Framing a Cold Roof

Preventing roof leaks caused by ice damming

by Steve Kearns

When I moved to Idaho's snow country after living in southern California and Hawaii, I had to learn a number of regional differences in construction. For one thing, it gets colder here, so we use 2x6 studs (at least) to accommodate R-19 insulation in the walls; R-30 is the minimum in our ceilings. I also learned to build what's known as a cold roof. Such a roof, paired with a Boston ridge vent (more on this later), prevents ice damming and roof leaks.

The scenario for a leaky conventional roof in snow country goes like this. With temperatures below freezing, snow accumulates on the roof over a vaulted ceiling. Even if the roof is well insulated, enough heat escapes to melt the snow, causing water to run down the shakes, and when this water hits the unheated portion of the roof (the cold eaves), it freezes. This process happens over and over until ice dams and picturesque icicles form as water drips from the eaves. The icicles may be pretty, but big ones are evidence of a problem roof. When ice dams get big enough, they can cause the melted water to work its way back under the shakes and leak into the house. A constant freeze/thaw cycle resulting from uneven day and night temperatures can also contribute to this ice build-up.

Builders deal with the problem in various ways. Some run a waterproof sheet over the lower portion of the roof, under the roofing. W. R. Grace & Co. (Construction Products Division, 62 Whittemore Ave., Cambridge, Mass. 02140; 617-876-1400) makes a sheet called "Ice & Water Shield" that can be applied directly to the roof decking.

You might think that metal roofing would seal out leaks caused by ice damming, but it doesn't. Mike Kimball, owner of Sun Valley Roofing, reports that metal roofing used on 4-in-12, 5-in-12, and 6-in-12 standard roofs can, and does, leak when ice dams form. On steeper pitches, the slick metal serves as a water barrier only because it encourages built-up snow to slide off (to crush unsuspecting bystanders, flower beds or car hoods...but that's another story). A product like Ice & Water Shield only treats the symptom, though; it doesn't cure the ice-dam problem. To do that we build a cold roof.

Framing the cold roof—The principle of the cold roof is simple: build a double-layer roof

that "breathes." A continuous air flow between the layers from eave to ridge takes any heat escaping from the house and exhausts it out the ridge. This keeps the outermost roof layer "cold" over the whole roof and prevents the ice damming that occurs on a conventional roof. We use 2x4 sleepers to separate the roof layers.

Construction of a cold roof is fairly straightforward. After the rafters of the lower roof have been sheathed, we snap two parallel chalklines about 3 in. apart on the plywood, somewhere over the eave overhang, and cut this strip out with a circular saw. This provides an avenue for air to travel up from the soffit area and into our cold roof. Next we put down 30-lb. felt over the whole roof, cutting it out at the soffit-vent strip. This felt layer protects against any condensation that may occur between the roof layers; it is not intended as a rain or snow barrier. Any condensation will leak out the soffit vent, and hasn't been a problem.

After the felt is down, we stack 2x4 sleepers on edge directly over the rafter layout and run them up the entire length of the roof. This will provide a 3½-in. air space up the roof. I haven't been able to find an engineer who has calculated exactly how much air volume is needed to keep a cold roof cold, but experience tells me that a 2x4 put down flat doesn't work well enough, while one on edge does. In the course of writing this article, I spoke with Professor Ronald Sack, director of the University of Oklahoma School of Civil Engineering, and he confirmed that analytical predictions for the performance of a cold roof are nonexistent. Ongoing research may, however, yield more precise answers soon. For more technical information on this topic, he suggested "Approximate Analysis of a Double Roof," in the journal *Cold Regions Science and Technology,* volume 16, 1989.

