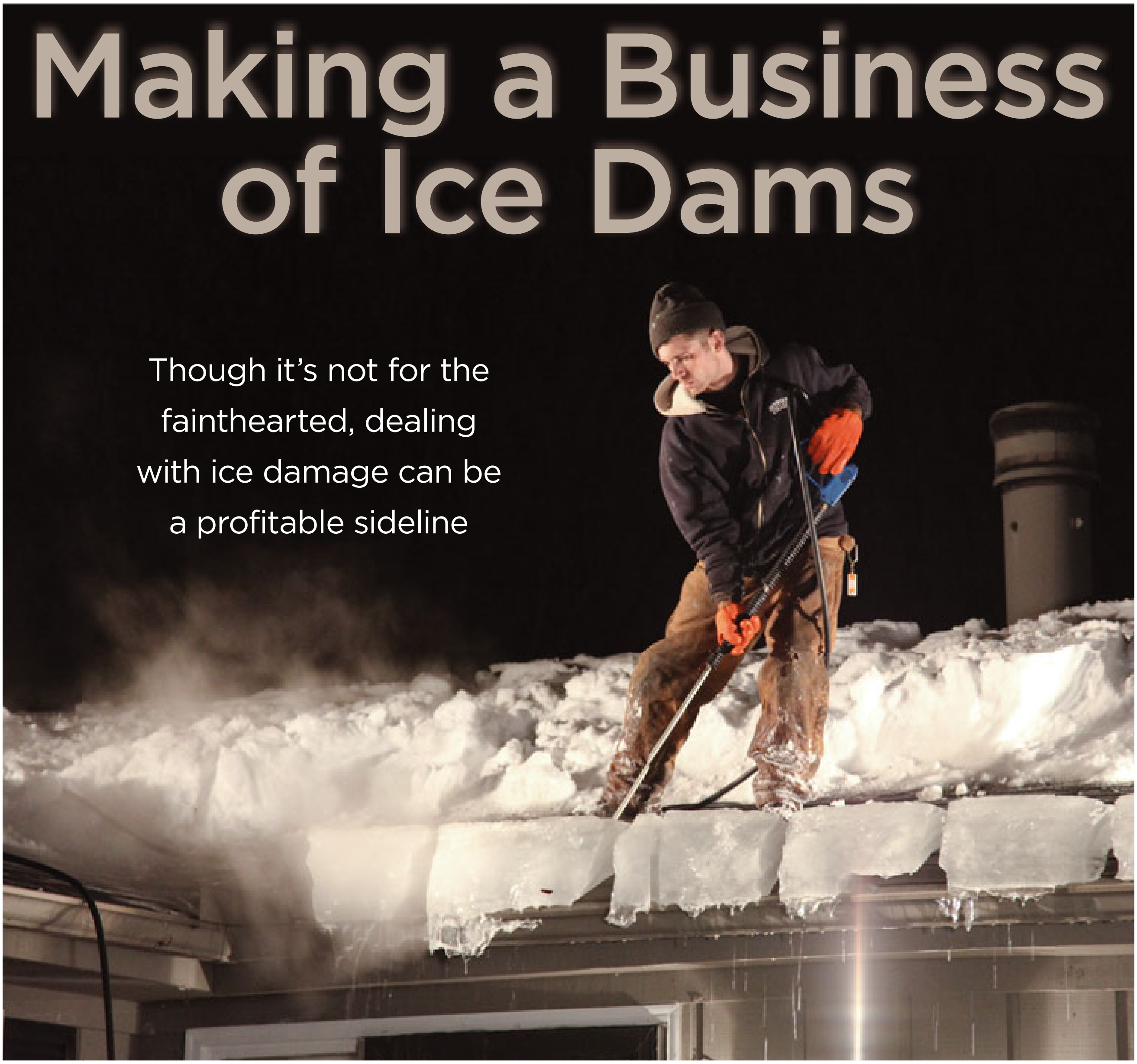
Making a Business of Ice Dams



Though it's not for the fainthearted, dealing with ice damage can be a profitable sideline

by Steve Kuhl

Ice dams cause millions of dollars of property damage across the snowbelt every year. In Minneapolis, we certainly get our share of problems, enough so that a few years ago I decided to add a sideline to my remodeling business — removing ice dams and retrofitting homes with proper air-sealing and insulation to keep them from coming back. It's proven to be a sound strategy: Although our main business is home renovation, removing ice dams has led to a lot of remodeling work. We've done 40 to 50 ice dam retrofits in the past six years and are about to start a $250,000 remodel that grew out of an ice dam job.

We make a point of presenting clients with a few solutions at different price points (**see Figure 1, next page**). For instance, one option might include sealing attic bypasses, installing spray foam insulation, and cutting in new continuous ridge venting, while a second option might be tweaking the existing roof ventilation to improve performance and adding fiberglass batts where they might help. For each alternative we include reasonable expectations in terms of thermal performance and the likelihood of ice damming in the future.

