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# DEFEATING ICE DAMS

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BY HENRI DE MARNE

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## PROPERLY BALANCED SOFFIT AND RIDGE VENTILATION IS THE ONLY FOOLPROOF APPROACH

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Ice dams are not peculiar to northern regions: They can and do occur in any area of the U.S. with a total mean snowfall of six or more inches annually—nearly three fourths of the continental United States, according to U.S. Weather Bureau data.

Most of us are familiar with how ice dams form, and the damage they can cause. But few of us seem to know how to prevent them or, at least, limit their damage.

### Ice-Dam Basics

For those unschooled in the mechanics of ice dams, a quick review may be helpful. On the roof of an *unheated* building snow will melt gradually from the perimeter first, while slowly sinking over the entire blanket. On a *heated* building, the snow will melt in the same pattern if the roof is properly designed and built. On a roof with ice-dam problems, however, the snow will soon take the shape of a wedge. It is paper-thin at the top where it melts fastest from warmed attic air that has risen to the peak, and thickest at the eaves, where it ends in a ridge of ice. In old houses with little or no attic insulation the roof area

above the attic will soon be bare, but snow and ice will cling to the overhangs.

Most roofs, unfortunately, have too little insulation for the climate or insulation that is installed sloppily. In addition, few roofs have adequate ventilation, and many have none at all.

Heat from the living quarters works its way through the ceiling insulation or convects into the attic (or rafter spaces in a cathedral ceiling) through unsealed openings around chimneys, bathroom fans, recessed light fixtures, plumbing vents, electric wires, or attic hatches. This warms the attic air and the roof sheathing to temperatures above the freezing point. The snow blanket begins to melt and the melt water runs down the roof where it freezes as it reaches the end of the insulating snow blanket or a cold eave. Ice begins to build up and can get as thick as a foot or more. Once this happens, run-off from the melting snow begins to pond behind the ice curb and finds its way under the roof shingles and into the building.

In houses with overhangs and steep roofs, water penetration may end there. In shallower roofs or during winters of

heavy snowfall, however, water may penetrate the attic and walls and even the inside finishes, particularly at door and window heads where the leakage is often first noticed.

If the water penetrates only at the overhangs, there may never be serious consequences such as wood decay since the wood will dry as warm weather returns. This is especially true where there is adequate soffit venting at each rafter bay, either deliberate or by unintentional cracks between the various cornice components. But where water has penetrated within attic and walls, a fact not always evident to the eye, damage can result over a single winter.

I recently investigated a new well-insulated house with a ventilated roof that the owner expected would give her problem-free service. Instead she got heavy ice damming and a huge crop of long icicles. She was not aware that water had backed up inside the walls. The giveaway was red wood-extracts bleeding from between the cedar clapboards below areas where ice had severely built up, such as valleys. Also, an icicle about 1½ inches in diameter had formed a stalactite-like pillar down the foundation wall, from the bottom of the wall sheathing all the way to the bottom of a basement window well. This ice column came from behind the sheathing indicating that a lot of water leaked into the insulated cavity.

How wet the insulation got and whether it sagged can't be known without opening the walls or inspecting them with infrared equipment. Perhaps the wall will dry in time without inflicting serious damage—perhaps only the paint or wallpaper will peel. But consider that there is a plastic vapor barrier behind the drywall and plywood sheathing outside. How will the moisture escape?

Regardless of the age and construction of a house, however, ice dams and the water damage they cause should not be allowed to continue. What are the solutions?

### Attempted Cures

Many years ago I saw an architect-designed house that had no overhangs at all. The architect-owner told me that this was his way to overcome ice dams: Since there were no cold cornices, the water wouldn't freeze. It was a novel idea at the time and I anxiously waited for winter to find out whether he had hit on something.

Alas, the results were not as expected. Snow melt-water froze as it came out from under the snow blanket



*Electric cables do not prevent ice dams — they merely change their shape into a distinctive zigzag pattern.*

# Metal Roofs:

## Not the Answer to All Your Problems



If you like metal roofing, use standing-seam — not corrugated or V-crimp — which are prone to condensation underneath. But metal roofing, along, will not cure ice dams.

Metal roofs applied over old wood or asphalt shingles, or when installed over poorly insulated old houses, do not produce problems. However, when installed on well-insulated houses, it is not unusual

to find the roof "leaking" after a clear, cold winter night, around 10:30 to 11:00 a.m. the next morning when the sun is shining on the roof.

The "leak" is really melting frost. The frost forms under the metal roof as the sun goes down, and melts as the sun warms the metal the next day.

Moisture comes in contact with the underside of the metal roofing in several ways. It can convect from the living spaces below through openings around ceiling fixtures, bathroom fans, chimneys, plumbing-vent pipes, electric outlets, and attic accesses. These high openings create "false chimneys," drawing in cold air from lower cracks and crevices and leaking out the top.

