# Preventing Ice Dams

## Proper insulation and roof ventilation can stop ice dams from forming, prevent damage and lower energy bills

by Paul Fisette

The call came on a sunny February afternoon: "The water line to my dishwasher burst, and I can't shut it off. Can you help me out?" I rushed across town to find a former client stuffing towels into the kick space below his kitchen cabinets. I quickly shut off the water to the dishwasher, but nothing happened. Although there wasn't a pipe anywhere near the leak, water still flowed. Puzzled, I made a brief investigation and found the source. The water running down the wall cavity was from an ice dam on the sunlit roof above.

This account is typical of dozens of ice-dam problems I've investigated as a builder, researcher and consultant. Although individual cases may look different and can result in different types of damage, all ice-dam situations have two things in common: They happen because melting snow pools behind dams of ice at the roof's edge and leaks into the house; and they are avoidable. The symptoms can be treated and the damage repaired, but the key to dealing with ice dams is preventing them in the first place.

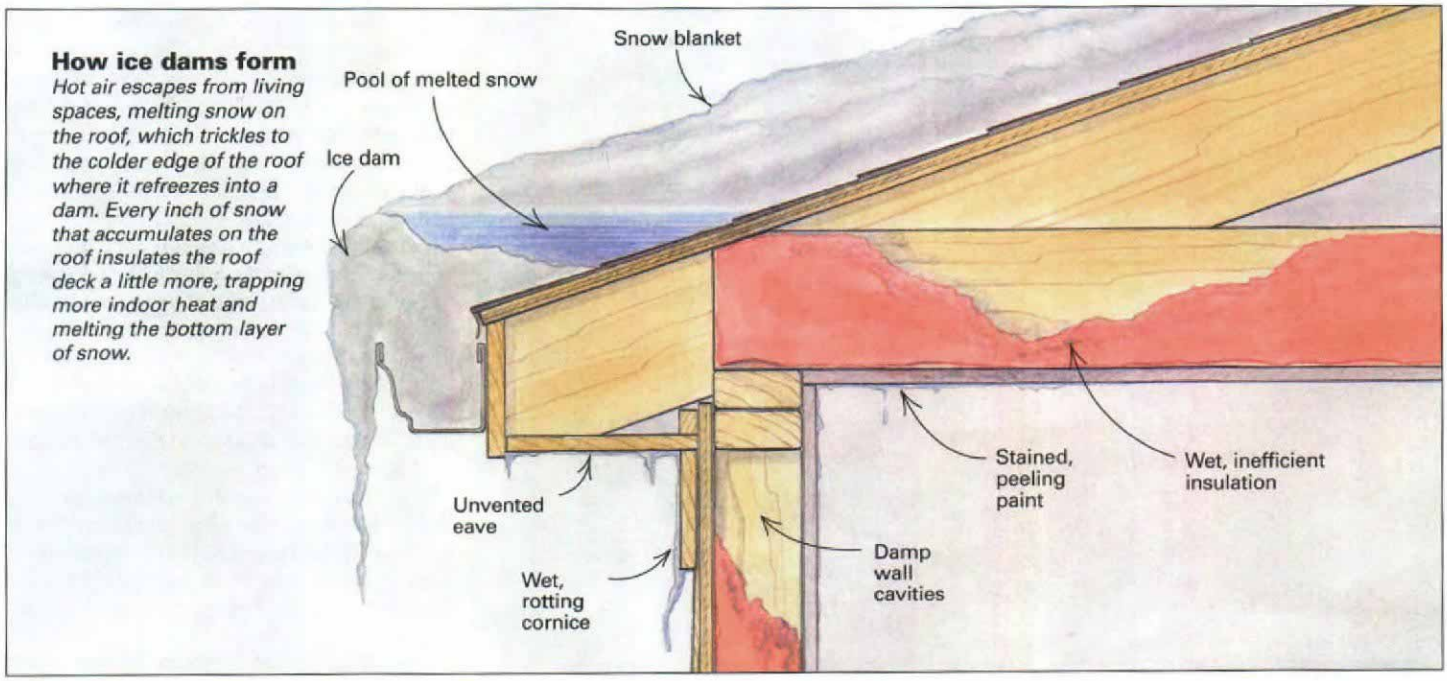
**Ice dams form when melted snow refreezes at roof edges**—Everyone living in cold climates has seen the sparkling rows of ice that hang like stalactites along eaves. Most people, however, don't stop to understand what causes these ice dams until damage is done. Ice dams need three things to form: snow, heat to melt the snow and cold to refreeze the melted snow into solid ice (photo left). As little as 1 in. or 2 in. of snow accumulation on the roof can cause ice dams to form. Snow on the upper roof melts, runs under the blanket of snow to the roof's edge and refreezes into a dam of ice, which holds pools of more melted snow. This water eventually backs up under shingles and leaks into the building (top drawing, facing page).