We never claim to prevent ice dams; instead, we tell clients that

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we will greatly minimize their likelihood. Although we write a custom contract for each retrofit job, we always include a stipulation about the importance of keeping snow off problematic areas.

Understanding the Problem

Ice dams form when heat from the house escapes into the attic and warms the roof enough to melt snow on top. (For simplicity's sake, I'm using "attic" to refer to any area between the heated interior and the roof deck, including traditional storage attics, roof truss cavities, and spaces in rafter bays above cathedral ceilings.) Because hot air rises, higher areas on the roof tend to be warmer than lower areas. Snow in contact with roof surfaces with temperatures above 32°F will melt. When that snowmelt flows downslope to a colder part of the roof — typically the eaves, but not always — it refreezes (**Figure 2, next page**). As this freeze-thaw cycle recurs, a ridge of ice develops and traps water on the roof. That water frequently leaks into the home, damaging walls, floors, ceilings, insulation — not to mention the homeowner's sense of tranquility.

Although ice dams are the result of a complex interaction between the snow cover on the roof, the outdoor temperatures, and the heat-loss characteristics of the house, a typical recipe might look like this: Moderate to heavy snow is

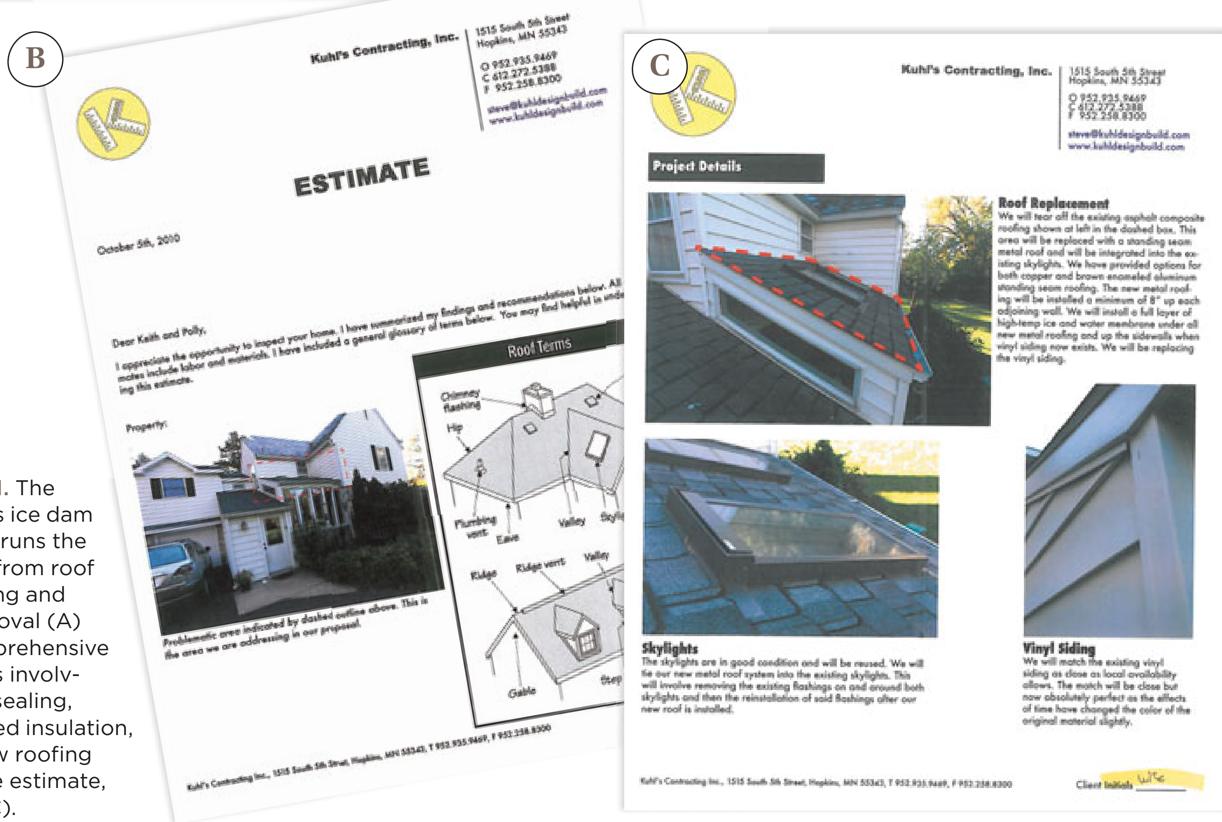
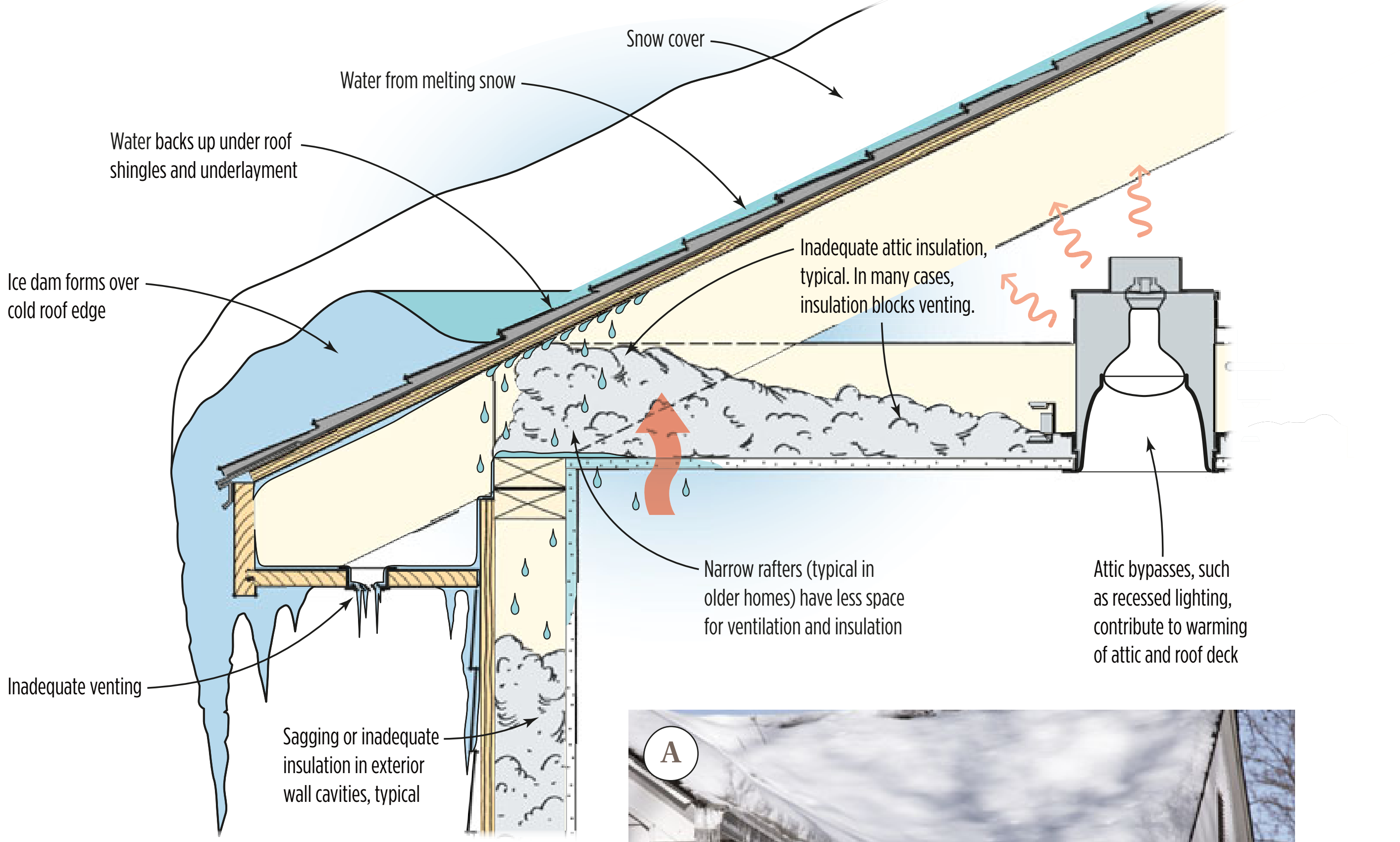


Figure 1. The author's ice dam service runs the gamut from roof shoveling and ice removal (A) to comprehensive retrofits involving air-sealing, improved insulation, and new roofing (sample estimate, B and C).