What engineers *can* give us (and some building inspectors require), is a nailing and fastener schedule for attaching cold-roof sleepers to the main roof. I've heard horror stories of a cold roof sliding completely off a house in Mammoth Lakes, California, and our inspectors would rather that didn't happen here. Mike Bouiss, of Bouiss & Associates, P. E., developed the nailing schedule we use. We nail A-35 clips (Simpson Strong-Tie, P. O. Box 1568, San Leandro, Calif. 94577; 415-562-7775) to the plywood directly over the rafters and then put each 2x4 sleeper over the clips, covering the side of the clip that lies flat on the sheeting. Then we nail through the vertical side of the clip into the side of the sleeper. A small aside—U. S. Nail Company (1840 National Ave., Hayward, Calif. 94545; 415-785-7443) makes a heat-treated joist-hanger nail for the Hitachi nailgun that speeds this work (and other metal-framing connector work) immeasurably. After sleepers have been laid over the whole roof, they are skip-sheathed and snaked just like for a conventional roof—up to the Boston ridge vent, that is.

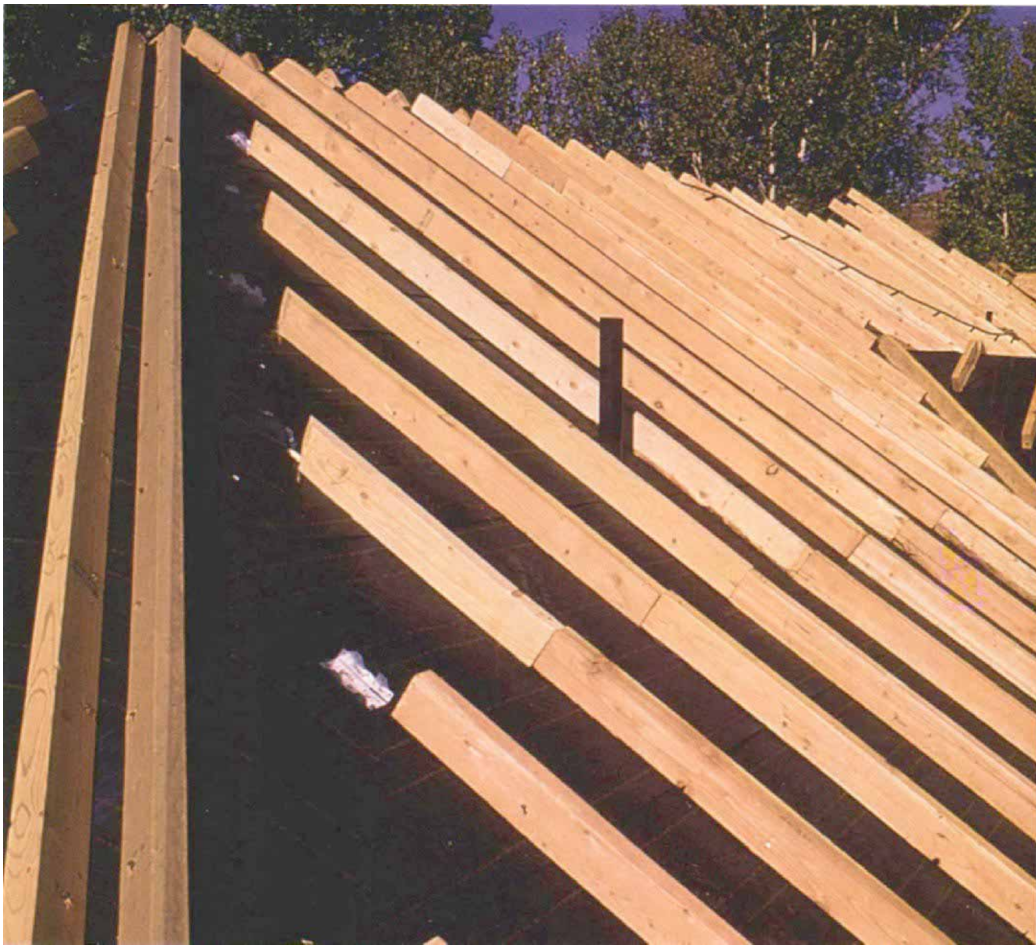
One variation of the cold roof involves an alternative to cutting a vent strip in the plywood sheathing over the soffit. In this case, we extend the sleepers 3 in. or more past the fascia line of the lower roof (bottom photo facing page). The ends of the sleepers can then be finished off with a separate fascia. Whatever method you choose, however, it's important to screen the vent to keep out birds and bugs. We buy our screening in rolls 6 in. wide and staple it in place. A light-gauge metal soffit vent is available in 8-ft. lengths (with a galvanized or bronze finish); it's easy to apply, but it's only 2 in. wide and the perforations cover only about 50% of the vent area. Figuring that these vents might overly restrict air flow, we stick to screening.

