INSIGHT™

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"Insight: to see into and understand; an item of knowledge gained by this power."

Every year, in northern climates, ice damming causes untold damage to roofs and interior finishes on buildings with sloped roofs - predominantly on residential or small commercial structures. Flat roofs can have their own problems with ice choking of roof drains. The good news is that the problems have remedies, however, they frequently are not inexpensive. In this issue, we will discuss ice dam basics, and present a successful remediation case study.

INSIDE

Figure 1 — Indian Prairie Public Library with snow on the roof and ice damming present at the second level.

Project Profile

Indian Prairie Public Library

The Indian Prairie Public Library (IPPL) is a two-story brick-clad building in suburban Chicago. The roof was designed as a cathedral ceiling utilizing prefabricated vented roof panels, a continuous roll roof vent, and asphalt shingles. RRJ was retained by the Library Board of Directors to investigate and design repairs to address interior water leakage experienced year-round since the building opened. The investigation identified deficiencies in the walls and roof that were contributing to the leakage experienced by the occupants. Additionally, improper design of the roof ventilation was identified and found to be contributing to the formation of ice dams.

Figure 2 – Severe ice damming.

Cathedral ceilings and attic ventilation require proper balance of outdoor air intake and exhaust to perform as intended. In cathedral ceilings, some type of vent channel is needed to connect the top (ridge) and bottom vents (eave or soffit). When attics are used, the principles remain the same, but the attic space connects the top and bottom vents. At IPPL, the vented roof panel included a ridge vent, but did not include eave or soffit venting to the exterior. Instead, the vented roof panel was left open to the building interior at the eave. This resulted in supplying interior conditioned air into the vent panel instead of outdoor air. During the winter, this air path warmed the deck sheathing and asphalt shingles, and under certain weather conditions created ice dams (see *Tech Tip* article for more information on ice dams). The ice damming was so severe that icicles from the second floor partially blocked an emergency exit on the ground floor of the building as shown in Figure 2.

Developing repair designs to address the ice dams required blocking air paths from the interior and providing thermal insulation at the eave to reduce heat loss. Installing new intake vents at the eaves presented a challenge because the building design did not include a roof overhang that would allow for installation of soffit vents. The eave configuration also included gutters that further complicated the repairs. The solution was to modify the air path by extending the vented roof panels to the eaves and adding eave venting behind the gutters. The gutters were reinstalled over new supports and a manufactured vent product, which allowed for proper air intake without changing the aesthetics of the building.

In addition to correcting the vent design, an air barrier and perimeter insulation were installed to further limit air flow and heat loss through the building materials. These components are important on any project, as both can be significant factors in the prevention of ice dams. The roof-to-wall interface in typical construction can make it difficult to detail these areas properly. Design and installation of an air barrier and thermal insulation are critical at these locations.

Roof and attic ventilation are often misunderstood. This is one of the reasons that ice dams and the resulting damage are so prevalent in cold climates. At IPPL, RRJ's repair designs effectively prevented interior air from directly warming the roof and reduced heat loss at the eave by properly insulating the building perimeter. Similar concepts can be applied to mitigating ice dams on most sloped residential and commercial roofs.

– Garth D. Hall, AIA

Figure 3 – Same view as Figure 2 (above) after repairs were implemented. Ice dams do not form.

Tech Tip

Tips for Reducing Ice Damming

Ice damming, quite simply, is the troublesome build-up of ice along roof eaves that causes a back-up of meltwater behind it. The ice build-up can pry up roof shingles and distort gutters and roof flashing. The backed-up meltwater can ultimately work its way through to the interior of the building, damaging roof sheathing, attic insulation, interior finishes, and anything else in its path. If the meltwater back-up is high enough, it can overtop the ice dam and form large icicles along the eaves. Both the icicles and the large blocks of ice can become falling hazards once the weather warms up.

A warm roof deck with a fresh deposit of moderate to heavy snow are the two fundamental ingredients for ice dam formation. Snow in the warmer regions of the roof melts and flows downhill, only to re-freeze along the cooler eaves and gutters. Ice builds up along the eaves, choking the gutters and downspouts, and forms a dam that prevents subsequent meltwater from draining off the roof deck. This problem is exacerbated by roof features such as valleys, dormers, penetrations, skylights, height transitions, and otherwise complicated roof geometry, which serve to concentrate the downward flow of meltwater and snow.

Effective repair approaches seek to alleviate both the symptoms and the root problem by: 1) elimination of water infiltration into the interior spaces, and 2) reduction of the ice build-up along the eaves. Stopping water infiltration is typically accomplished by the addition or improvement of roof flashing details and the installation of a waterproof self-adhering roof underlayment. Most building codes require such an underlayment in cooler climates. Reduction of the ice build-up along the eaves is accomplished by reducing heat loss from the house to the attic and/or increasing the attic ventilation to remove built-up heat. Creation of a cold roof deck is desirable because it substantially reduces the creation and flow of meltwater. The snow blanket stays intact longer and melts more uniformly, with more snow lost by sublimation than by melting. Reducing the heat flow means eliminating sources of heat and air infiltration from the building interior into the attic. The principal culprits are: 1) poor or incomplete insulation, 2) incomplete or non-existent air barriers (especially at the tops of partition or party walls), 3) open mechanical chases, 4) disconnected ducts, 5) unsealed light fixtures, and 6) uninsulated attic access hatches.

Figure 4 — An example of severe ice damming. Icicles hanging from the soffit vent (arrow) indicate melt water has penetrated the roofing and roof sheathing.

Good ventilation of the airspace under the roof deck is an absolute must (as well as another building code requirement.) A system with balanced intake vents along the eaves and exhaust vents along the ridge, with a clear air flow path between them, helps purge warm air that manages to infiltrate into the attic. A bit of ingenuity is required to provide clear air paths in complicated attic and cathedral ceiling spaces.

Some important tips:

- Don't overdo exhaust ventilation at the ridge. This unbalanced condition tends to draw more interior air into the attic.
- Manual removal of snow and ice is often hazardous and costly. Attacking blocks of ice with picks and shovels can be more dangerous and cause more damage than the ice dam itself.
- Snow guards and gutters installed too high block snow from sliding off the roof, and encourage ice dam formation. Gutters should be installed lower than the roof slope line in order to help snow slide clear. Increasing gutter size improves rain flow capacity, but does not reduce ice damming.
- Electric heating cables may cause more problems than they are worth. They have a limited service life and tend to cause secondary ice dams just above the cables. Why expend more energy to alleviate the symptoms of a problem caused by wasted energy?

– Robert C. Haukohl, P.E.

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