# Gambrel or Mansard Roofs and Ice damming

It's no coincidence that ice damming occurs most pervasively in the mansard or gambrel styled roof. The design was popularised both in America and France by virtue of tax avoidance without regard for thermal performance.

**'The mansard fix' near Ottawa. Photo Dean Sillito**

This roof style for cold climates unwittingly accelerates ice dam formation and accounts for a disproportionate number of calls to contractors for repair. The roof design doesn't leave the contractor with many options for remediation and if the source of the issue isn't specifically repaired, the ice dams will reappear. Because homeowners tend to buy more than one fix, in frustration, some home owners end up with "The Mansard fix", consisting of retrofitting a conventional roof on top the mansard.

## What's an ice dam?

In a well air sealed and insulated attic, snow on a conventionally shaped roof stays in its solid form and is either blown off the roof, or melts off uniformly in the spring. Snow is an insulation – R1/inch – that melts above $0^{o}$C and the more there is on a roof, the more it has a tendency to reduce the attic's ability to lose heat. Ice damming usually happens when conditioned, heated air from inside the living space of a house escapes into the attic space and warms the roof deck which in turn melts the snow on the roof. The cold melt water flows down the roof and if the outdoor temperature is freezing or the water moves over a section of roof that isn't kept warm, the melt water re-solidifies, usually at the eaves creating a 'dam' of ice.

## Solar and ice collectors

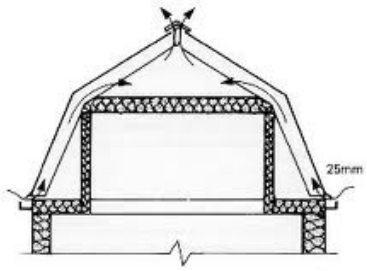


**Figure 1 - How NOT to vent the attics.**

The mansard style roof has two small volume attics covered by two shingled roof planes; an upper and a lower section. The upper section is squat with a small roof area where snow will stay. The lower section is steep with a small roof area that doesn't collect snow and faces the low winter sun perfectly so that it will collect and store the sun's heat in its attic air volume.

Even if the upper attic isn't badly insulated, if these two attic volumes are connected as in figure 1, the lower dumps it's heat into the upper attic and the snow starts to melt. Add dormers and the melt water gets focused on even shorter sections of eaves. One of the keys to successful resolution is to stop the transfer of air from one to the other.

## Myths about attic Ventilation

Adding attic ventilation as a preventative measure won't hurt the situation with the following two provisos; as previously discussed the two attics' volumes cannot be connected, and adding ventilation shouldn't come at the expense of adding a generous coat of insulation over the entire roof. In most cases opting to ventilate as the only solution won't resolve the ice damming.

Good air sealing and high levels of insulating trump ventilation. Attic ventilation theory says that heat is supposedly carried out of attics through vents by the forces of wind and convection. Depending on wind to drive out moisture means the vents can't be blocked by snow whereas convection requires vent holes at both the top and bottoms of the attic volume so that air exchange can take place as the sun warms the roof and drives the hot air out… in theory. [i] It has been established that ventilation has a negligible effect on the temperature inside the attic.[ii] We also know that unvented or hot roofs perform really well in any cold climate[iii] unless there's huge snow fall in the area. The moral; let's not rely on attic venting to keep the attic cold.

"The moral; let's not rely on attic venting to keep the attic cold."

## Remediation

When remediating ice dams for this style of roof, it is worthwhile to hire a good building scientist who has experience in both diagnostic and remediation of ice dams. See figure 2 for more details. Nothing beats experience on these complex jobs.

"…it is worthwhile to hire a good building scientist who has experience in both diagnostic and remediation of ice dams."

- *Divorce* - It starts by disconnecting the top from the bottom. Treating the lower roof and the upper roof independantly is imperative. If adding ventilation, each section must be ventilated separately at both top and bottom or sides (gable end).
- *Dormers* – Often dormer windows will project past the plane of the main floor wall and will be fed with heating ducts that run in or near the eaves. These need to be entombed in spray foam such that the duct becomes part of the inside of the house. The floor of dormers may also be exposed and if so needs to be insulated and spray foam works well. Ideally the walls will be insulated, and the small dormer roof needs to be insulated, likely dense-packed with cellulose.
- *Eaves* – the eaves at the bottom of the lower roof needs to have the soffit removed for inspection. Usually the floor framing needs to be air sealed and insulated.
- *Upper attic* – Ideally, the roof would be raised to accommodate a continuous R50+ level of insulation covering the entire floor. Getting lots of insulation above the double top plate of the wall below will be difficult. You may have to move a lot of insulation to gain access. If you insist on installing eaves ventilation, Maximum Ltd. makes a specialty product that could work if you have enough of a projection at the eaves, otherwise, use gable vents and or roof top vents. Air seal the attic floor, top plates, plumbing and electrical penetrations, make sure bath fans are vented out of the attic and ducts well insulated and air sealed, potlights are air sealed and insulated and that the hatch is well insulated and air sealed.
- *Lower attic* – It helps to think of this section as a wall that's tilted and like a wall there would be no spaces or empty volumes where air can move around in the lower section carrying heat – yes, it would be prudent to have a capillary break and a drainage gap behind the shingles - but the liability this air might end up in the upper attic is too great unless the upper portion of this lower attic I vented out using a strip of ridge vent. Again here, the name of the game is continuous insulation and air seal.

## Conclusion

You might be one of those weary home owners, who have tried everything and have thrown good money after bad. Know this, spring is around the corner and you have the summer to fix the problem, take your time do it once, do it right… unless you like the look “the Mansard fix”!