The Boston ridge—The Boston is essentially a raised ridge vent with an overhang that prevents the vent from being clogged with snow. It can be applied either before or after the shakes are on, but we prefer to do it before. We attach it to the skip sheathing because that provides a more secure connection.

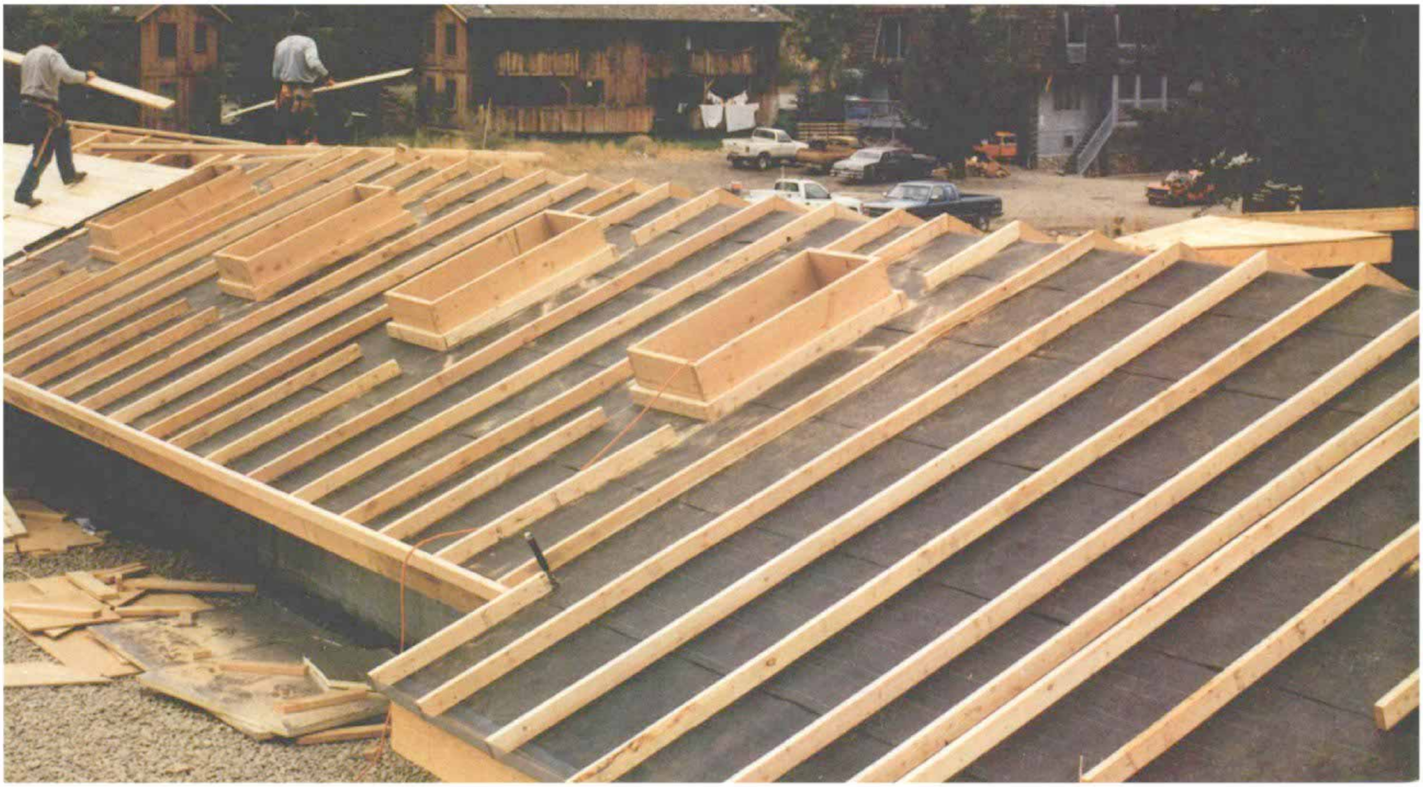
There are a number of designs for Bostons—some people take 2x8s, plumb cut them where they meet at the ridge, and put a 3½-in. by 5-in. notch in the lower end to provide the protected vent (bottom drawing next page). Another way (which we find faster) is to build 2x4 ladders along the length of the ridge; we stack the two wider ladders on top of the two shorter ones to provide a protective overhang for the vent (top drawing next page). The cross members are 4 ft. o. c., and the upper ladders are simply spiked into the lower ones. Don't forget to staple screening over the entire vent opening—to birds and bees, these Boston ridges look like dream homes.

