ICE DAMS

Ice dams can be easy to prevent when building, but expensive to correct after the fact. Ice dams are responsible for exorbitant maintenance costs caused by shoveling, roof and siding damage, roof leakage, and use of heating cables. Backed up water can get under the roof shingles and through the roof deck to the connection between the roof and the walls. Making its way into the building, water from ice dams can also lead to structural rot, mold and mildew, compromising the overall indoor air quality. Ice dams reduce the life of the roof, add structural stress to the building and pose safety problems. A house with ice dams can see its resale value reduced as the cost required to correct the problem is often very large. To some, ice dams are pretty while to others they show construction flaws in the building. A well-designed and constructed roof generally does not ice dam, even in our extreme climate.

What is an Ice Dam?

Ice dams are literally dam-like build-ups of ice on a roof. They normally occur at the edge of the roof, but can also occur higher up in certain circumstances. Ice dams form when heat loss through the insulation causes the snow to melt which then causes water to run down the slope of the roof, until it refreezes as it reaches the colder surface at the eaves (the edges, or overhangs of the roof).

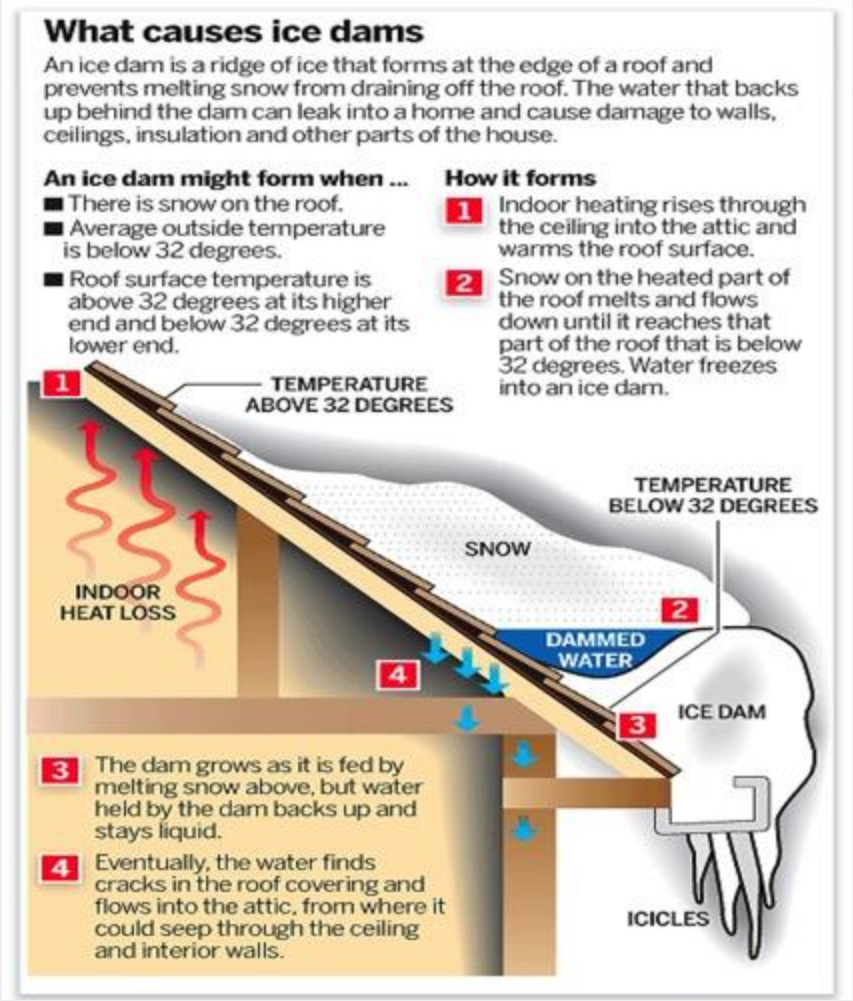
Two conditions cause ice dams. One is the natural melting and freezing of snow on the roof. Generally, ice dams from this cause are not severe, creating icicles instead of ice dams. The second cause is from air leaks and heat loss escaping through the insulation. The heat loss raises the roof temperature by warming the roof sheathing above the freezing point, causing the snow and ice on the roof to melt and flow downward. This can generally be prevented during construction by providing sufficient insulation, air sealing, and proper ventilation.