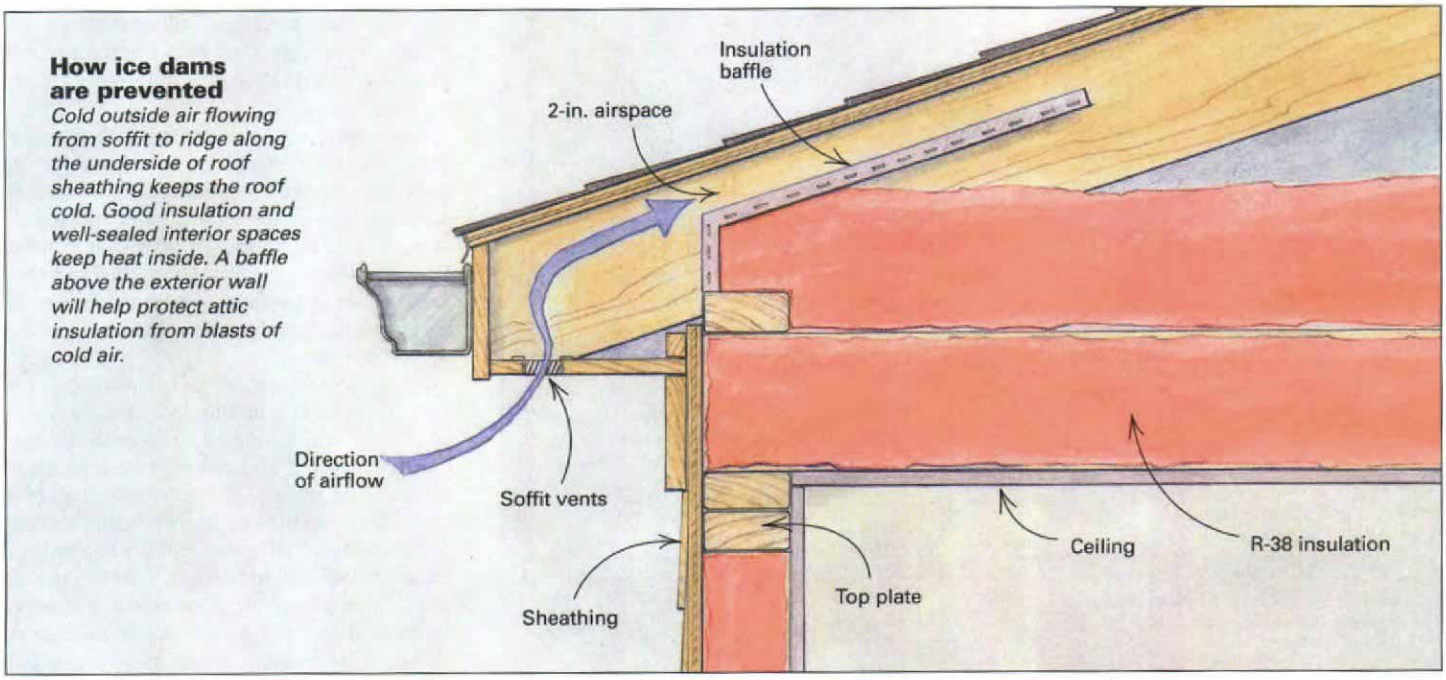
The cause is no mystery. Heat leaking from living spaces below melts the snow, which trickles down to the colder edge of the roof and refreezes into a dam. Every inch of snow that accumulates on the roof insulates the roof deck a little more, trapping more indoor heat and melting the bottom layer of snow. Frigid outdoor temperatures guarantee a fast and deep freeze at the eaves.