Ice Damming in Older Homes



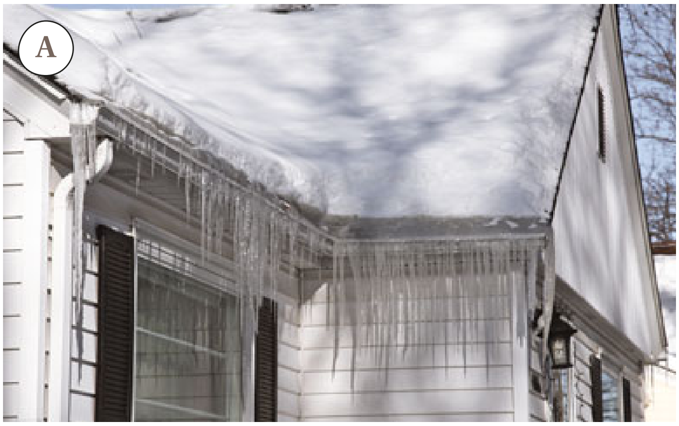
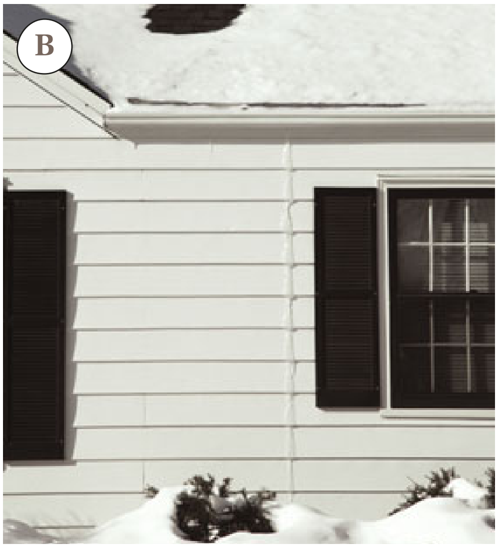
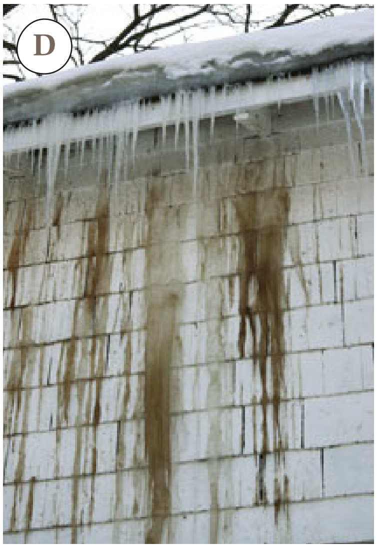


Figure 2. Ice dams form on cold days when heat leaking from inside the home warms the attic enough to melt the snow on the roof (A). Damaging leaks may show up in subtle ways, like this line of ice emanating from behind the siding (B), or not so subtly, in the case of icicles growing out of a soffit (C). Tannin stains on the siding of this home (D) are unmistakable evidence that lumber in the structure is being drenched with snowmelt.





followed by daytime temperatures of 15°F to 25°F. Mix in a dash of rain or dramatic temperature fluctuations and you have the perfect storm.

Why 15°F to 25°F? Because when it gets much colder than that, the average home, at least in our area, has enough insulation to prevent the roof deck from warming to the point where snow melts. Conversely, when temperatures reach into the 30s, the snow on the roof melts away too quickly for it to refreeze.

In theory, preventing ice dams is simple: Keep the roof surface cold. That means good air-sealing to prevent warm indoor air from leaking into the attic; enough insulation to prevent conductive heat losses; and adequate ventilation, to allow any heat that does make its way into the attic to mix with outdoor air before it warms the roof sheathing.

First, Some Misconceptions

Sometimes contractors who try to prevent future ice dams may make things worse, often because they don't understand the problem and where to focus their efforts. For example, there seems to be a widespread belief that simply adding more insulation will cure any thermal ill, including ice damming. The truth is that a bad insulation job can be more hindrance than help. I've seen many homes with insulation crammed into soffits or blown into eaves in an attempt to prevent future ice dams cheaply. But this extra insulation may also increase the risk of ice problems by blocking the soffit vents and trapping heat and moisture in the attic.

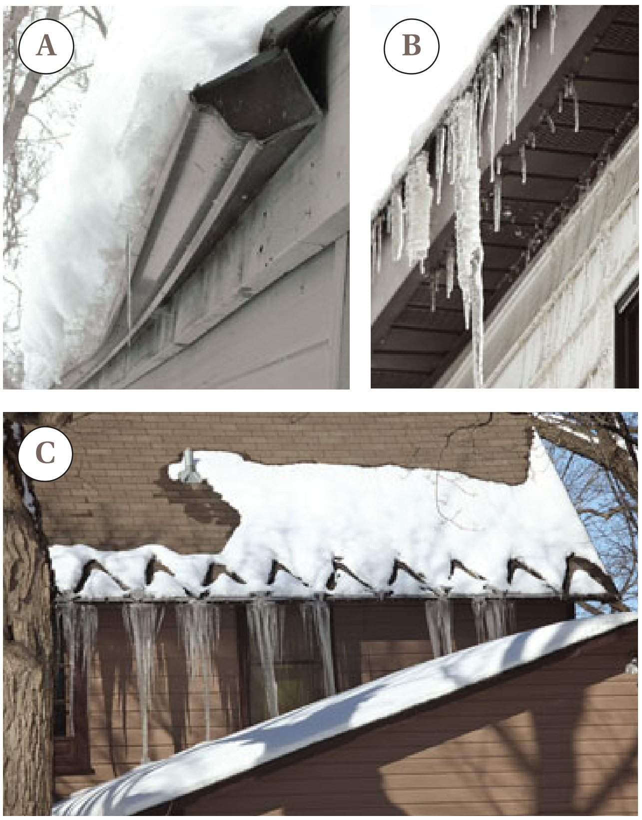


Figure 3. While gutters are often damaged by ice (A), they are not the cause of ice dams (B), as is commonly thought. Another misconception is that electric heat cables can prevent ice problems (C). Besides being largely ineffective, heat cables consume a lot of electricity and can burn out quickly.

