

# Ice Dams: Formations and Fixes

1st Edition



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As we approach the cooler change of seasons, we look forward to many things; the stunning change of foliage, football, and atmospheric water vapor frozen into ice crystals and falling in light white flakes, more commonly known as snow.

If you live in the north, you've probably had anywhere from a few inches to several feet of snow at one time or another. If you have experienced snow accumulation, freezing temperatures, and certain building conditions, you may have been the recipient of an ice dam.

The term "ice dam" refers to the damming of water behind an accumulation of ice buildup along the eaves and/or valleys on a roof covered with snow. Heat loss into the attic space or rafter cavities warms the roof deck and causes snow to melt. As this melted water makes its way to the eaves, it freezes at the eaves as there is no heat loss in this area. This can lead to a buildup of ice and a backup of water, hence the term "ice dam". See Figure 1 below for additional details.

Within this paper we review the cause of ice dams, steps to prevent their formation, and mitigation of damage when an ice dam forms. We will also review ANSI/IICRC standards to determine the categorization of water from ice dams.

## Ice Dam Basics

There are a few key points that differentiate an ice dam condition from typical snow accumulation on a roof:

- The outside temperatures must be below freezing for a duration long enough to allow freezing at the roof edge to occur. An ice dam will not typically occur during an early winter snow when outdoor temperatures are just beginning to decline or they routinely move above and below freezing during the day.
- A large enough snowpack has to exist on the roof. If the snowpack on the roof is not substantial enough, as it melts, there may not be enough water to form the dam or become deep enough behind the dam to flow back into the building structure.
- A heat source must exist that warms the roof sheeting and melts the snowpack. This heat source is typically from the interior of the structure but can also be the result of solar radiation heating the snowpack.

Ice dams are not as likely in early winter due to weather conditions that typically contain lower snowfall amounts and temperatures fluctuating between 20 and 30 degrees. In contrast, later winter months are more primed for this type of event. One example occurred in February of 2010, when Pittsburgh, Pennsylvania received upwards of 24 inches of snow during a three-day period. The temperatures during that snow, and for two weeks afterward, stayed in the low 20's to teens. As a result, numerous structures throughout the greater Pittsburgh area experienced ice dam issues.

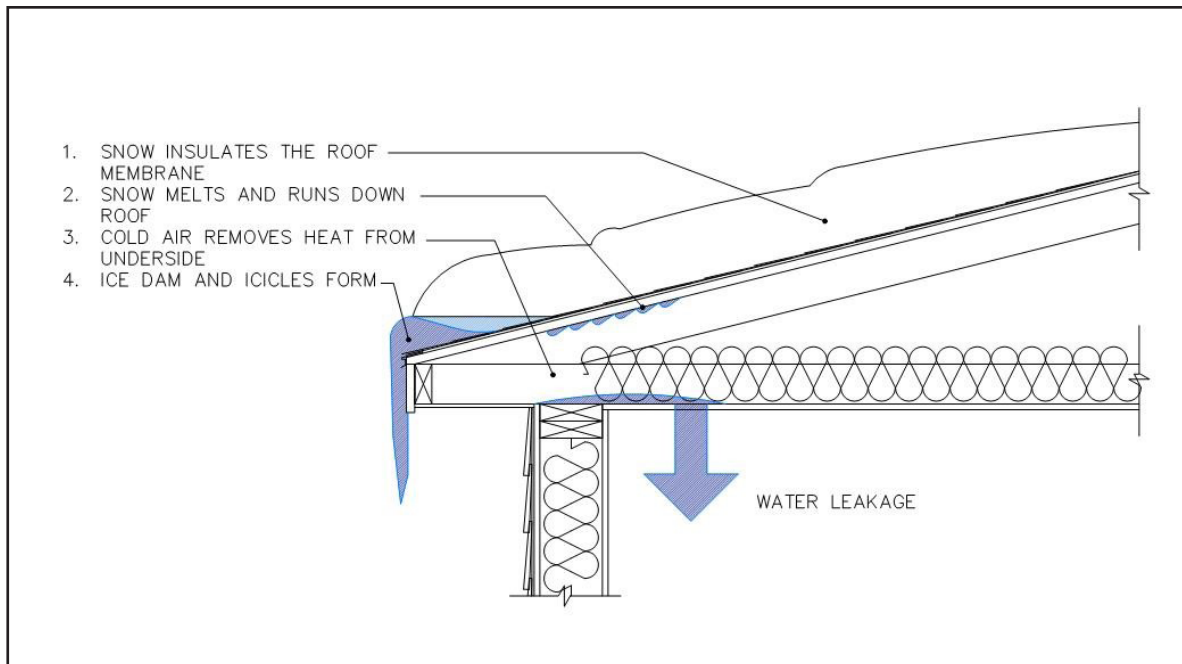


Figure 1 - Depiction of an ice dam with water infiltration.

