

Re-examining Roof Ventilation as a Moisture Solution

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Key Words

Attic ventilation, moisture control, ice damming.

Abstract

A new business opportunity is being created in cold-climate areas, as roofing contractors work with home - performance contractors to address issues of liability, technical innovation and customer service.

The world of roofing contractors is changing quickly. Only a year or so ago, roofing contractors were blamed for ice damming and wet-attic problems. The solution was simply to add attic ventilation in many cases beyond building code requirements. Why? Because it was the only choice. To provide a homeowner with a full manufacturer's warranty, ventilation had to be installed according to the requirements of the local building code: typically 1 ft² of ventilation for every 300 ft² of insulated attic space and twice that amount for low-slope roof systems.

Unknowingly, the roofing industry was making the wet-attic situation worse. How? Roofing contractors were following the correct procedure for ventilation but solving only part of the problem instead of the whole problem. Ventilating a previously unventilated attic has the effect of making the attic colder. This may help reduce or even eliminate ice damming, but if nothing is done to stop warm, moist air from entering the attic space from the living space, condensation of the moisture in this air on the now cooler surfaces is almost a certainty. Mold, mildew and, eventually, leakage into the living space will probably follow. Insulation contractors, armed with the same lack of information about attics as roofing contractors, have caused similar problems. Insulating an attic floor makes the attic colder in the same way as adding ventilation. But if contractors don't air-seal as well as insulate, they don't stop warm, moist air from entering attics and causing significant problems.

Now, thanks to public debate, re-education and the publication of *Attic Venting, Moisture and Ice Dams*, a report by Canada Mortgage and Housing Corporation (CMHC), roofing contractors know much more about what's happening, why and what to do about it.

Author

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The Problem

Wet attics are a continent-wide problem. This problem has been identified and verified by the Institute for Home and Building Safety in Boston, an insurance-funded group that investigate, advise and demonstrate curative and preventive measures for any potentially catastrophic loss. Of \$50 million worth of claims received by insurers in southwestern Ontario during a January 1999 storm, much of the property damage involved ice damming and seepage according to the Insurance Bureau of Canada. A recent article in *Canadian Roofing Contractor & Design* asked the question: "Who's responsible for snow or ice falling from the roof?" (And possibly injuring or killing innocent passersby. Insurers, like roofing contractors, were unaware until recently that ventilation was not always the sole solution to the problem.

Spores of mold and mildew are showing up far often in too many homes sometimes in houses not yet two years old. Small children, elderly people, and people with allergies or respiratory problems are especially at risk. Asthma levels in Canada have increased threefold during the past 20 years; this is blamed largely on the increase in bacteria, mold and chemicals in the home atmosphere. Health, comfort, structural durability, asset value and energy costs are all affected by wet-attic problems. The new understanding of why these problems occur and of the real role of attic ventilation is good news for roofing contractors. By bringing in experts to help prevent recurrence, the roofing contractor can provide better service, reduce callbacks and better protect the product warranty. It also means extra business for home-performance specialists because roofing contractors, in general, do not want their workers performing weatherization services in attics.

CMHC's new report is the strongest official document to date that puts attic ventilation in proper perspective. Ventilation is often needed to keep attics dry, but in a growing number of cases, it cannot cope with the moisture load coming from inside the house. This load can be reduced by preventive measures. According to most experts, the No. 1 priority in coping with attic moisture problems—including ice damming and condensation—is to stop the air in the attic from becoming warm and moist from internal sources.

Ice damming occurs when snow on a roof melts at the roof covering level. This occurs because of the combined effect of heat flowing from within the house and insulating effect of the snow. As the melted water runs down the roof, it tends to freeze at the eaves because no heat is flowing out of the building at the overhang portion of the roof - the temperature is the same on both sides of the roof. If the water collects because of the dam created by the ice, it will run under the shingles and underlayment and

potentially wet the sheathing and/or drip into the building. The heat required to cause ice dams can be delivered to the underside of the sheathing either by flowing through an insufficient amount of insulation (common in older roofs and new roofs with inadequate design) or because of warm interior air leaking into the attic.

Ventilation of sloped roofs is one solution to ice damming in a properly designed roof. Cold outside air removes the small amount of heat that passes through modern levels of insulation thereby maintaining the sheathing near the outdoor temperature. Hence, minimal melting occurs. Unfortunately, if the flow of heat is excessive, ventilation alone may not be enough.

If the cause of moisture problems is caused by interior air leaking through the ceiling plane and condensing on the underside of a roof deck, adding ventilation is likely to cause more problems. Why? Because adding ventilation will encourage air leaking through the ceiling plane and likely reduce the temperature of the roof sheathing. In many poorly built or older homes, a roof plane provides the most resistance to airflow. It is, in effect, the best air barrier provided (even if it is leaky). Adding ventilation without ensuring that an air-barrier plane exists at the level of the ceiling plane can, therefore, greatly increase airflow.