This stack effect is increased when the temperature of the metal is warmed by the sun's rays. As soon as the sun hides behind a cloud or sets for the night, the metal cools fast and condensation occurs, followed quickly, by frosting.

Another contributor to condensation and frosting under a metal roof is outside air circulating through its corrugations, "V's, or the vented space left under the roof. Again, this process is aggravated by the sun's heat as the warmed metal draws in more exte-

rior air which is warmed as it moves upward and absorbs additional moisture that may have worked its way from inside the house.

At the end of the day, particularly on clear, cold days, the metal cools fast. Night radiation can bring the metal's temperature 10 to 15°F lower than the ambient air, aggravating the situation. The entire underside of the metal roofing can be coated with a layer of frost.

As the sun warms it the next day—or when the ambient air temperature rises above freezing—the frost melts. Unless it is checked by a water-shedding membrane, it rains on the insulation and leaks into the house.

What can be done about this? If the metal roof is standing-seam, it is usually installed over solid sheathing covered with felt underlayment. Since there is no place for air to flow there should be no problem.

But most nailed-on (or screwed-on, as they should be) metal sheets are applied over strapped sheathing nailed across the tops of the rafters between which lies fiberglass insulation. You guessed it: You've got a problem!

If there is a plastic vapor retarder below the ceiling insulation, it may hold the water for a long time without anyone noticing the problem — unless a light fixture or bath fan starts dripping, or water finds its way between joints of the plastic and shows up through the drywall beneath it.

On sloping ceilings, the condensate will run to the wall plate and will show up where wall and ceiling meet unless the ceiling plastic was applied first and is overlapped by the wall plastic. In that case water will run down inside the insulated wall cavities, perhaps undetected for a long time.

In certain cathedral ceiling construction (often found in log homes) tongue-and-groove ceiling boards form both the finish ceiling and the roof deck. Rigid insulation goes over the boards with no air-vapor retarder installed other than the aluminum skins on the insulation. Then strapping is nailed from

rake to rake and the metal sheets are fastened onto them.

Again, the condensate will find the joints of the rigid insulation sheets and run through the joints in the tongue-and-groove ceiling boards. Taping the joints of the insulation sheets from above is one solution, but it does not solve the problem of condensate napped by the strapping and even following the nails through the insulation into the deck below. In one case I investigated, the nails holding the strapping were so rusted that the carpenters were able to remove the strapping by hand. It would not have been too long before the roof blew off in a strong wind or just slid down to the ground.

There are simple solutions, but they raise the cost of this roofing installation which is often selected because of its budget price in the first place.

Based on extensive experience with these problems, I believe a corrugated metal roof needs a water shedding membrane and a way to discharge the condensate harmlessly to the outside. All roofs I design or specify have these elements.

If a standard rafter systems is used with fiberglass insulation, there should be an air space of at least 1½ inches between the insulation and the sheathing. The sheathing is covered with metal edging and 30-pound felt-as if it were to be shingled. The air spaces under the sheathing should have soffit-vent strips at the bottom and a slot in the sheathing at the top covered with fly screening (see illustration).

Now, 2x3s on edge are nailed through the sheathing into the rafters. The tails extend an inch or two beyond the metal drip edge at the eaves and a new fascia is applied to them.

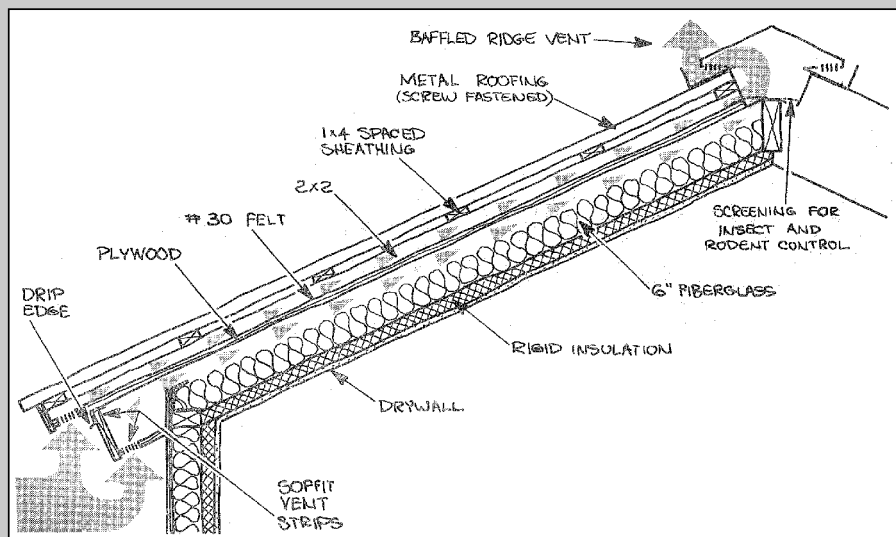
Next, nail spaced sheathing across the 2x3s and screw the metal sheets to it (with Woodtight screws) leaving a vent space at the top. Use filler strips to seal the corrugations, or in the case of V-crimp panels, make your own with pieces of pressure-treated wood and fasten a baffled ridge vent at the top.