There are a couple of reasons for the loss of heat from living spaces. First, on most homes rafters sit directly on top of exterior walls and leave little room for insulation between the top of the wall and the underside of the roof sheathing. Second, some builders aren't particularly fussy when it comes stopping the movement of warm indoor air into this critical area.

**Avoid expensive damage by recognizing the signs of ice damming**—Ice dams cause millions of dollars in damage every year. Much of the damage is apparent. We easily recognize water-stained ceilings; dislodged roof shingles; sagging, ice-filled gutters; peeling paint; and damaged plaster. So check your home carefully when you notice any of these signs.

Not all damage is as obvious as water stains on the ceiling, however, and some hidden damage can go unchecked. Insulation is one of the




biggest hidden victims of leaks. Roof leaks dampen attic insulation, which in the short term loses some of its insulating ability. Over the long term, water-soaked insulation compresses so that, even after it dries, the insulation isn't as thick. Thinner insulation means lower R-values. As more heat leaks from living areas into the attic, it's more likely that ice dams will form and cause leaks. The more water that leaks through the roof, the wetter and more compressed the insulation becomes. Cellulose insulation is particularly vulnerable here. It's a dangerous cycle, and as a result, you pay more to heat and cool your house.

There's more: In the wall, water leaks soak the top layer of insulation and cause it to sag, leaving uninsulated voids at the top of the wall (top drawing above). More heated air escapes. More important, moisture in the wall gets trapped between the exterior plywood sheathing and interior vapor barrier. The result is smelly, rotting wall cavities. Structural framing members can decay; metal fasteners can corrode; mold and mildew can form on wall surfaces as a result of elevated humidity levels; and exterior and interior paint can blister and peel.

Peeling wall paint deserves special attention because its cause may be difficult to recognize. It's unlikely that interior or exterior wall paint will blister or peel while ice dams are present. Paint peels long after ice and all signs of a roof leak have evaporated. The message is simple. Investigate even when there doesn't appear to be a leak. Look at the underside of the roof sheathing and roof trim to make sure they're not wet. Check insulation for dampness.

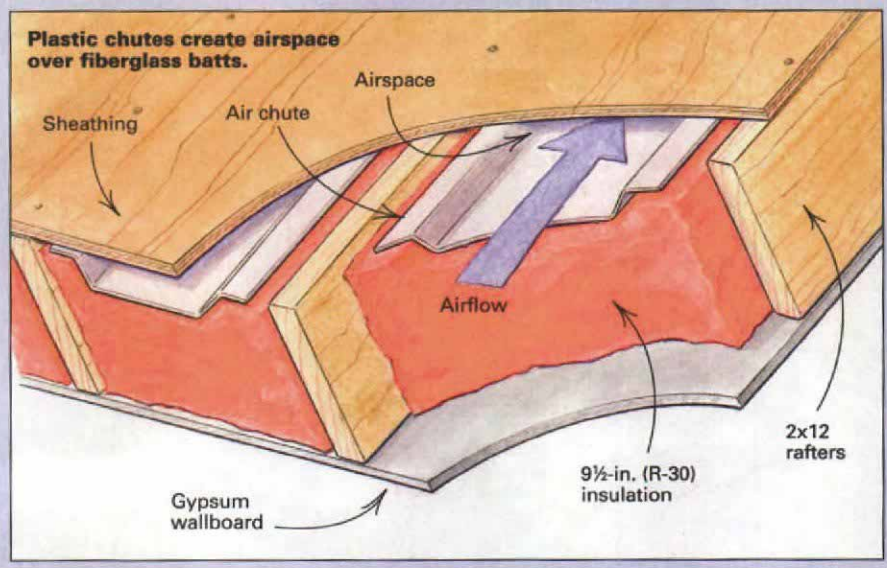
It's often difficult to follow the path of water that penetrates a roof. However, patching the roof leak won't solve the problem. You do need to make sure the roof sheathing hasn't rotted or that other, less obvious problems in your ceiling or walls haven't developed. Once you've got a handle on the damage, it's good to detail a comprehensive plan to fix the damage, but first you need to solve the problem.