Cause and Effect

Ice damming and attic condensation, or wet attics, are symptoms of similar problem conditions in a home. They can be blamed on a range of usual suspects—inappropriate design, poor construction techniques and workmanship, poor communication between trades, location of heating and air-conditioning ducts, and botched renovations. In addition, many people crowded into one living space—all of them taking showers, cooking and drying clothes indoors—can send indoor moisture levels soaring. There may be no single cause. An indoor relative humidity of 50 percent can cause problems in an attic with major bypasses, and a humidity level greater than 65 percent can move through small cracks and create damage.

Solutions center on isolating an attic in cold and moderate climates making it completely independent from the rest of the house. This will ensure that warm, moist air in the living space cannot get into the nonconditioned space in the attic. Keeping the attic sealed off from the living area (using air-leakage control measures to seal holes, cracks and gaps) is key. It is important to add insulation as appropriate to keep the attic cold, but insulation without sealing can make matters worse.

Southern climates—particularly those with high outdoor humidity -- may be approached differently, of course. Isolating attics with ductwork and mechanical equipment is more complicated because it is harder to define the thermal boundary of the living space. Nevertheless, the rule remains same: Prevent warm, moist air from finding its way to cold condensing surfaces.

One-Step Cure and Prevention

The author's firm has created a residential comfort-contracting division to work with its local roofing, insurance and home-inspection services to solve wet-attic problems. As a referred or consulted contractor, the division usually arrives on the scene once the roofing contractor has discovered the problem. If rotting, moldy or mildewed wood has been found, cleanup and, possibly, replacement may be required before the comfort contractor can start work.



Photograph 1: Rotting wood is fragile and dangerous, as this pocketknife test shows.

After a blower-door test, visual inspection or both have been completed, remedial work begins. All the typical sites for potential leaks must be checked and corrected if needed (see Table 1). Crews have learned to watch out for unusual air bypasses to the attic that have been created by a original contractor or homeowner, including laundry chutes, retractable projection equipment, huge wall cavities, bulkheads, skylights, furnaces and air-conditioning equipment.

A trained, two-operator crew uses a specially formulated two-component polyurethane foam attic sealing spray as its primary air-sealing system. The spray is pressurized and blows away dirt as it is applied. The crew wears complete safety gear whenever it is working in an attic. This includes a disposable Tyvek suit with a hood, gloves, safety glasses and a respirator designed to cope with organic vapors. The two cylinders of foam are placed near the center of the attic, usually across two beams for extra support. With a 30-ft hose assembly, it is often possible to reach almost every corner in an attic without moving the cylinders. If the existing insulation smells or makes it impossible to perform remedial measures, it may need to be removed and replaced with new insulation.



Photograph 2: A crew always wears complete safety gear, including disposable Tyvek suits. Here, one crew member is foaming into block cores to stop stack effect within the party wall.

Leakage Path	One-component foam	Two-component foam	Other
Attic Hatch			Weatherstrip, caulk, latch, insulate
Ducting		Yes	Insulate to R-12 (2" or more of foam), cover with additional attic insulation
Chimney Stacks			Drywall and high-temperature caulking
Electrical Penetrations	Yes	Yes	Or caulk
Plumbing Penetrations / Vent stacks	Yes	Yes	
Top Plates		Yes	Or caulk
Recessed Ceilings		Yes	Stuff with batts first
Knee Walls		Below wall between joists	Mineral fiber batts on vertical walls
Perimeter and party walls		Yes	Drill or punch block cores in lowest course above ceiling -- then fill with foam
Light Fixtures			Caulk from below
Recessed Lights		Yes	Plus sealed drywall box around unit

Table 1: Typical Air and Heat Leakage Paths and Means to Seal Them

Individual crews have their own preferences about how to divide the work depending on accessibility and the type of roof. Common sense suggests that an attic be divided into manageable sections. In each section, the first operator exposes top plates at the perimeter and interior walls by clearing any blown insulation and lifting batts or other insulation away from the area to be sealed. The second operator follows and lays one or more continuous beads of foam from the attic-sealing kit to seal the leaks. As soon as the foam cures—a 30-second process—the second operator lays the existing insulation on top of the seal. Soffit vents are added or improved taking into account homeowner preferences for exterior aesthetics.

For kneewalls, the top plates and joist cavities under the half-story are sealed with foam, and the vertical wall is insulated using mineral fiber batts. Ventilation requirements are frequently coordinated with the roofing contractor.

As the operators move along the top plates, they deal with any electrical or plumbing penetrations. For recessed light fixtures, a drywall box can be built and foamed to seal the edges.



Photograph 3: The crew lays continuous beads of foam to seal all leaks.

Heating ducts in attic spaces cause many roof problems (see Figure 1). In homes that have recently been converted from electric to gas heating and have suddenly started experiencing roof problems, ducts should be the first suspect. In general, ducts are frequently damaged, have leaky joints and are poorly insulated. They are nearly always guilty of bringing warm, humid air into an attic. All ducts need to be sealed and insulated to at least R-25. The crew encapsulates the ducts completely and seals everything to the air-barrier plane.