Where rigid insulation is applied over the wood deck of a cathedral ceiling, you will undoubtedly have it contained within a wood perimeter curb. You will need to build a grid of the same depth to serve as underpinnings to the sheathing. Now cover the insulation and the grid with ¼-inch thick Aspenite. Tack it only enough to hold it in place temporarily and staple 30-pound felt over it. Then proceed as explained above.

You can think up your own variations as long as you keep the essential principles in mind: provide a vented space, a water-shedding membrane, and drainage for condensate under all metal roofs (except as noted above for standing seam roofs applied over solid felt-covered decks).

This will give you a trouble-free metal roof, but not a cheap one. If you want metal, look into standing seam, which doesn't have the condensation problems of the corrugated type. Or if you want economy, stick with a simple asphalt or fiberglass-shingled roof.

—HdM



In a cold climate, corrugated metal roofing requires double strapping to safely drain away condensate. To avoid cost and complexity of this "double roof," you could use standing-seam metal or plain old asphalt or fiberglass shingles.



Keeping the lower portion of the roof clean with a shovel or snow rake only shifts the ice dam farther up the roof to the bottom of the snow blanket.



In heavy snow country, the fewer valleys in the design, the better.

and ice sheets covered walls and windows like a frozen waterfall.

Shoveling all the snow off the roof or building the roof so that it will shed its snow cover after each snowfall are two very effective ways to prevent ice dams. However, the former is not too practical, hard on the roof covering, and dangerous to life and limb.

Removing the snow partially from the bottom of the roof by means of a snow rake, while standing on the

ground or on a ladder, only results in a secondary ice dam forming higher up the roof at the bottom of the snow blanket. All that has been accomplished is to shift the water leakage higher where it can create more havoc with the ceiling insulation and finish.

Every fall, hardware stores heavily advertise electric roof cables as a sure means of solving the ice-dam problem. Instructions recommend their installation in a zigzag pattern at the eaves of

the roof and in valleys, gutters, and downspouts. Secondary ice dams form just out of reach of the tape and the situation is further aggravated by the fact that we now have "V"s of ice catching the water.

Metal ice belts are very commonly used in heavy snow areas and many contractors swear by them. They are certainly more effective at eliminating leakage than the previously mentioned methods, but are no panacea. Secondary ice dams form at the upper edge of the metal band after it has shed the ice that formed on it. And do you really want a roof with a 3-foot or wider metal edge if you can avoid it? Why do so many contractors still install these unsightly devices when far better means are available?

W.R. Grace, the pioneer of the now widely used bitumen membrane, came out several years ago with its Bituthene Ice and Water Shield. There are now several competitors on the market. The material comes in a 3-foot-wide roll and is self-adhering to clean roof sheathing. It is applied at the eaves, in valleys, and around skylights—wherever the possibility of water ponding behind ice dams exists. In houses with wide overhangs and shallow roofs, it may be advisable to use more than one strip at the eaves in order to obtain at least two feet of coverage above the line of the wall plate.

The roof covering is simply nailed right through the membrane, which seals around the nails much like a puncture-proof tire does.

But as effective as this underlaid membrane is, you should only use it where you can't design in the best solution: insulation and ventilation. Indeed, ice on any roof covering is undesirable: It's weight and destructive action can tear granules right off the base felts of shingles, dislodge slates, or break the bond of felt plies and metal gravel stops in built-up roofs.

#### Design Solutions

Ice dams, with what we know today, are inexcusable in new houses. First, the designer should avoid roof details that make good ventilation difficult or impossible. They should set aside their artistic egos and design a roof that's practical for the climate.

Valleys are one of the worst offend-

ers. If dormers are necessary, use shed dormers instead of "A" roofs, which converge the snow into the valleys. Avoid secondary gables as decorations over front doors or half circle windows. You can design attractive houses with the plain gable roofs found on most of the old farm houses and Capes of New England. Get rid of valleys and you are well on the way to resolving the problem, if you follow it up with the right combination of insulation and ventilation.