Before looking at details that work, I want to look at some of the most common misunderstandings we've encountered over the past 20 years.

Myth #1: Ice dams happen only on older homes. Ice dams are often associated with older homes, but newer homes are not immune. Of the nearly 300 ice dams we removed last winter, about one quarter of them were on homes built within the last 20 years.

Myth #2: Ice dams happen only at the eaves. While most ice dams do form at the eaves, about 20 percent of the ice dams we deal with are in less obvious locations, including:

- Valleys. I've seen ice dams grow 12 feet up valleys, where they force water under the shingles and valley flashing high up on the roof.
- Shed dormers, roof pans, or other low-pitch areas. Ice dams can cover large areas on low-slope roofs and cause major leaks without ever forming those telltale icicles. We have removed ice dams that were invisible from the street yet covered an entire shed roof or pan area. In general, lower pitch roofs suffer more from ice dams than steep roofs do.
- Roof penetrations. We see mini ice dams around all types of roof penetrations, including skylights, bath fans, chimneys, and plumbing vents. These are extra sneaky because they are virtually invisible from the ground.

Myth #3: Ice dams are related to gutters. The fact is, gutters do not cause or even increase the severity of ice dams. We remove ice dams from many homes without gutters every year, and in the past 20 years I have seen no compelling correlation between gutters and ice dams. Because ice weighs almost 60 pounds per cubic foot, however, ice dams can certainly damage gutters (**Figure 3**).

Myth #4: Size matters. An ice dam does not have to be big to cause big damage. Even an inch of ice can force water into the structure, especially on low-pitched roofs.

Myth #5: Self-adhering membranes will prevent leaks. Many owners believe that self-sticking bituminous eaves membranes — the various "ice shield" products — will protect their roof from ice damage. In fact, of all the homes we are called to visit because of water damage from ice dams, well over 90 percent already have membranes installed per code at the eaves and valleys. Not only is every nail hole a potential leak, but ice is strong enough to work its way up under the laps in the membrane. While self-adhering

Figure 4. Uninsulated can lights are a common source of attic heat (A). Leaks around bath ceiling fans (B) introduce moisture as well as heat, as evidenced by mold on the sheathing in this attic. In one home, a disconnected vent pipe led to icicles inside the attic as well as ice dams on the roof (C). Frost can build up in the attic even when there is no ice on the roof (D); this is an insidious problem, as it can take weeks to detect.

membranes reduce the severity of leaks, they do not prevent them altogether.

Myth #6: Heat cables are the answer. Electric ice-melting cables installed at the eaves are sometimes appropriate as a last resort, but only after you have taken the other measures described in this article. And be warned: Cables can also create problems. For instance, they can cause leaks if the ice around the cables melts but there is no way for water to drain to the ground. Heat cables can also dry out asphalt shingles, causing them to become brittle and crack, thus voiding the shingle manufacturer's warranty. Most heat cables last only a few seasons, giving homeowners a false sense of security. And of course heat cables at the eaves do nothing about ice further up on the roof.

Myth #7: Salt will do the trick. Sodium and calcium compounds may melt ice, but they also shorten the life of metal flashings and gutters and can damage landscape vegetation and certain types of pavers. Given the potential risks, I would never recommend using salts to remove ice dams.

Remediation: Air Sealing First

Although a surprising number of contractors neglect air-sealing, it's perhaps the most crucial step in preventing ice dams. Warm air will always find a way to get through the ceiling plane and into the attic. These leaks are called thermal bypasses, and the goal of proper air-sealing is to minimize them as much as possible. The good news is that most bypasses can be sealed with a trained eye, a can of spray foam, and a little elbow grease (see "Air-Sealing Attics in Existing Homes," 2/08). First you have to find them. The best way to detect bypasses — and indeed to figure out the overall thermal behavior of the house — is to conduct a heat loss study. This can involve blower-door tests, infrared cameras, and other specialized inspection equipment. For the client with an adequate budget, a blower-door test is a great first step. Fortunately, most bypasses should be obvious to an experienced remodeler even without these sophisticated methods.

In the attic, look for gaps around bath and kitchen exhaust fans, plumbing vents, recessed lights, plumbing and wiring penetrations, and attic hatches (**Figure 4**). Top plates at partition walls are another source of leaks. We usually pull back the insulation at these spots and seal them one at a time. On some older leaky homes, we completely remove the deteriorated insulation, then seal the leaks and reinsulate the attic. By placing a few 500-watt halogen lights in the rooms below the attic, we can quickly find the major bypasses by looking for light pouring through the gaps.