**‘The Mansard fix' near Washago Ontario. Photo, Google Street view.**

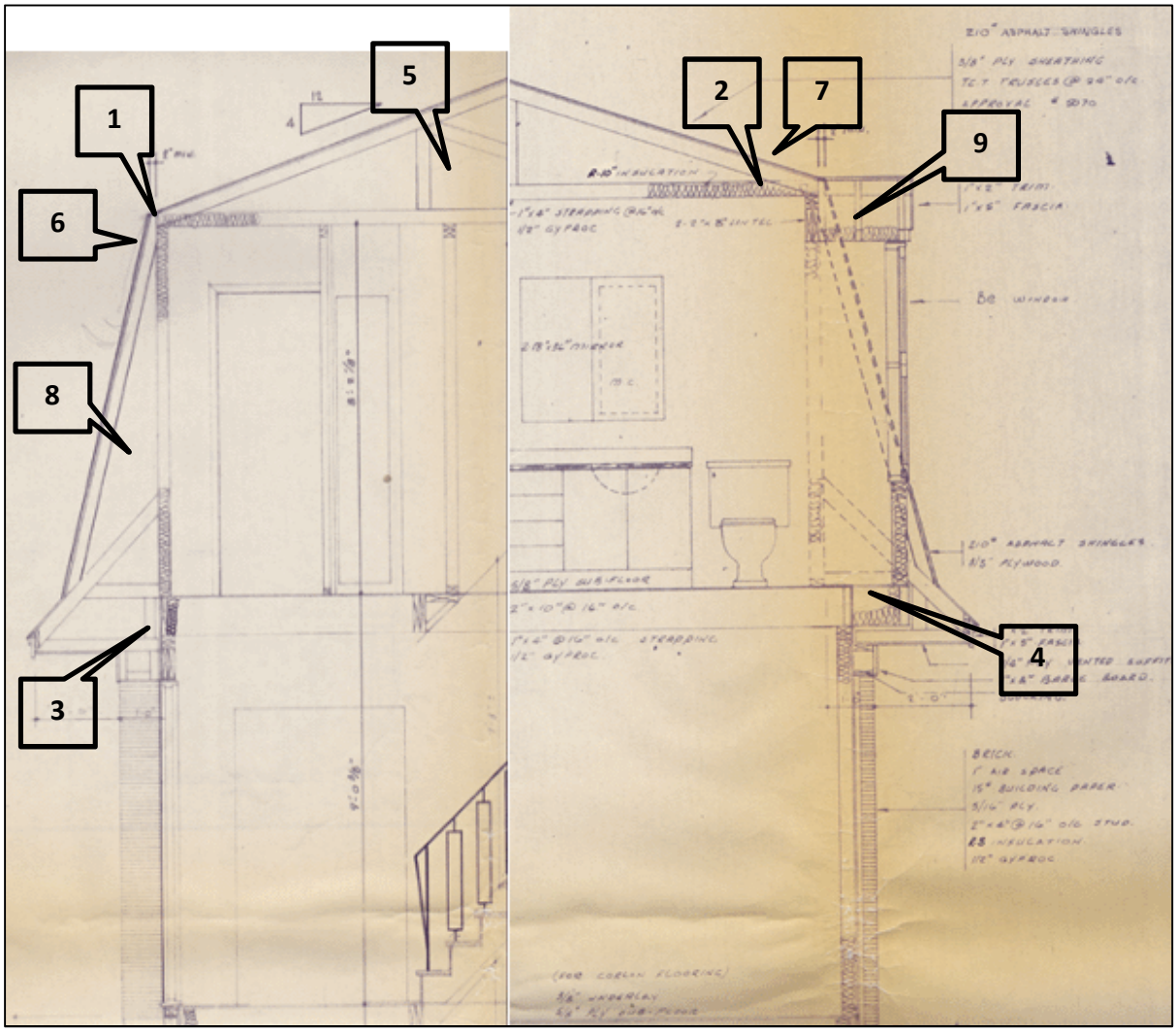


**Figure 2: A 1960's Mansard cross section.**

1- Is where an absolute air seal between attic volumes 8 and 5.
2- Above the wall double top plates doesn't leave much room for more than R8, so best to spray foam while being mindful of foam expansion.
3- Worthwhile to remove soffits and spray foam seal and insulated the rim joist area.
4- Often dormers have heating ducts under them that are poorly insulated, spray foam seal and insulate in place.
5- The small attic is tough to move in, and may have to vacuum attic to get a perfect seal on attic floor. Gable vent works.
6- Could have a proprietary vent for top of attic 8 installed.
7- Could have eaves vent installed near edge of attic 5.
8- If not covered in snow, sun will heat this air volume up and if allowed will get into top attic via 1.
9- The dormer's little attic is usually not accessible form the main attic and might need to be dense packed full of cellulose.

[i] **Attic Venting, Attic Moisture and Ice Dams.** Ottawa, Ontario, Canada: Canada Mortgage and Housing Corporation, 2004. To download a copy of this report, go to www.cmhc-schl.gc.ca/en/co/maho/gemare/gemare_001.cfm.

[ii] **Cash, Carl G. and Edward G. Lyon.** "What's the Value of Ventilation?" Professional Roofing Magazine, March 2002. To download a copy of this article, go to www.professionalroofing.net/archives/past/mar02/feature2.asp.

[iii] **Schumacher, Chris.** Building Science Digest 149. "Unvented Roof Assemblies for All Climates" Building Science Press, 2007. Go to www.buildingscience.com/documents/digests/bsd-149-unvented-roof-assemblies-for-all-climates.