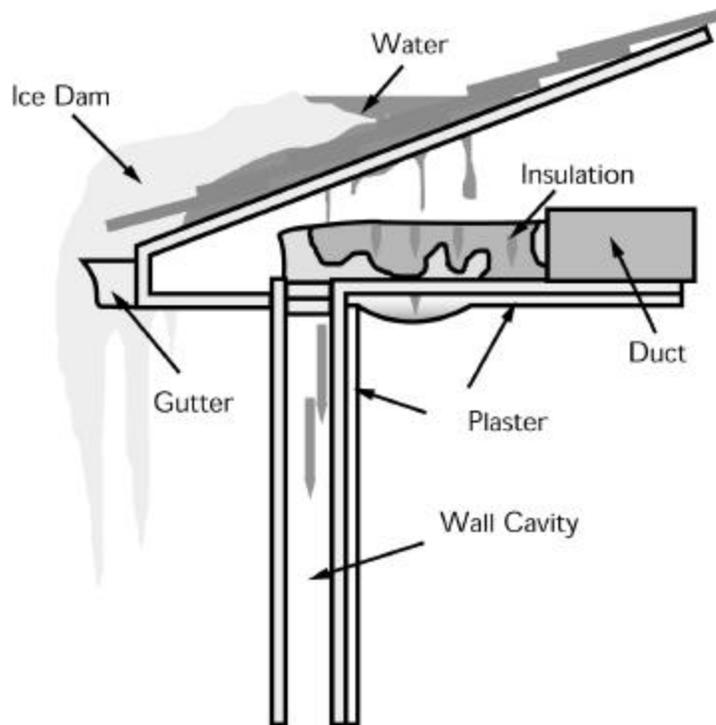


Figure 1: Ducts are nearly always guilty of bringing warm, humid air into the attic, which can lead to ice damming.

It is important to check existing exhaust fans. Most of these are improperly installed; sometimes, they are found to be exhausting directly into the attic. In 20 years of home contracting, the author's firm has rarely seen a properly sealed exhaust fan box. This must be done as part of the remedial measures.

Once all cracks, gaps, holes and leaks have been satisfactorily sealed according to the experienced judgment of a crew, it is time to insulate. If the space is sealed thoroughly, blown cellulose is the recommended insulation because of its superior air-tightening capabilities.

Before the operators leave an attic, they weatherstrip the entry hatch, using C-fold polyethylene-clad foam compression seal. Then they insulate to R-30 with three 2-inch slabs of extruded polystyrene foam cut to the exact size of the hatch. The hatch door is latched with a hook and eye (or, better yet, latches that compress the weather stripping) to hold it down. Prefabricated, airtight insulated metal assemblies can also be used for hatches or kneewall entryways.

The last, but important, step is to address the source of the moisture. This is generally associated with lifestyle -- a lot of teenagers taking showers, for example -- but it could be a below-grade problem such, as a crawlspace with an earth floor. Mechanical ventilation is essential to remove and dilute interior moisture sources. For crawlspaces, one should first lay a vapor barrier consisting of a layer of 6-mil-thick or heavier polyethylene on top of the earth and hold it in position at the perimeter walls with two-component foam. Also, one should spray the walls with 2 inches of foam or use

extruded polystyrene foam board and seal the joints to complete the air barrier. Sprayed foam will also effectively seal the rim joist, a common source of air leaks.

Comfort Problem Solving

In the home-performance contracting industry, what homeowners want, what they need and what they will buy is foremost in the mind of business owners and marketing people. For the policymakers, energy and environmental performance ranks No. 1. Fortunately, there are participants in this fledgling market who believe both issues are critical.

Wet attics, ice damming and other moisture-related problems are extending the business opportunity for the comfort contractor. Why? Because other trades and interests are becoming aware of the risks and benefits that these problems entail for their business.

Roofing contractors, of course, do not want to be blamed for problems they did not cause. They also see the added value of providing a service that meets a customer's need. Home inspectors have been caught unaware and now realize they need to know more about potential moisture problems. For instance, in Toronto last winter, a home inspector was sued for issuing a certificate without even going up into the attic. The same is true for insurance companies, which face claims from homeowners for expensive repairs.

There's more Energy-efficiency guidelines, wherever you do your research, indicate the potential energy savings to be realized from controlling air leakage. It's a side benefit, but one that appeals to policymakers, marketers and homeowners alike. However you want to characterize your business—comfort provider, energy saver, performance specialist, problem solver -- it's good to know there are still new opportunities for growth, profit and job satisfaction.

Further Reading

Attic Venting, Moisture and Ice Dams. Canada Mortgage and Housing Corporation (CMHC), 700 Montreal Road, Ottawa, Ontario K1A 0P7. Tel:(613)748-2367; Fax:(613)748-2098. Report CE-13 in the "About Your House" series is available on the Internet at: www.cmhc-schl.gc.ca/publications/aboutyourhouse/ce13.html.