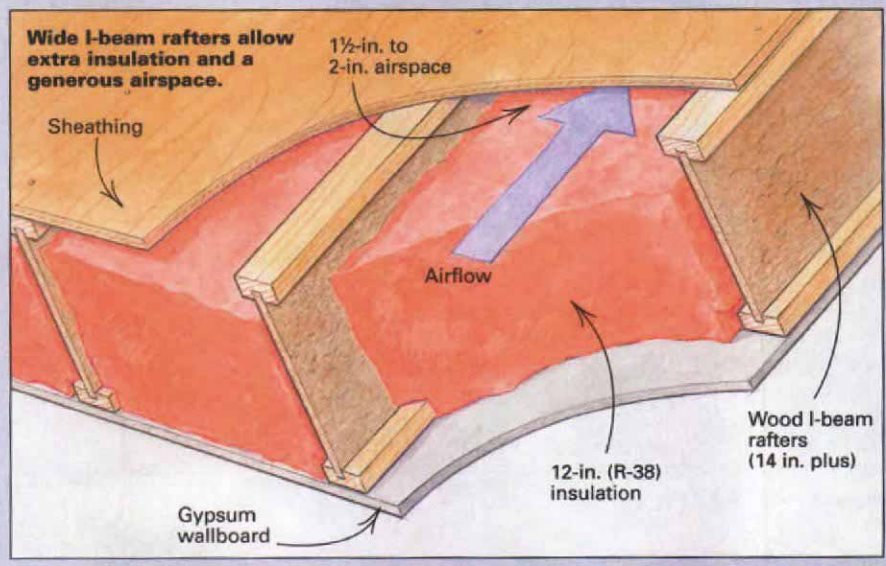
**Keep the whole roof cold to avoid ice dams**—Damage by ice dams can be prevented in two ways: Maintain the entire roof surface at

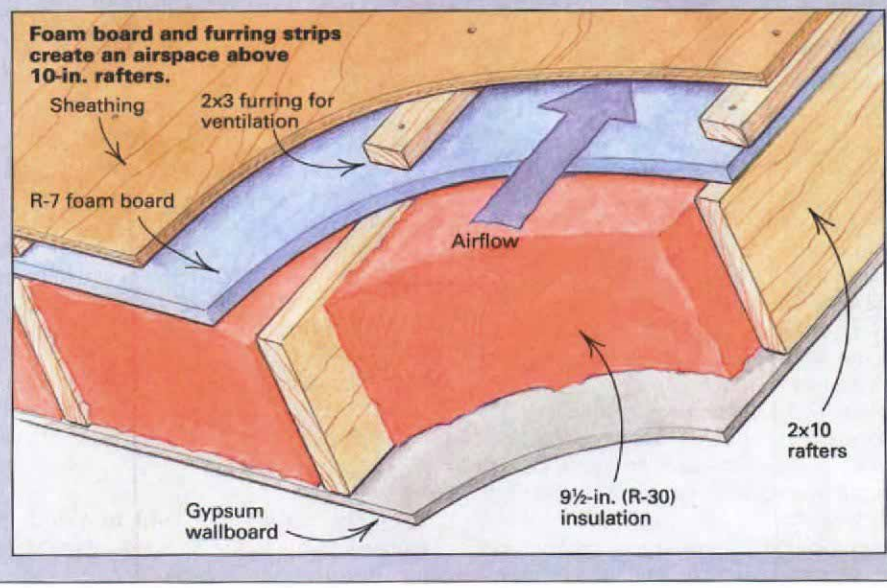
Drawings: Dan Thornton

**Three ways to vent a cathedral ceiling**

*Ventilation in cathedral ceilings is a little trickier than in conventional ceilings, but it is just as necessary to prevent ice damming. Careful sealing of heated spaces and good insulation and ventilation all are required.*




