Builders offer clever ways to keep heat in and moisture problems out of energy-efficient homes

Eave Details

Practical Ways to Insulate & Ventilate

by Alex Wilson

Roof details have long been a thorn in the side for energy-conscious builders. Providing high insulation levels, adequate ventilation, and a continuous vapor barrier is a real challenge. Among the builders I interviewed for this article I found a wide variety of solutions to these goals, but also some similarities.

Insulated Ceilings

Insulated ceilings (unheated attics) are not as common as insulated roofs (cathedral ceilings) among the builders and designers I spoke with – most of whom are primarily involved with custom homes. Al Topping, a builder in Merrimack, N.H., and Chuck Silver, an architectural designer in New Paltz, N.Y., use a very similar system in which the ceiling joists are boxed off with a rim joist, and the rafters are supported on a plate secured to the joists. (see Figure 1).

By raising the rafters in this manner rather than setting them directly on the wall plates, R-value is not lost at the eaves as it is with conventional framing. Along with saving energy, this will minimize the risk of ice dams forming. Both Topping and Silver also install continuous soffit and ridge vents (usually Air Vent brand) and continuous vapor barriers. Topping's insulation contractor puts in a layer of fiberglass mesh and blows in fiberglass insulation with a binder from the inside. Silver specifies two layers of fiberglass batt insulation – usually 9-inch batts, providing a total R-value of 60.

When Silver uses roof trusses instead of standard rafters, he specifies raised-heel trusses with vertical legs and extended rafter chords (see Figure 2, next page). These fit over the wall plates, provide plenty of room for blown fiberglass insulation, and allow the wall sheathing to extend right up to the rafter chords, simplifying exterior finish details. The extended sheathing provides a baffle to hold the insulation in place.

Insulated Roofs

With insulated roofs, I found considerably more variation in the eave details employed. Two of the builders I spoke with use Trus-Joist TJI rafters 24 inches on-center. These provide more depth than readily available 2x lumber and they are thinner, resulting in less bypass heat loss through the wood. Greg Smith, a builder in Long Island, generally uses 14-inch I-joists with two layers of 24-inch-wide, 6-inch-thick, R-19 fiberglass batts, as shown in Figure 3, next page. He sets the I-joists on a miter-cut top plate, or, when necessary, uses special metal ties (Simpson) to secure them. He provides a 2-inch air space with molded polystyrene vent spacers.

Chuck Silver also uses wood I-joists as rafters, though he uses deeper members and can get by without vent spacers at the roof sheathing (see Fig-

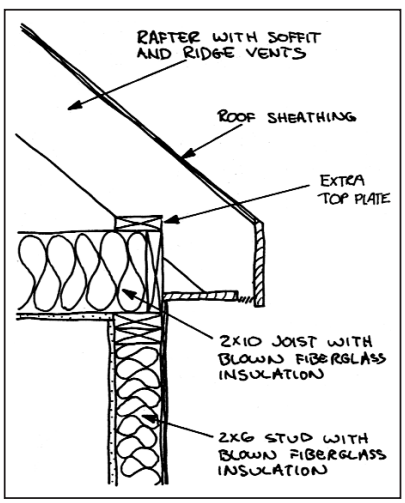

Figure 1. *N.H. builder Al Topping uses an extra top plate to raise the rafters up above the ceiling joists. The result: full insulation at the eaves and good roof ventilation.*