While insulation retards the conductive flow of heat from the house to the roof surface, an air barrier retards the flow of heated air to the underside of the roof. A special effort must be made to block the flow of warm indoor air into the attic or roof area. Small holes allow significant volumes of warm air into attic spaces. In new construction, avoid making penetrations through the ceiling whenever possible.

It requires about 143 BTU’s to melt 1 pound of snow. Without taking into consideration factors such as roof pitch or the thickness of the snow on the roof, the heat loss from an R30 insulated ceiling is about 1 BTU per square foot. On a roof if the length of the roof run is 20 feet, the amount of water melted per foot of wall line is .07 pounds every hour. This is about 1.7 pounds of water that is melted from the snow per foot of wall line everyday. When conditions are right, this can translate into large ice dams in a hurry.

Insulation Levels

Building code requires a certain legal minimum amount of insulation to be installed in the ceiling. The amount of insulation required is determined by the Model Energy Code, which recognizes the least acceptable amount of thermal insulation required for a building. It does not address heat loss control for ice damming problems. Many builders choose to exceed these minimum requirements, not only to increase the energy efficiency of the home but also to help reduce the possibility of ice dams.



Snow is an insulator. The more snow there is on the roof, the warmer the roof becomes and the quicker the snow melts. A roof with very little of snow on it, when it is 20 below, will have a cold roof substrate, as the cold will permeate into the structure. This keeps the roof substrate cold and reduces snowmelt age. When the roof has a lot of snow on it, the snow is insulating the roof structure and preventing cold air to get to the roof. Any heat loss through the insulation can therefore more easily heat up the roof sheathing and cause snow melt. The more snow that sits on a roof, the more insulation that is needed to reduce ice damming.

Maintaining sufficient levels of insulation is not only helpful for ice dam prevention; it is also great for attaining a higher level of energy efficiency in your home. By properly insulating, you decrease heating and cooling costs, which in turn will lower your home's carbon footprint and help save money off the utility bill.

Ventilation

When designing a vented attic or vaulted ceiling, building code stipulates the ventilation requirements. The code requirements are based on moisture control issues, and not on concerns of ice damming. As a rule of thumb, there should be one square foot of ventilation in the ceiling for every 150 square feet of attic floor.

Proper ventilation can help dissipate heat loss through a ceiling and reduce ice dams. While ventilation can help, it does not solve the under lying problem of excess heat loss through inadequate insulation.

VENTED ATTIC SPACES

If the attic space exceeds 32 degrees in the winter, heat loss through the sheathing will melt the snow

above. Most attics are insulated with fibrous insulations, which allow air to flow through them, as they are air permeable. The more recessed fixtures, bathroom vents, attic hatches, etc that are in the ceiling, the more air leakage there will be. Air can also infiltrate up into the attic from behind the drywall at interior walls. Truss ceilings with fireplaces are more prone to ice damming, as often those attic spaces can be 7 degrees warmer than attics without fireplaces. Generally, providing a raised heel truss to allow for adequate insulation at the wall line, properly venting the soffits and ridge or gable vents will help prevent ice damming. The more recessed fixtures and air infiltration avenues there are, the more venting and insulation should be.
Heat ducts located in a vented attic space are pretty much guaranteed to cause ice dams as it is impracticable to create enough ventilation to dissipate the amount of heat that is loss through the ducts.