ambient outdoor temperatures so that an ice dam never forms; or build a roof that won't leak if an ice dam does form (bottom drawing, p. 61).

The first choice is definitely the best. Cold roofs make sense because they make the cold outside air work for you. If you keep the roof as cold as the outdoor air, you solve the problem. Look at the roofs of unheated sheds. Ice dams don't form on them because the air inside the roof is as cold as the air outside.

It's relatively easy to keep a roof cold in new construction: Design the house to include plenty of ceiling insulation and effective roof ventilation, and make sure heat doesn't escape from the house into the attic. Insulation retards the flow of heat from the heated interior to the roof surface; good ventilation keeps the roof sheathing cold; well-sealed walls and ceilings keep the heat where it belongs.

In an existing house this approach may be more difficult because often you're stuck with less than desirable conditions. This opportunity is a good point to take a closer look at the issues that will guide your strategy.

**When treating symptoms is the only choice**—The list of efforts to deal with ice dams is long. The problem I have with most of these solutions is that they treat the symptoms of ice damming and don't deal with the root cause, heat loss.

For instance, some people assume they can fix the problem by installing a metal roof. Metal roofs are common in snow country, so they must work, right? Well, a deeply pitched metal roof does, in a sense, thumb its nose at ice dams. Metal roofs are slippery enough to shed snow before it causes ice problems. However, metal roofs are expensive, and they do not substitute for adequate insulation.

Or you might consider using sheet-metal ice belts if you don't mind the look of a shiny 2-ft, wide metal strip strung along the edge of your roof. Ice belts are reasonable choices for some patch-and-fix jobs on existing houses. This eave-flashing system tries to do what metal roofing does, which is shed snow and ice before they cause problems. Unfortunately, it doesn't always work. Often, a secondary ice dam develops on the roof just above the top edge of the metal strip, so the problem simply moves from one part of the roof to another. Ice belts are sold in 32-in, by 36-in, pieces and come with fastening hardware for about $ 12 per panel.

Many people install self-sticking rubberized sheets under roof shingles wherever ponding of water against an ice dam is possible: along the eaves, around the chimneys, in valleys, around skylights and around vent stacks. The theory is that if water leaks through the shingles, the waterproof underlayment will provide a second line of defense.

These products are sold in 3-ft, by 75-ft. rolls for about $80 per roll. They adhere directly to clean roof decking. Roof shingles are nailed to the deck through the membrane, which is self-healing and seals nail penetrations automatically. Grace Ice and Water Shield (W. R. Grace Co., 62 Whittemore Ave., Cambridge, Mass. 02140; 617-

**Continuous vents keep roof washed in cold air.** A ridge vent draws cold air from the continuous soffit vents uniformly across the underside of the roof sheathing.

**Elevated rafters make room for insulation.** The builder made room for a thick blanket of insulation above the exterior wall by nailing the heels of these rafters to a toe board that sits on top of the ceiling joists. This construction method also maintains an adequate ventilation space between the sheathing and the insulation so that air can flow from the soffit vent to the ridge vent.

876-1400) and Ice and Water Barrier (Bird Roofing Products Inc., 1077 Pleasant St., Norwood, Mass. 02062; 800-247-3462) are two common brands. Installing such products is a reasonable alternative for many existing structures where real cures either are not possible or cost-effective.