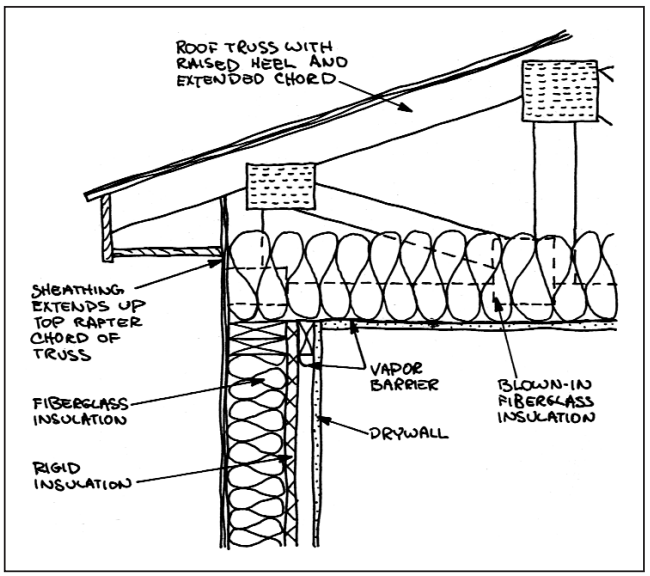

Figure 2. *N.Y. designer Chuck Silver specs "raised-heel" trusses, which allow plenty of room for blown insulation. The wall sheathing extends upward and serves as an insulation baffle.*

ure 4). He achieves an R-50 roof system using 16-inch I-joists and two layers of fiberglass batt insulation.

Silver cautions that full 24-inch-wide batts may be difficult to find in building supply centers. (Trus-Joist's webs are only 1/2 inch thick, not 1 1/2 inch like conventional rafters, so 22 1/2-inch-wide batts, used for conventional 24-inch on-center rafters, would not fit tightly. Full-dimension 24-inch batts are generally used in metal-framed commercial buildings and may only be available with vinyl facing. If Silver has to place vinyl facing within the insulation, he recommends slashing the vinyl to avoid trapping moisture. Depending on what is available from suppliers, he uses either 9-inch and 5 1/2-inch batts or some other combination to achieve a total thickness as close to 15 1/2 inches as possible.

Both Smith and Silver use vapor barriers under the Trus-Joist rafters. Smith continues the polyethylene vapor barrier up from the wall, while Smith uses poly only on the ceiling (foil-faced foam insulation with taped joints provide his wall vapor barrier). Silver uses a baffle extending up between the I-joists from the wall plates to keep insulation out of the soffit, while Smith relies on friction-fit batts and has never had any problems. With Trus-Joist rafters, the manufacturer's installation instructions must be followed for proper reinforcing and lateral bracing. Smith and Silver both use continuous soffit and ridge vents, as shown in Figures 3 and 4.

The two factors are meticulous care in the construction process and use of relatively dry lumber. While an unvented roof sounds risky, an increasing number of building experts are looking into the issue seriously.

Of the builders and designers I spoke with, John Abrams, of South Mountain Company, on Martha's Vineyard, uses the simplest detail, but in some ways the most radical. He does not ventilate the roof at all, thereby avoiding the difficult venting details at the eaves. He makes the inside very tight with foil-faced foam insulation (joints taped) and strapping to protect the foil vapor barrier (see Figure 5).

Abrams eliminated roof venting seven years ago, and after building four to six houses per year and designing another three to five per year, all with this roof system, he has experienced only one problem (in a temperature island climate). The problem was on a house with a combination of timber and stick framing – some of the green pine timbers did not fully dry out.

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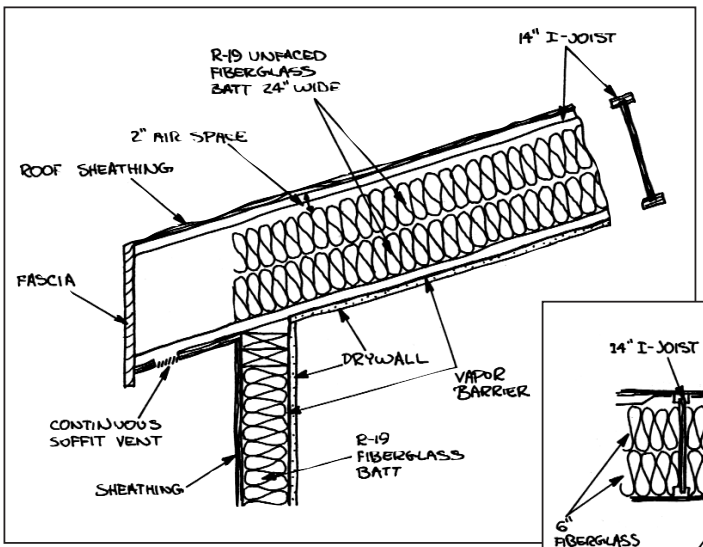