The goals are:

- to reduce heat loss to the attic by using ample insulation installed well
- to carefully seal all ceiling air leaks mentioned earlier by means of foaming urethane, packed mineral wool, caulking, weatherstripping, or sheet metal, as appropriate
- to very carefully install an effective air-vapor retarder on the winter-warm side of the ceiling and walls
- to provide ample and effective ventilation to quickly remove from the attic whatever heat gets through the insulation before it has a chance to warm the sheathing

Particularly vulnerable areas are the wall platelines. Standard construction generally leaves very little space for insulation over the top plate. And often, insulation over the plate blocks any air passage from soffits to attic space. In new construction, however, it's easy to allow space for both the full thickness of insulation and adequate ventilation at the plates.

#### Raised Heels

If you're using trusses, order them with an elevated seat (Figure 1). Otherwise set a secondary 2x4 plate on top of the ceiling joists at the eaves and set the rafters on top of it instead of next to the joists (Figure 2). Use metal fasteners to tie rafter ends to the plate and joists if you need stronger anchoring here.

In order to ensure that the air channels at the eaves remain unblocked as the insulation fluffs up, I strongly recommend using insulation baffles. I personally do not like molded-polystyrene baffles because they do not cover the vulnerable lower ends of the insulation batt, offer a rather shallow air slot, and do not ventilate the entire width of the rafter bay. Condensation can occur in the remaining unventilated area.

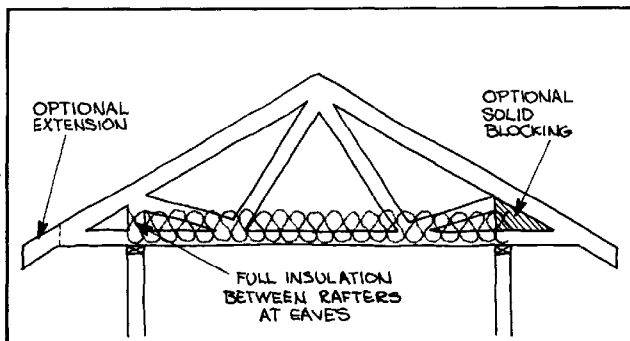


Figure 1. If you use trusses, order them with an elevated seat to accommodate a full thickness of insulation at the eaves. Note the vertical support at the bearing point.

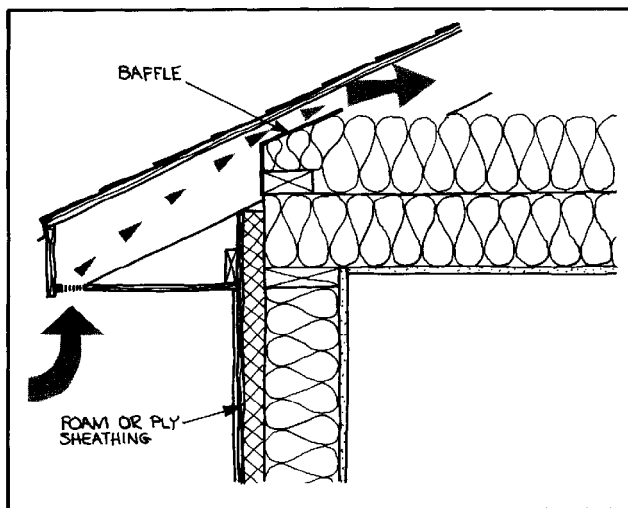


Figure 2. To get extra room for insulation with conventional rafters, you can set a second top plate above the ceiling joists. You may want to tie rafter to joist with metal connectors.



I prefer cardboard baffles, which can easily be altered to fit any insulation thickness (Figure 3). One manufacturer of a HUD-approved baffle is Edwil Manufacturing (103 Timber Ridge Drive, Ashland, VA 23005; 800/446-1687). The cardboard baffles have the advantage of providing a pocket that seals the lower end of the insulation, preventing soffit air from washing through and reducing its R-factor. Another strategy with elevated rafter seats is to carry the foam or plywood sheathing all the way to the rafters thus sealing the ends of the insulation (shown in Figure 2). For retrofits, I use a site-built plywood baffle with extended arms for slipping it into place (Figure 4).

The depth of the air space generally recommended is 1½ inches. I would suggest providing more wherever possible, as cold winter air is very heavy and sluggish.

The insulation thickness at the eaves should be at least R-38 for northern regions. (Incidentally, effective levels of insulation and ventilation for cold climates in winter apply as well to the hotter southern regions in summer.)

### Can't Have Too Much

Much has been said and written about attic ventilation. Our Canadian

friends even recommend, under certain circumstances, no ventilation at all. But you won't find me on their side in this argument; I've seen far too many problems with unventilated roofs.

HUD's minimum property standards offer guidance on how much ventilation to have. But again, I have seen problem-free roofs with far less than the recommended ventilation levels, while others that appeared to meet the standards had horrendous ice problems. I prefer, therefore, to be guided by the commonsense rule that says that there is no such thing as too much ventilation in an attic.

We still find many technical writers advocating the use of gable vents. This is puzzling to me. Anyone who has studied the subject should know that no ventilation system, except for continuous soffit and ridge vents, does a complete job of venting an attic.