VENTED CATHEDRAL CEILINGS

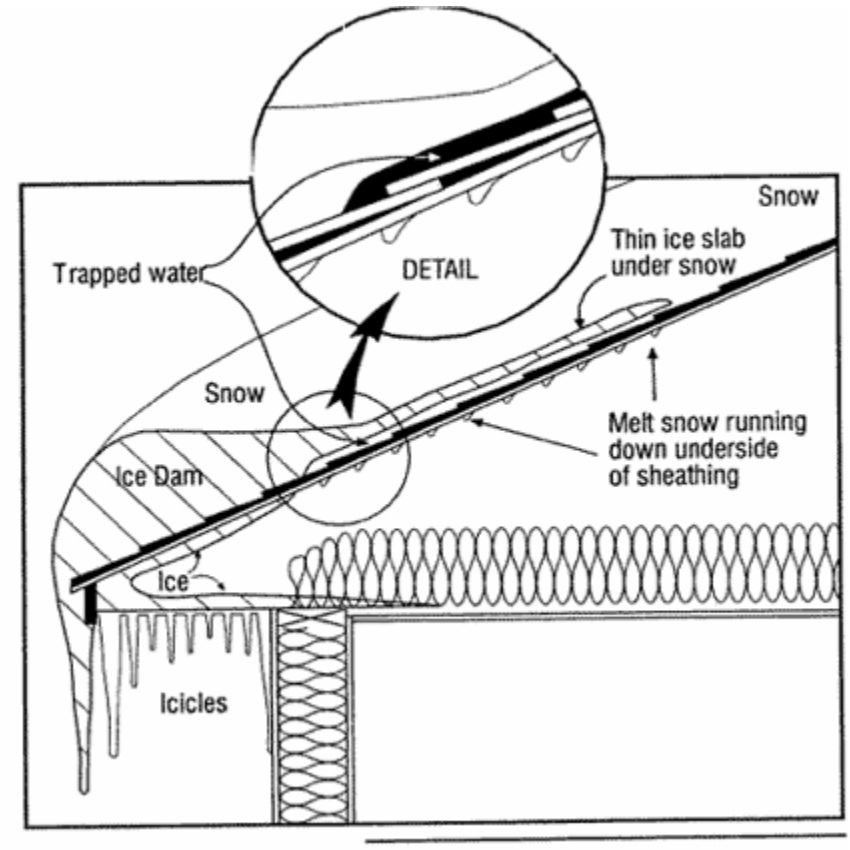
Supplying a sufficient airflow in vaulted ceilings is a good way to exhaust heat that is loss through the insulation. Building code requires a minimum of a 1” free airflow clearance through out the roof. The warm air is exhausted out by drawing cold air into the soffit vents and as the air is heated up from the heat loss through the roof, it is drawn out the ridge vent due to the warm air rising. On long pitched roofs, the air needs to travel further and the square footage of friction encountered by the roof sheathing and baffles compromises the airflow. When the length of the roof run is long, increasing the size of the air space helps to produce a better airflow. The pitch of the roof is also critical in having a cold roof work. The steeper the pitch, the more readily warm air will rise up and out the ridge vent. On low pitch roofs, cold roofs become less effective as the rate of uprising air becomes less effective.
Ridge vents should be reviewed as most rolled ridge vents do not have enough net free venting to dissipate the airflow that needs to be drawn through them. Snow sitting on the ridge vent will decrease the free airflow. Screens used on soffit and monitor vents restrict the airflow by about 40%.
Valleys and dormers make it hard to provide the 1” continuous venting. Drilling holes or providing small cut outs ruin the venting system. Venting, while helping ice damming, is not an effective energy conservation procedure.

NON-VENTED CEILINGS

Non-vented ceiling, per code, requires the use of an air impermeable insulation. Fiberglass and cellulose are air permeable and are not allowed. Air leakage through these products in addition to convention looping which naturally occurs within these insulations reduce the R value and allow heat to escape. In wall systems, these only results in colder walls, but in ceilings this adds to the problem of ice damming. Rigid boards and spray foam are air impermeable insulations. Air permeable insulation allows air to pass through it, allowing the heat loss to be much higher than air impermeable products. Air impermeable insulations stop the air movement through and within the insulation. The use of air impermeable insulations result in an overall better real life R-value in addition to the reduction in air infiltration and air movement through the product.
The R-value required is based on building code is for the minimum amount of insulation to make a home energy compliant. The code does not address R-values needed to control ice damming. The amount of insulation required to prevent ice damming is dependant on the amount of snow on the roof, outdoor temperatures and the length of time that the roof will be snow covered.

When roofs have ice dams, it is generally narrowed down to:

- Air leakage within the insulation.
- The ventilation space between the insulation and roof sheathing is inadequate.
- Ventilation air is restricted by small holes drilled in blocking or beams for air flow, instead of allowing unrestricted airflow through those areas.
- Ridge or soffit vents screens plugged by snow or debris.
- Mechanical equipment or recessed lighting providing heat loss into the ceiling.


Snow
Thin ice slab
under snow
Trapped water
DETAIL
Snow
Melt snow running
down underside
of sheathing
Ice Dam
Ice
Icicles