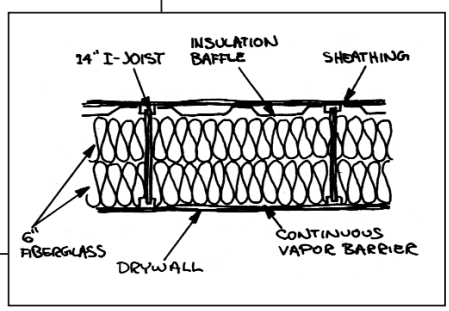


Figure 3. *Greg Smith uses 14-inch-deep plywood I-beams, which leave room for two 6-inch batts plus an air space. However, full 24-inch batts may be hard to find at the lumberyard.*

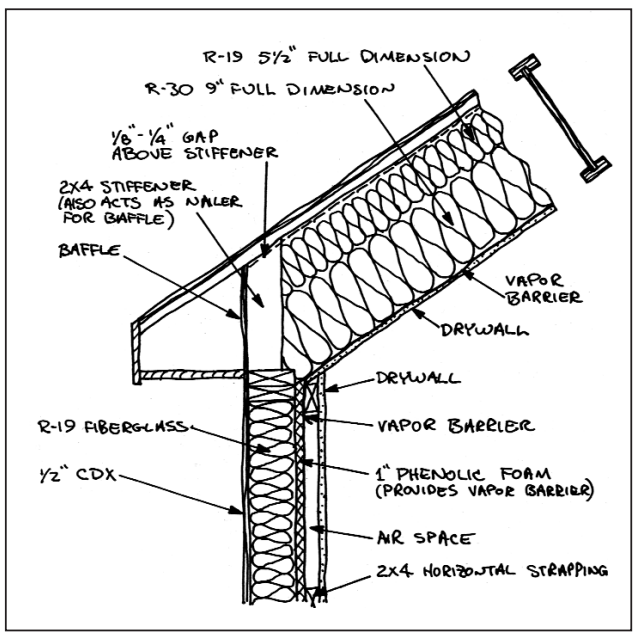


Figure 4. *Sixteen-inch TJI rafters will accept an R-50 layer of fiberglass batts. Here, the ceiling vapor barrier is taped to the rigid foam on the walls.*

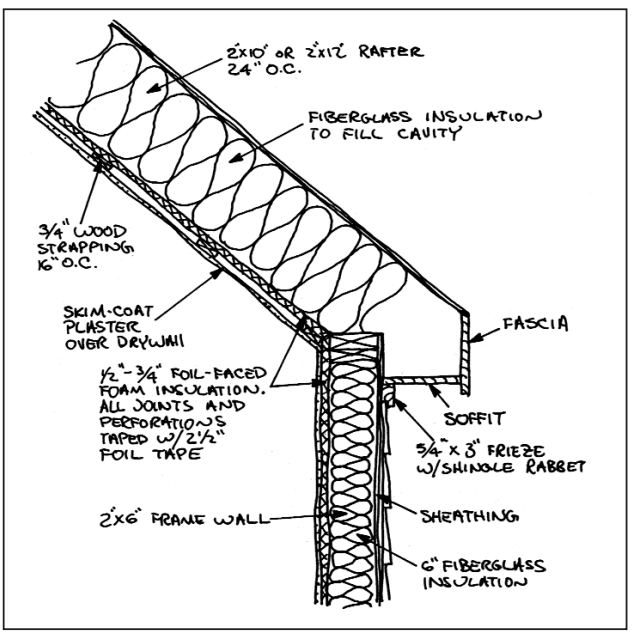


Figure 5. *Martha's Vineyard builder John Abrams prefers a "hot roof," that is, one with no ventilation at all. Success with this, he says, depends on a flawless vapor barrier and dry lumber.*