Gable louvers only function when the wind is blowing against them, and then they ventilate only partially. Combined with soffit vents, their performance is not much better.

Other types of vents, such as cupolas, roof vents and fans, turbines, or soffit vents alone, do not do a thorough job. There are always large areas of the sheathing that do not get ventilated.

On the other hand, a balanced com-

bination of soffit and ridge vents encourages a continuous air wash of every square inch of sheathing where condensation is most likely to occur.

### All Vents Not Equal

But not all ridge vents are created equal. The only type that should be used is a *baffled* ridge vent. The baffle deflects wind blowing up on the roof. This both increases the airflow from the attic (due to the venturi effect), and prevents the penetration of water and snow. Conversely, ridge vents without baffles can admit water and snow in large quantities, wetting insulation and ruining ceilings. Some are banned by a number of local officials for this reason.

In the course of my practice I have witnessed attics with several inches of freshly blown snow lying on top of the insulation below an unbaffled ridge vent. A responsible contractor should not use such products.

I would also caution builders not to use cheap plastic ridge vents; I have seen roof leaks that were due to cracks in these products.

The better ridge vents are made of metal (more later on a relatively new, molded polyethylene model) and have an integral metal baffle. (Do not accept accessory plastic wind baffles.) In heavy snow regions, however, even the best aluminum ridge vents can collapse from the weight of a deep, wet dump. To prevent this, order enough joint blocks so that you can insert one every 24 inches maximum into the ridge-vent sections before installation.

Most metal ridge vents available commercially are manufactured for shallow to medium-pitch roofs. When used on steeper roofs, they must be bent to fit the pitch. This closes their throats and reduces the air flow, while also exposing the louvered sections to wind-driven snow and rain (since the louvers are now above the baffle). Ridge vents should not be used when they need to be deformed to fit.

Some manufacturers make a version of their standard ridge vent for steeper roofs, or recommend installing a wedge under the base of the vent to reduce the pitch of the roof. I am not excited about either suggestion. I prefer a site-built

vent that makes use of a product called the Utility Vent (Air Vent, Inc., 4801 N. Prospect Rd., Peoria Heights, IL 61614; 800/247-8368). The utility vent is nothing more than a half ridge vent (see Figure 5 for installation procedure).

Air Vent, Inc. recently came out with a molded, flexible polyethylene ridge vent, called Shinglevent, which seems to answer all ridge venting problems; it bends to any roof pitch, is covered by the roof covering, is strong enough to withstand a heavy, wet snow load, and is baffled. In addition, it has a fiberglass filter to prevent snow penetration when the ridge vent is installed without balanced soffit ventilation. This filter, if installed carefully, is also useful in preventing insect penetration into the attic. One concern is that the ventilation slots are so big that the ubiquitous paper wasps could enter and build their nests, blocking the ventilation system. I would prefer smaller screening but am told the extrusion process does not permit it.

**With cathedral ceilings, you must take great care to seal all possible paths of convection of moist, heated air from the living spaces into the rafter spaces. Recessed lights are out.**

### Cathedral Ceiling Retrofit

Readers may be interested in a case history. The roof panels of a pre-cut house in northern Vermont were paneled and built of 2x4s, 16 inches on-center, with a plastic vapor retarder towards the inside, R-11 fiberglass batts, and plywood glued and nailed to both faces. This formed a cathedral roof that was covered with cedar shakes with felt strips interlaid. The ice-dam problem was very serious and eventually the eaves rotted.

The roof was retrofitted by the addition of one-inch extruded polystyrene over the old sheathing. Two-by-three sleepers were fastened on edge over the rigid insulation from eave to ridge but extending three inches past the old fascia. New sheathing was nailed over the sleepers and covered with new fiberglass shingles. Continuous soffit venting was installed under the projection of the sleepers as was a new fascia. Ridge venting was also installed. In the last four winters not a sign of ice damming was seen. This same system can be used to retrofit uninsulated cathedral ceilings with exposed wood decking (Figure 6).

Cathedral ceilings provide the builder with additional challenges. With such ceilings, it is even more important to pay close attention to design and workmanship. You must take great care to seal all possible paths of convection of moist, heated air from the living spaces into the rafter spaces and to provide the best possible air-vapor retarder. Recessed lights are out.

The amount of insulation is limited by the depth of the rafters and the ventilation space. The preferred system, in my opinion, is to allow a 2-inch minimum air space under the sheathing, fill the rest of the rafter spaces with fiberglass insulation, and fasten rigid insulation below the rafters.