Recessed lights. The recessed ceiling lights in many older

Figure 5. Inadequate insulation (manifested here as lines of snowmelt along the rafters), a narrow, poorly ventilated soffit, and heat loss around the skylight all contributed to ice dams on this house (A). Low-slope roofs, like the one on this shed dormer (B), are commonly plagued with ice dams. In this retrofit job, the author has used two-part spray foam to thoroughly seal and insulate a pair of skylight wells (C).

homes aren't IC-rated, so they can't be directly covered with insulation. These lights can throw off enough heat to cause snow-melting problems by themselves. At a minimum, we advise the homeowner to switch to compact fluorescent bulbs, which produce far less heat than incandescents.

The best remedy is to replace the old fixtures. If that's cost-prohibitive, we cover them with site-built rigid-foam insulation boxes made from 3⁄4-inch foil-faced insulation board. (These boxes are also available at some insulation supply shops.) For fire safety, we make the boxes big enough to leave 3 inches of air space around the fixture, then place them over each fixture and seal them to the top of the ceiling vapor barrier with standard silicone. Even IC-rated fixtures are seldom airtight, and can add plenty of heat to the attic, so we often cover them with insulation boxes as well.

Hvac ducts. Don't overlook ducts running through the attic. Many are so poorly insulated and sealed that they blow hot, moist air into the attic all winter. The simplest remedy is to seal the duct seams with foil tape, then wrap the ducts with foil-faced batt insulation.

Gaps around chimneys. Don't forget the space between the framing and the chimney, where fire codes require a separation. Here we use sheet metal, bent on site, to bridge the gap, then seal the joints with a firestop caulk.

Attic hatches. One place you can't seal permanently with foam is the attic hatch. Existing hatches can be retrofitted with rubber gaskets, weatherstripping, and layers of rigid insulation. When possible we prefer to install a prefabricated hatch with an integrated gasket, such as the EZ Hatch from Battic Door (batticdoor.com).

The Role of Roof Design

Much of the typical advice on ice damming overlooks the role played by home design. For example, it's clear that complex rooflines increase the likelihood of ice buildup. Dormers, valleys, and other breaks in the roof plane are all places where insulation has to be cut, seamed, and fit into place. Plus, these areas are frequently difficult or impossible to adequately ventilate. The solution isn't to get rid of these features, but to do a better job with air-sealing, insulation, and ventilation in the original construction.

Skylights. Any penetration through the ceiling is an opportunity for heat to escape into the attic, and skylights are no exception (**Figure 5**). Wells connecting the skylight with the ceilings are usually wrapped in fiberglass batts, which tend to settle and sag over time, resulting in heat loss. That's why I use spray foam around all such penetrations, even if the rest of the house is insulated with batts. Closed-cell spray foam seals any air gaps and provides an R-value of 6.5 per inch.

Cathedral ceilings. With a cathedral ceiling the chance of ice damming rises exponentially, particularly if there are skylights or recessed lights. Even with insulation installed to code, cathedral