Of course, geographically, weather conditions vary greatly and as a result the frequency and magnitude of ice dams will vary as well.

## Prevention

Preventing ice dams is easy, just eliminate snow. See, there is a positive side to global warming! Obviously, since snow and colder temperatures are still regularly occurring, the answer to preventing ice dams lies in good building design.

Structures come in all shapes, sizes, and uses. For this paper, we'll be using a typical wood-framed residential home as the model for our discussion. The following are some contributing factors that increase the likelihood of ice dams as well as potential solutions.

### LACK OF SUFFICIENT INSULATION

Attics must be properly insulated to minimize the heat loss from inside the home to the attic space in the winter and vice versa in the summer. The use of insulation greatly slows the heat loss, which is why the building codes require certain R-values based on where you live. The colder the area you live in, the more insulation you need in the attic. The premise behind the insulation is to create a blanket in your attic to keep the heat inside the house and keep the cold air in the attic.

Additionally, air leaks and poor insulation can allow heat to quickly escape into the attic. In Figure 1 above, you will notice the insulation does not extend over the exterior wall plates. This condition can allow heat to easily migrate into the attic, thus warming the roof sheeting.

**Solution:** Be sure the proper amount of insulation is installed so it does not allow for these conditions at roof/wall intersects and at ceiling penetrations (recessed lights, HVAC devices, etc.).

## LACK OF ADEQUATE ATTIC VENTILATION

By not having sufficient attic ventilation, warm air from inside the structure will migrate into the attic and become trapped, which then warms the underside of the roof sheeting. Similar to insulation requirements, the building codes also require ventilation of an attic space. The code requires one square foot of net free area per every 150 square feet of attic space (if you have a 1500 square foot attic space, you need a minimum of 10 square feet of net free ventilation). Ideally, 50 percent of the ventilation would be placed along the ridge of the roof and the remaining 50 percent would be installed along the eaves. This would give 5 square feet of intake air into the attic at the eaves and 5 square feet of exhaust at the ridge.

**Solution:** Properly installed and sized attic ventilation (soffit and ridge vents) will provide air flow that removes warm air from the attic before it accumulates.

## AIR LEAKAGE

Similar to the lack of insulation, air leaks from the interior of the home also introduce warm air into the attic. A common location of air leaks is at pull down attic stairs or around light fixtures in the ceiling. Heat from the interior can quickly escape into the attic space at these areas.

**Solution:** Seal any penetrations into the attic space, insulate recessed light fixtures, caulk and/or foam around electrical, plumbing, or HVAC penetrations, and seal and insulate attic access doors.

## HEAT SOURCES IN ATTIC SPACES

Any device that generates heat and is installed in the attic has the potential to warm the attic space and the roof sheeting. Furnaces are typically installed in the attic with poorly insulated supply ducts. Light fixture housings are also commonly installed in ceilings and the insulation is pulled away to facilitate installation. These conditions can allow the attic space to be heated.

**Solution:** If possible, eliminate heat sources from the attic space. If there is an air handler or supply ducts in the attic, ensure that no air leakages exist at duct connections, and/or appliance covers. Then, insulate all ductwork for heating and exhaust devices. Light fixture housings should be insulated (some fixtures become extremely hot and do not allow insulation to be in contact with the fixtures – replacing these hot light sources with LED or fluorescent lights can allow the fixtures to be properly insulated. Refer to the manufacturer's requirements or contact a qualified electrician for these type of conditions).



## SNOW THICKNESS

At times, due to wind direction and intensity, it is possible that snow can be blown from the upper portion of the roof and expose the shingles. Conversely, if snow catchers are installed at the base of the roof, an accumulation of snow will occur at the base of the roof. When the roof is heated by solar radiation, the upper roof will warm faster, causing the snow to melt and flow down the roof slope. The lower roof, which is insulated by the snowpack, will not heat as quickly.

**Solution:** Removal of most of the snow from the roof surface, or at least equalizing the thickness, will help prevent variants in the snow thickness and allow for even melting.

## Mitigation

We are commonly asked how to mitigate the resulting damage from an ice dam condition. Often, we are the first to be called after our client inspects a property and sees that water is pouring through a ceiling of a residence or commercial building. The solution to this problem is actually very simple – **remove the water source**. However, the execution of the solution can present some challenges.

Removal of the water source, the snow, will eliminate the potential for the ice dam to grow and it will also eliminate the potential for water to back up under the roofing material and ultimately enter the structure. While easy in theory, the removal of snow from a steep, icy, and snow-covered roof is dangerous work. We highly advise the engagement of professionals who are familiar with working in these conditions. In addition to the dangerous conditions mentioned above, the weight of several feet of snow, combined with shovel-wielding workers bouncing on a roof, could lead to a very sudden roof collapse.