Heat tape is another favorite solution to ice damming. I have never seen a zigzag arrangement of electrically heated cable solve an ice-dam problem. Electricity heats the cable, so you throw more costly energy at the problem (keep in mind that ice dams are a heat-loss problem). Heat tape is expensive to install and to use. Over time the tape makes shingles brittle and creates a fire risk, and its loose fasteners allow water to leak into the roof. Take a good look at roofs equipped with heat tape. The electric cable creates an ice dam just above it. My advice is don't waste your time or money here.

Shoveling snow and chipping ice from the edge of a roof is my least favorite of all solutions*. People attack mounds of snow and roof ice with hammers, shovels, picks, snow rakes, crowbars and, new to my list, chainsaws. The theory is obvious: Where there's no snow or ice, there's no leaking water. Some people have even carved channels in the ice to let trapped water flow out.

Whatever plan you decide to follow, focus on the cause. Ice dams are created by heat lost from the house. So whenever possible, develop a strategy that includes plugging all heat leaks into unheated spaces. You can use urethane spray foam in a can, caulking, packed cellulose or weatherstripping to seal leaks made by wiring, plumbing, attic hatches, chimneys, interior partition walls and bathroom exhaust fans.

There are no excuses for ice-dam problems in new construction. But in existing houses you can improve ventilation, upgrade insulation and block as many air leaks as you can. However, cures for existing structures are often elusive and expensive, and in some cases you may have to settle for merely treating the symptoms. The payback is damage prevented.

**Prevention is the key in new construction-** Houses in heating climates should be equipped with ceiling insulation of at least R-38, which equals about 12 in. of fiberglass or cellulose. The ceiling insulation should be of continuous and consistent depth.

As I mentioned earlier, the biggest problem area is just above the exterior wall. Raised-heel trusses or roof-framing details that allow for R-38 above the exterior wall—while maintaining room for airflow from the eave to the ridge—should be used in new construction (photo above right). (In existing structures, where there's little space between the top plate and the underside of the roof sheathing, install R-6-per-in. insulating foam). Insulation slows conductive heat loss, but an effort must be made to block the flow of warm indoor air into the attic or roof. Even small holes allow significant volumes of warm indoor air to pass into the attic. In new construction it's best to avoid ceiling penetrations (such as recessed lights) whenever possible.

Soffit-to-ridge ventilation is the most effective way to cool roof sheathing. Power vents, turbines, roof vents and gable louvers don't work as well. Soffit and ridge vents should run continuously along the length of the house (photo above left). A baffled ridge vent is best because it exhausts attic air regardless of wind direction. Exhaust pressure created by the ridge vent sucks cold air into the attic through the soffit vents.

In cathedral ceilings it's important to provide a 2-in. space or air chute between the top of the insulation and the underside of the roof sheathing. The incoming air washes the underside of the roof sheathing with a continuous flow of cold air. The construction of cathedral ceilings requires some special consideration because the ceiling and the roof are the same structure (drawings facing page).

### *Sources of baffles and air chutes*

**ADO Products**
**7357 Washington Ave.**
**Edina, Minn. 55439**
**(800) 666-8191**
**Sells high-impact polystyrene chutes.**

**Guaranteed Baffle Co.**
**P. O. Box 510**
**Bend, Ore. 97709**
**(503) 383-0095**
**Sells air chutes.**

**Insul-Mart Inc.**
**156 Wickenden St.**
**Providence, R. 1.02903**
**(401) 831-0800**
**Sells Proper-Vent polystyrene chutes.**

**Insul-Tray Inc.**
**E. 1881 Crestview Drive**
**Shelton, Wash. 98584**
**(206) 427-5930**
**Manufactures water-resistant corrugated-cardboard baffles.**

I want to add a caution here. Cold air flowing in through soffit vents in any kind of roof can blow loose-fill fiberglass or cellulose insulation out of the way. It will find pathways through batt or roll fiberglass. Unless the pitch of the roof prohibits it, install cardboard or polystyrene baffles in the attic space above exterior walls (bottom drawing, p. 61) to protect insulation from cold air. ☐

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