented polypropylene with acrylic adhesive) to prevent air and moisture leaks. Then I installed the lower layer of foam and taped those

seams as well.

The rigid insulation is held tightly against the top flange of the wooden I-joist with a gasket made of ½-inch foam board. I cut the gaskets ¼ inch taller than the space left between the bottom side of rigid insulation and the top of the lower wooden I-joist

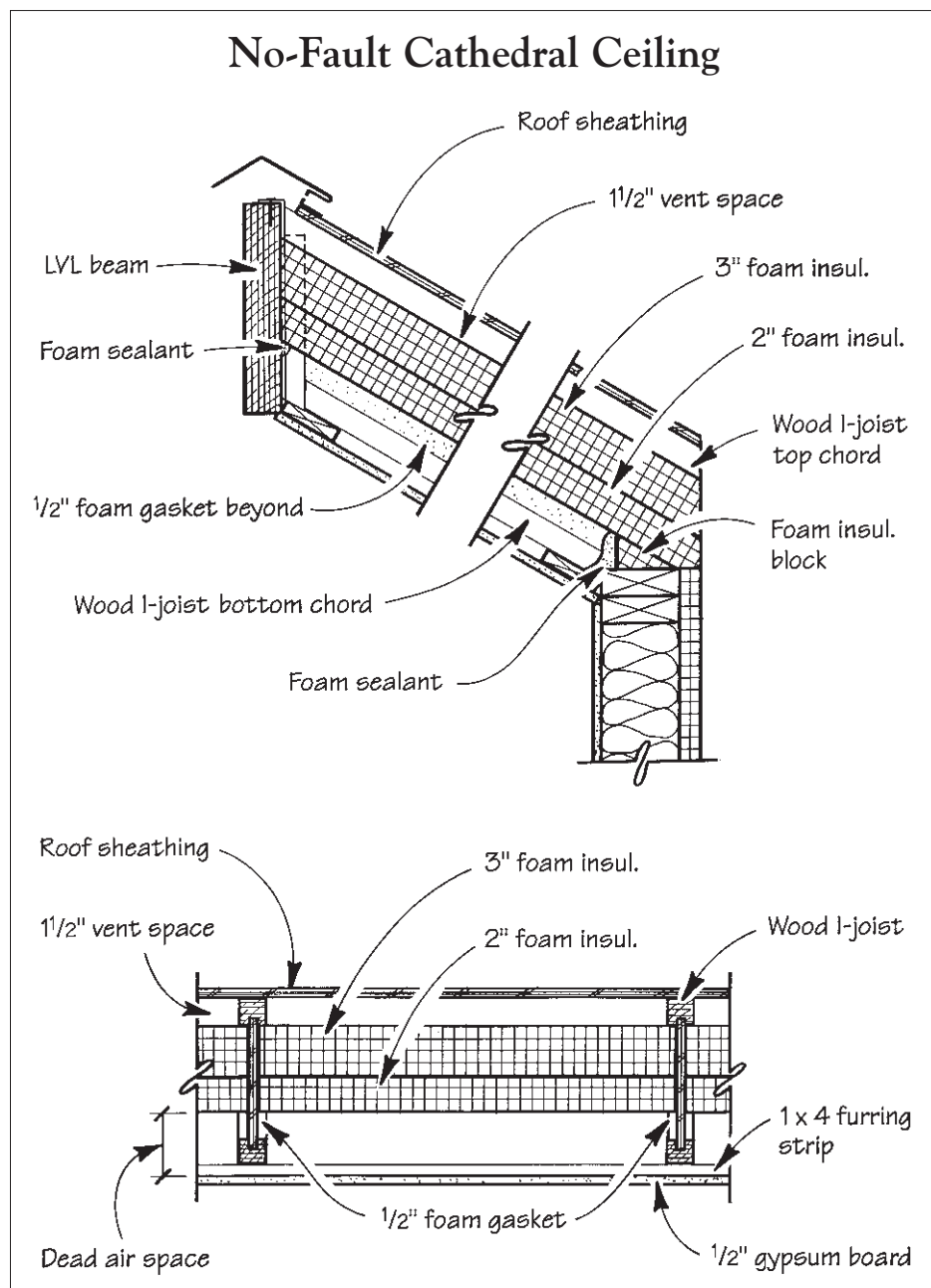


Figure 1. The author uses wood I-joists and foil-faced rigid foam insulation to create a leakfree, ventilated cathedral ceiling with an R-value of 39.



Figure 2. Working from the open eaves, the author slid the snug-fitting rigid foam into place between the I-joists while a worker inside pulled them into place.



Figure 3. Thin strips of rigid foam inserted above the bottom flange of the I-joists hold the double layer of foam board snug against the top flange. Note the filler piece used to block the vent channel at the skylight well.

flange (Figure 3) to create a tight seal between the inner building envelope and the ventilation space. At the ridge board and wall plates, where the rigid insulation would not seal tightly, I used an aerosol spray-applied foam.

Cost Comparison

The total R-value of the no-fault cathedral ceiling assembly is 39.10. This compares well with a conventional cathedral ceiling using 2x12s 16 inches on-center and fiberglass batts, whose R-value is 29.07. The 1/2-inch I-joist web contributes to the higher R-value of the no-fault cathedral ceiling by minimizing the effects of thermal bridging compared with solid wood framing.

A conventional cathedral ceiling is about one-third cheaper to build,

because foam board is more expensive than fiberglass insulation. But when you factor in the performance gain, the costs are similar: Both the no-fault design and the conventional framing method cost 10¢ per square foot per unit of R-value.

Performance

The cathedral ceiling has proved to have a very low air leakage rate. Leakage is difficult to measure precisely, but visual inspection with a smoke pencil at wall-ceiling intersections, the ridge intersection, and around ceiling-mounted light fixtures produced no evidence of leaks. And since there is no evidence of air leakage, it's a safe assumption that little vapor transmission through air transport is taking place. Likewise, the

four foil surfaces on the rigid foam prevent moisture movement via diffusion.

Blower-door testing done before and after the addition indicate the house is 25% tighter than before even with a 35% increase in exterior surface area. The improvement is due to removal and replacement of 50% of the old, leakier house roof, installation of Icynene insulation in the exterior walls of the addition (see "New From Canada: Icynene Insulation," 6/92), and the no-fault cathedral ceiling. ■

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