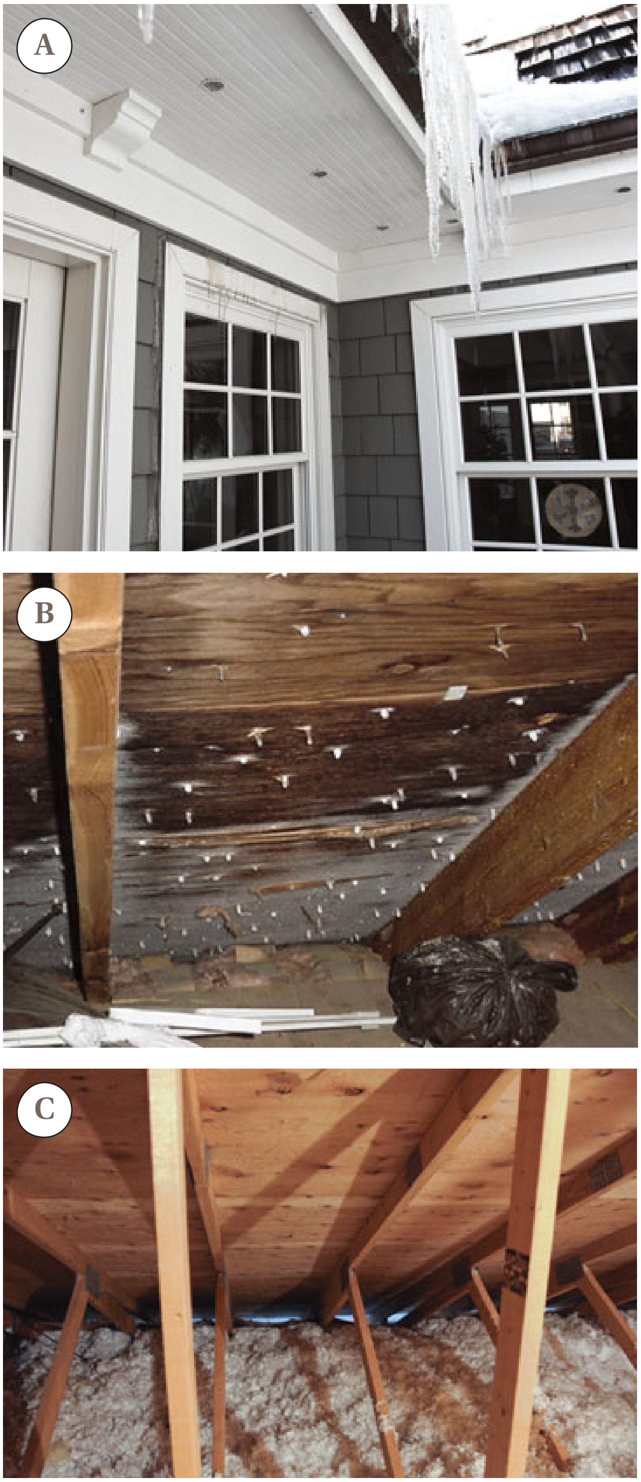


Figure 6. While in theory soffit vents should allow enough cold outdoor air into the attic to prevent snow on the roof from melting, they are often either too small (A) or blocked by insulation (B). Daylight at the eaves is a sign that there is at least some airflow through the soffit vents (C).

ceilings by their very nature allow interior heat to get closer to the roof deck. There is also far less space for efficient ventilation, making them a great breeding ground for monster ice dams.

Shed dormers. In some older homes, shed dormers with 2x4 or 2x6 rafters make it impossible to get enough R-value from fiberglass. Here I use closed-cell spray insulation to create a hot roof with no roof ventilation. Although some people have theorized that hot roofs aren't a good choice for snow country, I have had no problems with these installations.

Eaves. In general, the smaller the eaves, the more likely the home will have ice dams. Small eaves have less room for vents, and the smaller vents are more likely to clog (**Figure 6**). A few paint jobs can be all it takes to choke off adequate air flow. To test soffit vents, we use a yard blower to move air up through the vents, with someone stationed in the attic to make sure the air paths are clear. (Bring your dust mask!) If the lights are off, the person stationed in the attic should also see daylight coming in at the eaves or through the insulation chutes. While we're at it, we also look for daylight coming through the upper half of the vent system — ridge vents, gable vents, or box vents.

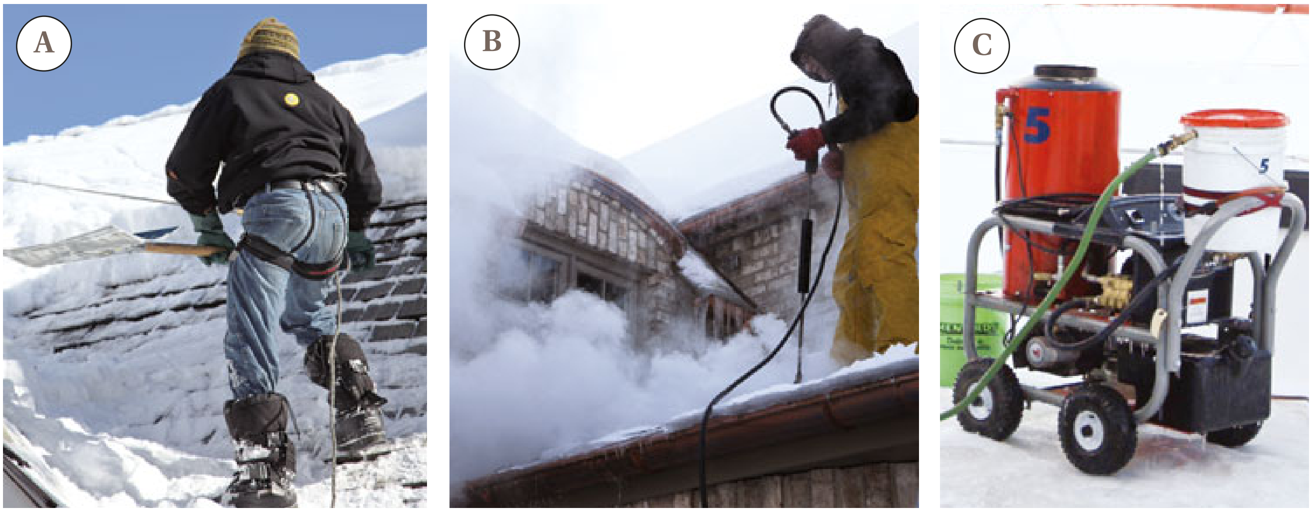
I seldom see an overventilated attic. You want as much airflow through the attic and truss spaces as is reasonably possible. Unfortunately, most homes we see have minimal attic ventilation. On homes troubled with frequent ice dams, I recommend adding more ventilation whenever possible, especially on a complex roof. One way to do this is to add gable vents, which in my opinion are underused. When it's architecturally appropriate, we install gable vents in addition to soffit vents. As a rule, houses built after 1955 tend to have better roof ventilation than older homes.