Now, what will assure that the

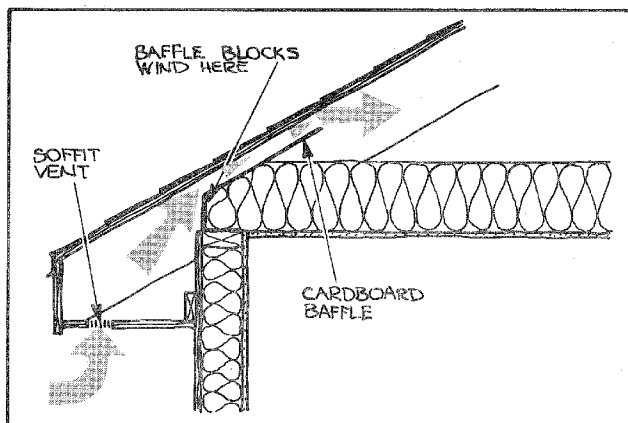


Figure 3. Cardboard baffles have stapling flanges for easy installation. They also have the advantage of folding over the end of the insulation to block out wind penetration.

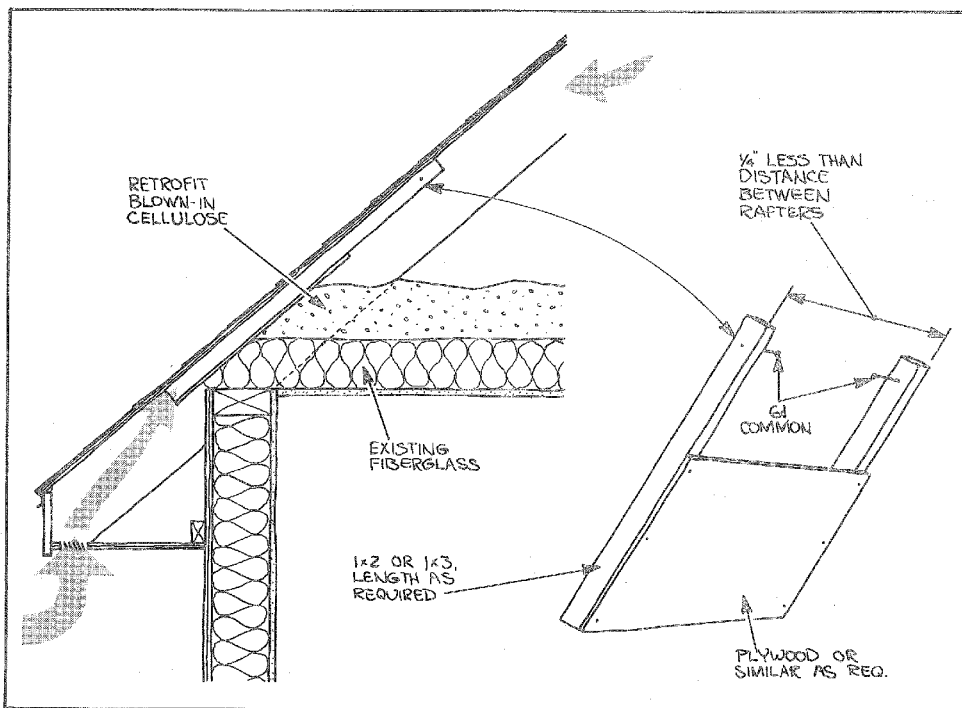


Figure 4. For retrofits, you can fashion baffles from strapping and thin plywood. The strapping extensions form handles to slip the baffle in place, and a convenient place to nail.

# Problem Venting

## How to Handle Hips, Valleys, Sheds & Skylights

When you're working with a straight gable roof, it's not hard to provide effective ventilation. But add an ell, or a few dormers, hips, or other curve balls, and the job can get a lot more complicated, if not impossible. In most cases, "effective ventilation" can only be achieved by using a combination of continuous soffit and ridge vents. This is the approach applied to all the situations discussed below unless otherwise specified.

Roofs with valleys (where an ell ties in) and conventional flat ceilings are not that difficult to handle. The only problem you may run into

is the difference in length between the soffit and ridge. More ridge than soffit venting can lead to weather infiltration through the ridge vent, because the ridge will function as both an air intake and exhaust under some wind conditions. In order to maintain the desirable ratio between soffit and ridge-half at the soffits (combined) and half at the ridge-you may have to double up the soffit-vent strips in the shorter soffit areas.

In the case of ells with cathedral ceilings, the only solution seems to be to notch the tops of the jack rafters by removing a piece at least

1½ inches deep and as long as possible near the valley rafter, letting the plywood sheathing bridge the gap. Cut the vertical leg of the notch parallel to the valley rafter to help increase air flow. Since rafters are generally oversized in cold regions to allow for added insulation, this should not present a structural problem.

Valleys at small dormers can be treated as discussed above.