If you or your clients do not have the means to engage a professional service, they may want to consider using a roof rake. This tool can assist in the removal of snow from the roof while the operator stands safely on the ground.



Figure 2 – Example of a roof rake being used to remove snow accumulation.

If the snow cannot be removed, what should be done? Let's first discuss what not to do.

## **REMOVE THE GUTTERS**

While removing the gutters may eliminate some of the ice dam, it typically removes only the bottom portion of the dam. The upper portion at the eave still exists. Plus, it is dangerous to attempt to remove a frozen chunk of gutter that is several feet in the air.

## **BREAK THE ICE DAM UP WITH AN AX, HAMMER, OR OTHER TOOLS OF DESTRUCTION**

Hitting ice adhered to frozen, brittle shingles or in a gutter is a sure way to damage the materials. Common damage incurred includes cuts, punctures, and displacement of the material. When the ice begins to melt, water may pour into the structure through the holes created by the removal of the ice dam.

## **APPLY SALT OR CALCIUM CHLORIDE TO THE ICE DAM**

This may work in theory, but if the snow pack still exists above the melted remnants of the ice dam and the exterior conditions stay the same, what is going to happen in a few days when a new ice dam forms? Additionally, placing these products on roofing materials can cause immediate and/or long-term damage to the materials.

## **OPEN UP THE CEILING WHERE THE WATER IS LEAKING INTO THE STRUCTURE**

Building owners and contractors alike tend to do this. The rationale is that because the ceiling and insulation is wet, mold will grow. Going back to the beginning of this paper, we discussed warming of the roof deck being a contributing factor to ice dams. Opening a ceiling, removing the insulation, and allowing large amounts of warm air to impact the roof sheeting will not help the situation at hand. Opening the ceiling after the ice dam event is over, for the year, would be a plausible solution.

**What should be done when experiencing water infiltration from an ice dam event and unable to remove the water source?**

## **CONTROL WHAT IS BEING WETTED**

Often, the water does not spread over a large area. It tends to find the path of least resistance, say along a truss chord then through a hole in a ceiling from a plant hook. The best response to this type of situation is to place a bucket in position to catch the water. Other times, the water may leak into the structure at multiple locations, such as the ceiling of a bay window. If the leak is minor enough, simply place towels in position to absorb the water, exchanging them with dry towels as needed. In some cases, access of the ceiling may be required to drain the water. If necessary, make a small hole to drain and direct the water. Again, do not make the hole larger than needed as this could make the condition worse by allowing additional warm air to enter the structure.

If the water intrusion is not minor, then a professional mitigation company may need to be contacted to provide dry-out of the wetted materials.

## Water Categorization

We are often asked what category the water from an ice dam event is. Although not specifically defined in the IICRC S500, Standard and Reference Guide for Professional Water Damage Restoration, (S500), water from an ice dam that enters a structure could be placed into either of the three categories depending on the situation. For example:

### CATEGORY 1

The S500 defines melting ice and snow as part of this category. In theory, if the water does not contain any contaminants or additives that may be picked up while flowing through the building materials, then it could be classified as Category 1. In reality, these conditions would most likely not occur with an ice damming condition.

### CATEGORY 2

The S500 does not discuss melting ice and snow in this category. It does state that this category, “contains significant contamination and has the potential to cause discomfort or sickness if contacted or consumed by humans.” Because of the potential to contain contamination as the result of flowing through building materials, this category appears to be the best definition of water that flows into a structure from an ice dam and does not contain a significant hazard.

### CATEGORY 3

The S500 again does not discuss melting ice and snow in this category. By definition, Category 3 water “is grossly contaminated and can contain pathogenic, toxigenic, or other harmful agents and can cause significant adverse reactions to humans if contacted or consumed.” If the ice dam water were to flow over/through an asbestos shingle roof, flow through drywall joint compound containing asbestos, flow through a drywall/plaster ceiling, or flow through a wall containing lead paint the water could then be considered Category 3.

## Conclusion

Ice dams are a fact of life in northern climates and will continue to pose a challenge in terms of how to best manage the conditions that cause this condition and/or fix the resulting damage.

Good building design and maintenance are the best practices to ice dam prevention, however since the weather plays a crucial role in the frequency and severity of ice dams, we as building owners may not always have the final say when dealing with an ice dam condition.

The intent of this paper is to share information on the origins and mechanisms of ice dams, methods to prevent and/or minimize their formation, and methods on mitigating interior and exterior building damage resulting from ice dams.

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