Roofing types. On very shallow roof slopes we try not to use asphalt shingles, even if it's allowed by code. Where it fits with the home's design, a single-ply roof system like EPDM is a great choice. If the roof is visible from the ground or from inside the home, I prefer metal roofs, either standing seam or soldered flat seam. Architecturally, metal roofs look great on low slopes, even if the rest of the roofing is a different material.

Removing Snow and Ice

Besides being a profitable side business in our climate, snow and ice removal is a great way to connect with prospective clients. If your company doesn't do roofing, you can probably contract with your favorite roofers to do the snow removal. They will have the necessary insurance and safety equipment, and will probably be happy to have work during the winter. As for us, we perform all of our work under rope and harness to keep things safe (**Figure 7, next page**).

When to remove snow from the roof depends on the house: Some homes can handle 10 to 20 inches before we worry; others can start having problems at 2 inches. It also depends on what we



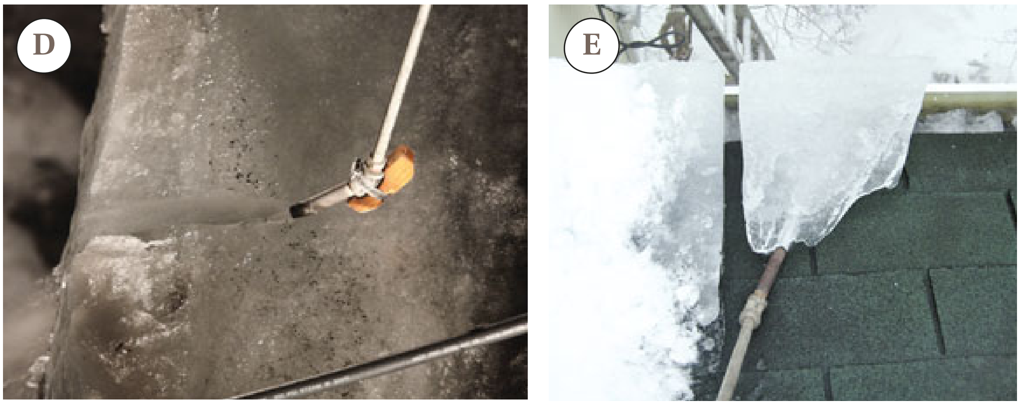


Figure 7. The author puts safety first when mounting roofs to remove snow and ice (A). The crews use commercial-grade steamers (B), modified for easy flushing with antifreeze (C), to cut ice into chunks that can be safely tossed to the ground. A wood block attached to the base of the steamer wand (D) prevents damage to asphalt shingles (E).

can negotiate with the client. In some cases they might want us to come out only when there's a snowfall of more than 4 inches. Or they might like to receive an e-mail whenever conditions are right for ice dams.

Snow can be removed with roof rakes, a stiff broom, and a plastic shovel. It's important to use plastic rather than metal to lessen the chance of damaging the roof shingles. In most cases — though it's more expensive up-front — I recommend removing all the snow from the roof rather than just the bottom few feet. After all, it's the snowmelt from the upper half of the roof, where the warm air in the attic collects, that feeds the ice dam.

Removing ice dams is a bit tougher. We have repaired hundreds of roofs that have been damaged by homeowners and even well-intentioned professionals using hammers, picks, and hatchets to attack the problem. No matter what anyone says, never trust those kinds of tools for removing ice dams; companies that use those methods due so only because they can't or won't invest in professional equipment.

Our company has been using commercial steamers for over 20 years. When used properly, steamers are very effective and totally safe for roofs. Even so, I've seen terrible damage done to homes by inexperienced users. Steamers are powerful but finicky machines. The problem is that you're running cold water outside in a hose, and unless you know what you're doing, that water is going to freeze and ruin your $5,000 steamer. Over the years we've modified our machines to keep everything running in the cold, using a system that allows us to flush the steamer with anti-freeze between jobs. We collect and reuse the anti-freeze with each cycle.

Another simple modification we made was to clamp a piece of oak to the bottom of the steamer wand. Though the wand can heat up to 300°F, the oak keeps it off the roof surface so that it doesn't mar the asphalt shingles. We use the steamer to undercut the ice dam and to slice it into blocks about 12 to 18 inches long, depending on the thickness. Then we gently pick up each block and throw it off the roof, making sure there is nothing or no one below (the blocks weigh 40 to 60 pounds apiece).

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