Hip roofs present a different set of problems. Here, soffit venting is far greater than ridge venting—a more desirable situation than the reverse. (In fact, a little extra soffit venting is probably optimal.) If there are flat ceilings below the attic, just provide soffit venting on all four sides and full-length ridge venting.

In the case of cathedral ceilings in a hip area it gets more complicated. Notching of the jack-rafter tops where they tie into the hip rafters will allow some air movement. (As with valleys, cut the vertical leg of the notch parallel with the hip rafter.) If there's not a small attic space at the top to ventilate into, you'll need to also notch where the hip rafters meet the ridge to allow the air to reach the ridge vent.

An alternative is to install a baffled ridge vent over the upper portion of the hip (although I've never actually done this). If you go this route, make sure you use a baffled vent with the extra weather protection of a fiberglass filter, such as the one made by Air Vent. Be sure you leave a slot open in the sheathing on each side of the hip rafter.

On a complete four-way hip (with no gable ridge), you'll need to vent at the top with a cupola, or with a raised roof cap—made by raising the uppermost portion of each face of the roof and installing Utility Vents on all four sides (similar to the steep-roof ridge vent described in the accompanying article and shown in Figure 5).

Skylights, ever popular, interrupt the ventilation of rafter bays below and above them. The only

strategy here is to notch the rafter tops near the headers to allow air to move to the adjacent rafter spaces. In this case, be as generous as you can in cutting the length of the notches (plywood can easily bridge 16 inches) and cut their vertical legs on a slant following the direction of the air movement: outward at the base of the skylight and inward at its top.

Shed roofs are easy to handle. Use a standard soffit vent strip at the eave. At the ridge, use a half ridge vent with the back flashing turned down at the ridge. These are available from leading vent manufacturers.

Where a shed roof ties into the wall of a second story, such as at a clerestory, use a half ridge vent with the back flashing turned up so it can be tucked under the siding. These are also available from vent manufacturers (see illustration).

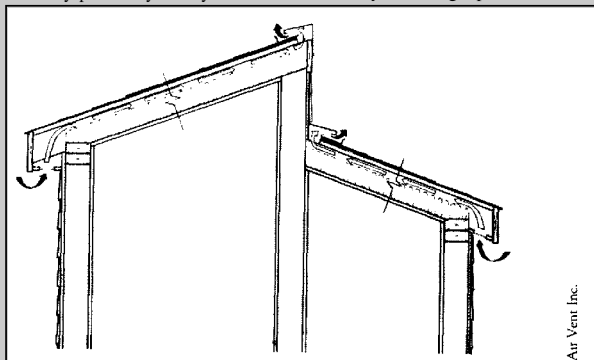
If you are faced with the job of providing ventilation at the soffit of a house with no overhangs, some manufacturers offer drip-edge strips and entire fascias with venting at the bottom.

The main problem you face in these situations is finding the product. The hard part usually is familiarizing your local lumber supplier with what's available and getting him to order it. The best defense is to know exactly what you need and want and to order it well in advance of its scheduled installation.

One of the leading manufacturers and a pioneer of ventilation products is Air Vent, Inc., 4801 N. Prospect Road, Peoria Hts., IL 61614; 800/247-8368 (outside Illinois); 309/688-5020. Ask for their product catalog; you'll find a vent for every conceivable situation you are likely to encounter.

Browning Metal Products Co. also has a number of the vents mentioned above although it doesn't have as wide a selection as Air Vent, Inc. Their address is: P.O. Box 2405, Norcross, GA 30091; 800/841-8970 (outside Georgia) and 800/241-3135 (within Georgia).

—HdM



Major vent manufacturers make special vents for shed roofs and clerestories.