The gable ends and the eaves of a Boston ridge are normally finished with fascia to complement the regular roof. We sometimes double or triple the fascia along the edges of the regular roof, which gives our roofs a massive look.

One design issue is whether to bring the Boston ridge all the way out to the end of the gable's eaves or to stop it at the house line. The roof doesn't need to be vented over the already cold eaves, of course, but some architects prefer the look of a full-length Boston,

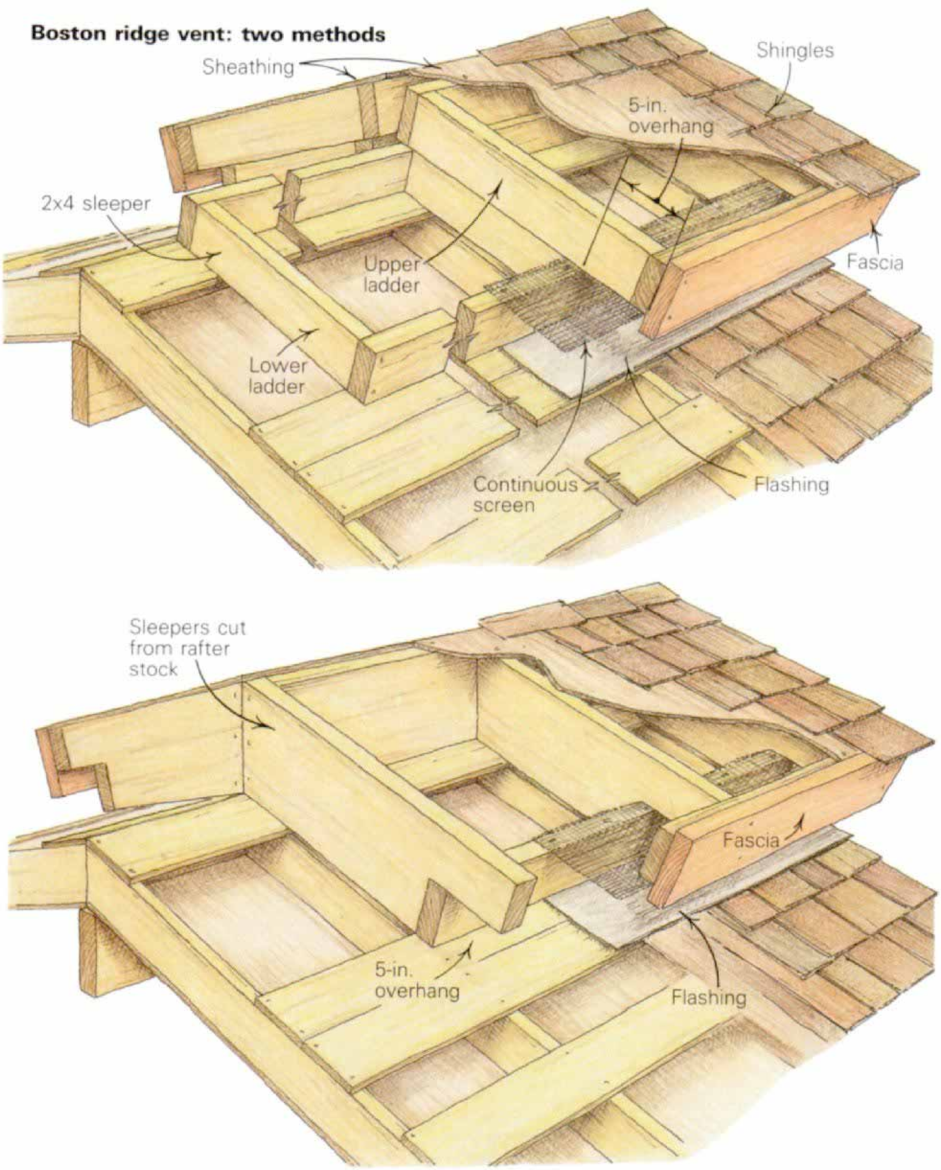


The sleepers on adjoining roof planes at hips and valleys should be oriented to channel air upward. Nothing should obstruct the flow of air from soffit to ridge.



In this application of a cold roof, the sleepers extend several inches past the fascia of the underlying roof to form a protected vent area. Screening (just visible in the foreground of the photo above) has been stapled in place to keep bugs and birds from invading the roof later on.

The Boston ridge (photo above) used for a cold roof is a site-built variation of the standard ridge vent, but with an overhang that prevents it from clogging with snow. Two methods for framing the vent are shown in the drawings below.



Drawing: Christopher Clapp

particularly when it caps a gable that forms the entry to a house. Another design consideration: your roofer will love you if you make the width of the Boston fit his shake layout.

Skylights and other obstructions—The most important consideration in cold-roof construction is to provide adequate, unrestricted air flow from eave to ridge. On a standard gable roof this is fairly simple, but when you start building cold roofs with hips and valleys and skylights, you have to be certain that the air will flow all the way to the ridge. You don't have to be a rocket scientist to figure this out, but you do have to pay attention and think about it a little.