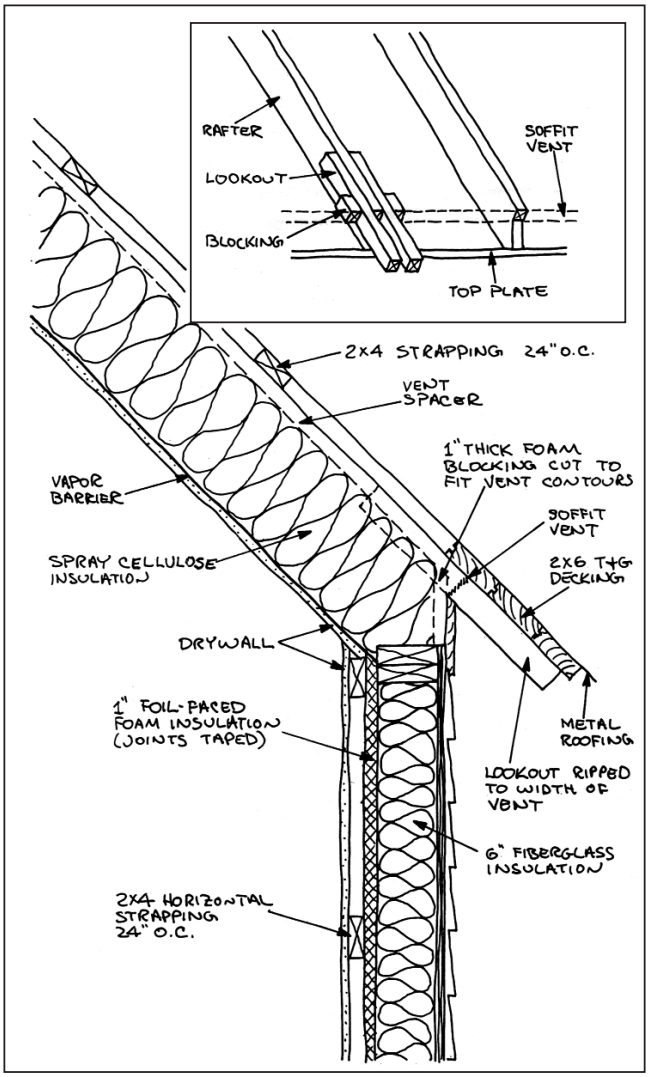
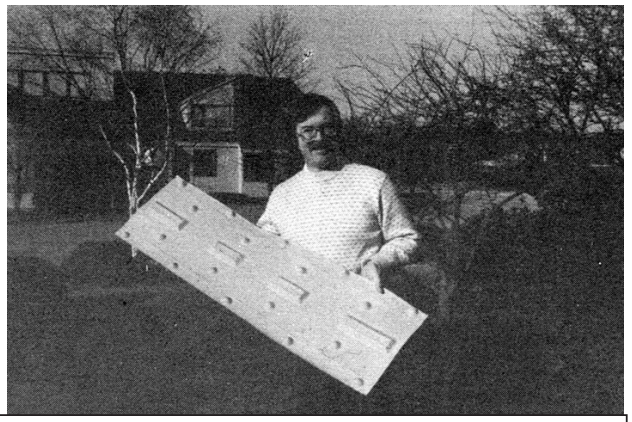


Figure 6. *Restoration contractor Tom Griffith, creates an open soffit with 2x decking sitting on lookouts (inset). A special notch in the rafters accommodates a 3-inch aluminum soffit vent.*