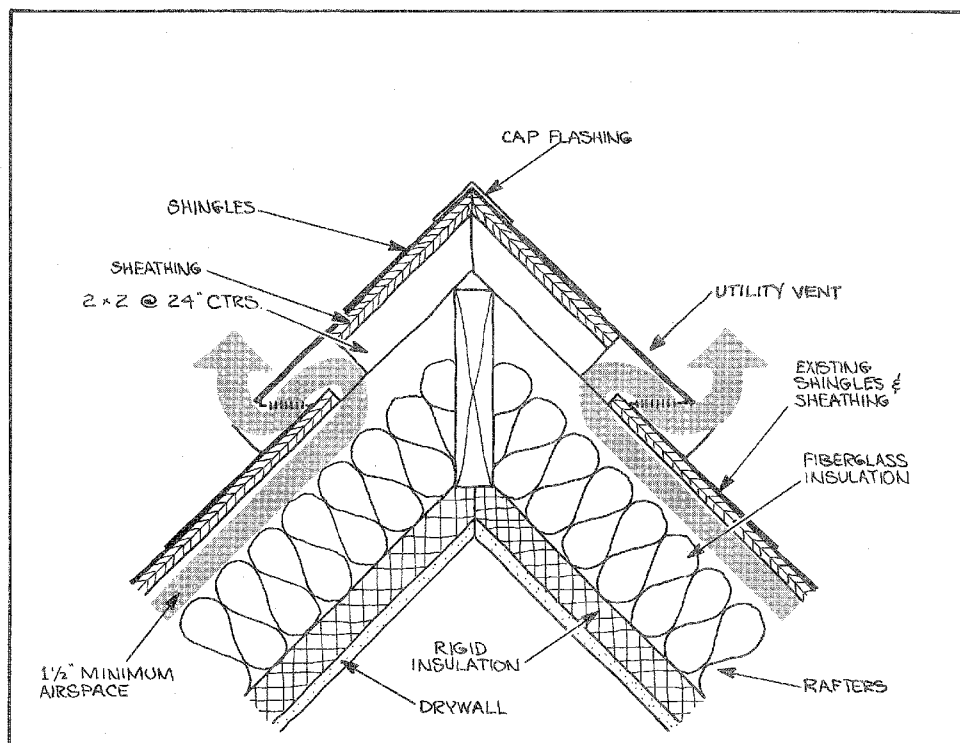


Figure 5. A standard baffle won't work well on steep pitches. A simple site-built vent with two half vents (such as Air Vent's Utility Vent) does the trick.

2-inch airspace will not be restricted by the fiberglass insulation, which might fluff up? Instead of the molded polystyrene vents discussed above, I would suggest tightly stapling nylon cord zigzag to the sides of the rafters no less than two inches below the sheathing. Preferably use two staples at each point and drive them in with a follow-up blow, if necessary.

Another method is to nail 1x3s to the sides of the rafters just below the sheathing and to staple the nylon cord to their edges (Figure 7). This is a stronger, fail-safe system, though more costly.

In conclusion, it is not hard to build an ice-free roof in new construction and it is inexcusable not to do so. It is, however, often much harder to accomplish this in existing houses. Wherever the levels of insulation and ventilation can be improved enough to reach this goal, that is what should be done. But where this is not possible, the next best alternative is to install a product such as W.R. Grace's Ice & Water Shield at the eaves and at all other leak prone points of the roof.

No other procedure, except a metal roof steep enough to shed snow, is truly safe or foolproof. But keep in mind, before replacing the existing roof with metal, that it too has its potential problems (see "Metal Roofs"). ■

*Henry de Marne, a remodeling contractor for many years, is now a building consultant in Waitsfeld, Vt.*

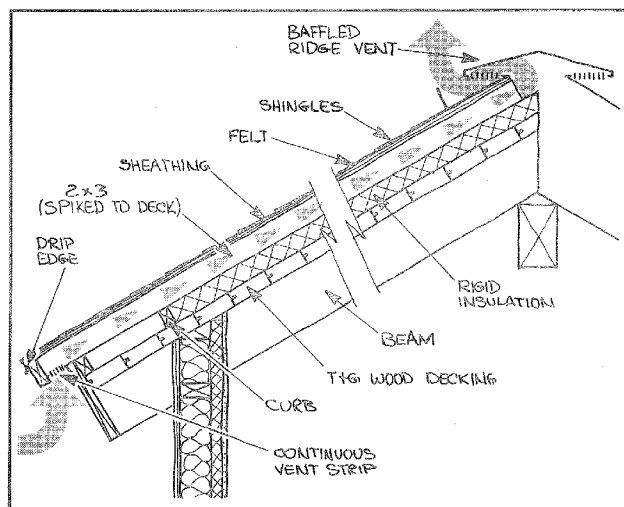


Figure 6. To retrofit insulation into a cathedral ceiling with exposed wood decking (common on log homes and vacation homes) insulation and ventilation must go on top.

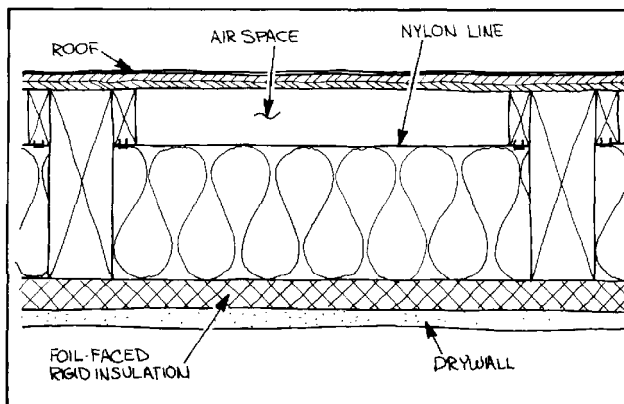


Figure 7. One way to keep insulation from fluffing up and blocking the 2-inch airspace is to string nylon mason's line in a zigzag pattern up the rafter bay.