The rough framing of skylights should be boxed in with sleepers (bottom photo, previous page). Additional sleepers above and below the skylight should stop short of the skylight framing so that air will flow around the obstruction. At hips and valleys, sleepers on adjoining roof planes should be oriented to channel air upward (top photo, previous page). By the way, don't forget to leave the skylight wells a little deeper and the plumbing vents a little taller than normal. It wouldn't be good for either one to end up inside the cold roof.

Looking for an easier way—By now you're wondering if there isn't an easier way to prevent ice dams in snow country. Some builders have tried, with uneven results, to get away with a modified cold roof. This method eliminates the sleepers and is accomplished by holding the insulation down in the rafter bays and trying to get the air to flow to the ridge between the insulation and the sheathing. I've seen cardboard baffles inserted 2 in. down from the top of 2x12 rafters, with R-30 batts underneath. This method can work, but it does sacrifice 2 in. of insulation space. The most successful use of the method I know of involved using 16-in. deep wood I-joists as rafters; there was more than enough airflow space above the insulation.

The major problem with this approach comes when condensation forms above the insulation and drips down to soak it. Even with a standard cold roof, it is very important to install a vapor barrier on the warm side of the insulation to keep moisture from migrating into the rafter bays.

One alternative that works—The need for a cold roof comes largly from a penchant for vaulted ceilings. Cold attics, whether they are built with trusses or rafters and ceiling joists, work just fine to prevent ice damming *if they get enough air flow.* This means you must provide gable-end vents of sufficient size and/or provide soffit and ridge vents (for more on roof venting, see *FHB* #61, pp. 76-80). I've heard few reports around here of leakage problems on well-insulated houses with well-vented cold attics. □

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