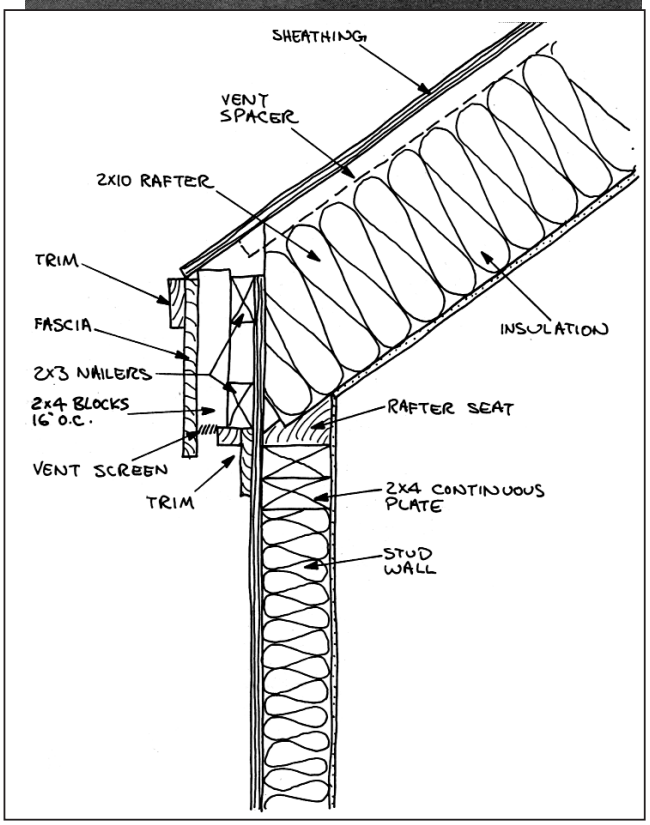


Figure 7. *Acorn Structures uses a "box vent" (preassembled from 2x3s and 2x4 blocks) to hold the fascia off the rafter tails. The sheathing forms an integral insulation baffle. Acorn's engineer Mark Kelley holds the company's patented vent spacer.*

cess of the system, he says, are meticulous care in the construction process and use of relatively dry lumber for framing and sheathing. While an unvented roof sounds risky, an increasing number of building technology experts are looking into the issue seriously.

Tom Griffith, of Jonathan Jesup Restorations, in Putney, Vt., has developed a rather different detail at the eaves (Figure 6). The rafters are cut with a special notch for the aluminum soffit vent (about 3 inches wide). On every other rafter, Griffith scabs on "lookouts" ripped to the same width as the rafter notch, which support the overhang (see Figure 6 inset). By putting the rafter-extending lookouts on only every other rafter, the soffit vent strips can span two rafter bays. Solid 2x6 tongue-and-groove decking supports the metal roofing at the overhang, which 24-inch on-center 2x4s support the roofing above the overhang.

A key difference between this vent spacer and others on the market is that air can flow sideways as well as upwards, which is important for skylight, roof valley, and hip roof venting.

Because Griffith uses spray-in cellulose insulation (with binder), he needs a foam baffle at the outside edge of the wall plate to keep the insulation out of the soffit vent during installation. This is contour-cut to fit snugly under the polystyrene vent spacer at the top of the rafters. While contour cutting foam blocks for the vent spacers sounds difficult, Jesup Restorations has found that it is really quite fast. They cut the extruded polystyrene blocks on a bandsaw using a plywood template. After setting up the template, they can cut the foam blocking for a whole house in about 20 minutes. To keep all the cutting as simple as possible, the company sticks to a 12:12 roof pitch on all the roofs it builds. In this way, all cuts are either 90 degrees or 45 degrees – a huge timesaver.

Acorn Structures, a high-quality panelized home manufacturer in Concord, Mass., uses a fairly sophisticated eave detailing that is pre-manufactured and nailed in place on site. Most aspects of this "box-vent assembly" should work very well even for builders who are not using a panelized construction system, according to energy engineer Mark Kelley.

The assembly is made of two horizontal 2x3 nailers with vertical 2x4 blocking 16 inches on-center, as shown in Figure 7. Vent screening wraps around the base of the assembly and is secured in place with the trim details. The assembly attaches to the ends of plumb-cut rafters, which are either flush with the wall plates or overhanging. With an overhang and horizontal return soffit, the soffit should extend far enough to leave a 3/4-inch-wide screened soffit vent. To channel the air flow upwards rather than through the fiberglass insulation, sheathing is installed in the rafter tails before the box-vent assembly is nailed on.

A proprietary vent spacer is used by Acorn Structures to assure an air space above the insulation (see Figure 7 inset). The vent spacer is made of breathable heavy-duty compressed fiberboard (the same material used for egg crates). A key difference between this vent spacer and others on the market is that air can flow sideways as well as upwards, which is important for skylight, roof valley, and hip roof venting (with notches cut in the tops of the rafters for lateral air flow). The vent spacer is also much more rugged than the polystyrene products. Acorn sells the vent spacer to a few outside contractors and is considering introducing it commercially. ■

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