MIFACE Investigation: #01MI006

SUBJECT: Pastor struck by falling roof ice dam, subsequently died from complications

SUMMARY

On January 28, 2001, a 48-year old male died of injuries he sustained approximately two weeks earlier when he was clearing icicles from the church roof at the church where he was pastor. The victim stood facing the church building and used a snow shovel to knock off icicles from the west side of the building roof. He began the roof clearing operation by clearing the small icicles from the roof first. After clearing the smaller icicles, he began work on the bigger icicles. Starting from the tip of the icicle, he used the snow shovel to break the icicle into smaller portions. The victim apparently loosened an ice dam at the roof edge during the icicle clearing operations, and the icicle and the associated rooftop ice dam, estimated weight of one-half ton, fell on him. The icicle crushed his foot, and the ice dam hit his shoulder. He was rushed to the hospital, and due to the extent of the injury, his leg was amputated below his knee. The victim was treated and eventually released from the hospital to continue recuperating from the injury at home. Several weeks later, he began to feel ill, and had difficulty breathing. He was rushed to the hospital, where he died a short time later from a blood clot in his lung.

RECOMMENDATIONS

- Increase truss space ventilation to alleviate accumulation of warm air at the peak of the truss space, subsequent melting of snow that refreezes at the eave edge resulting in an ice dam.
- Increase truss space insulation to minimize heat loss from the building below.
- Identify and seal ceiling openings that allow heat to escape from the heated area of the building to the truss space.
- Use proper tools and removal techniques to remove accumulations of snow on the roof or other methods to minimize ice dam formation.

INVESTIGATION

On February 1, 2001 MIFACE became aware of this work-related fatality through a newspaper clipping. MIFACE contacted the police and medical examiner for a copy of their reports and the county clerk for a copy of the death certificate. The family was contacted in March, 2001 and agreed to allow MIFACE to conduct an on-site investigation. On March 27, 2001, a MIFACE investigator visited the family of the deceased and interviewed the wife of the deceased.

Weather conditions leading up to the accident played a major role in the formation of the icicles. Significant snow accumulations began in mid-December, and by late December 2000, approximately a foot and a half of "wet" snow had fallen. This heavy snowfall acted as an insulation barrier to prevent heat loss through the roof sheathing. Another factor was the temperature; mid- to late- December temperature range was from a low of –5 degrees F to a high of 38 degrees. The average temperature for this December time frame was approximately 20 degrees, well below freezing. The first week of January had below freezing temperatures (minimum temperature of 2 degrees at night to high of 28 degrees during the day). The next two weeks had unseasonably warm weather, with above freezing daytime temperatures, with alternating temperatures at night of below and above freezing. The combination of the snowfall level with low ambient temperatures in December 2000, and alternating January 2001 ambient temperatures above and below freezing contributed significantly to the ice dam/icicle formation. An ice dam of approximately 10 linear feet can weigh approximately 500#; the ice dam that fell on the deceased was estimated to weigh one-half ton.

Icicle formation on the eave edge was a common occurrence for the church in the winter. On both sides of the church, the eaves were near a walk to gain access to the rear of the sanctuary. In previous winters, icicles falling to the ground had broken ground-level windows, so the icicles were usually knocked off with a standard snow shovel before they "grew" too big to cause damage if they fell to the ground. Due to the snowfall levels, more attention was paid to clearing the parking lot to provide safe parking for people attending worship services than for clearing icicles. Because they were not knocked off, the icicles grew larger than usual, and the safety of visitors and children became an issue. Children had been observed playing under the icicles hanging from the roof, and the deceased was very concerned about the safety of the children, as well as other individuals who may walk under the icicles. The deceased performed many job functions as well as being a pastor, and one of which could be classified as "maintenance".

Following a meeting earlier in the day and still in his dress work clothes, the deceased decided to clear the icicles from the roof edge. Facing the building and beginning at one end of the roof where the icicles were smaller, he used a snow shovel to knock off the icicles. He then went to the other end of the roof, and worked toward the middle where the icicles were larger. After having cleared off all the smaller icicles, he started to work at clearing the largest icicles. To remove the larger icicles, he used the snow shovel to "chop" the icicle into smaller pieces. Starting from the icicle tip, he broke the icicle into smaller portions, moving up the icicle to the roof edge. The deceased's wife said that he was not looking for and did not see an ice dam at the roofline. The victim apparently loosened the ice dam at the roof edge during the icicle clearing operations, and the remaining portion of the icicle he was clearing and the associated ice dam, estimated

weight of one-half ton, fell on him. The icicle crushed his foot, and the ice dam hit his shoulder, breaking his collarbone. He was rushed to the hospital, and due to the extent of the injury, his leg was amputated below his knee. The victim was treated and eventually released from the hospital to continue recuperating from the injury at home. Several weeks later, while at home, he began to feel ill, and had difficulty breathing. He was rushed to the hospital, where he died a short time later. An autopsy revealed a blood clot in his lung. The deceased's wife stated that the church has since hired a full-time janitor since the death of her husband.

After speaking with the deceased's wife, the MIFACE investigator went to the church site and took pictures of the roof edge. The roof was shingled, and did not have gutters, soffits or roof vents. When MIFACE visited the church site, icicles and their ice dams were present on the sanctuary roofline. At one location, the sanctuary roofline was bent downward, perhaps damaged due to the weight of repetitive ice dam formation. The sanctuary roof shingles ended directly at the edge of the roof, with a metal drip edge directly under the shingle edge. The drip edge was attached to a wood support, that was attached from underneath to the building itself by bracing supports. The sanctuary roof was approximately 68 ft long and 12 feet above the ground. Church officials were contacted to obtain more information about the church, building contractors, and a copy of the church building plans. MIFACE was informed that the church was built in 1962, and that church officials could not find a copy of the building plans or any information about the building contractors. The Building Inspector at the City Hall was contacted to see if he could provide any information about the building plans. He stated that building codes were enacted in 1972, and records or plans from any structure built before 1972 were not kept on file.

CAUSE OF DEATH

The cause of death as stated on the death certificate was bilateral pulmonary thromboemboli due to crushed lower extremity due to falling ice.

RECOMMENDATIONS

- Increase truss space ventilation to alleviate accumulation of warm air at the peak of the truss space and the subsequent melting of snow that refreezes at the eave edge.

An ice dam is a barrier formed at the roof edge that prevents melt water from running off a roof. Ice dams can form when as little as 1 or 2 inches of snow accumulates on a roof - if the snowfall is followed by several days of sub-freezing temperatures. An ice dam develops when there is a temperature difference between different areas of a roof. In the winter, heated air enters the truss space, accumulating at the truss space's peak unless it is vented outside. Because warm air rises, the upper portion of the truss space is always the warmest. Lower areas of the roof, especially the area just above the eave, remain cold. The area near the eave may have a roof temperature that is not

much higher than the ambient outdoor temperature. Especially in an unvented truss space, heat high in the truss space raises the roof sheathing temperature and causes snow to melt near the roof peak. The water from the melting snow flows toward the eave area, where colder roof temperatures allow it to freeze. If conditions persist over several days, this refreezing of snowmelt can form an ice dam. Deeper snow and colder temperatures increase the likelihood and size of ice dams. Every inch of snow that accumulates on the roof's surface insulates the roof deck a little more, trapping more indoor heat beneath the roof deck. Frigid outdoor temperatures assure a fast and deep freeze at the eaves. So the worst ice dams usually occur when a deep snow is followed by very cold weather.

Upgrades in both ventilation AND insulation must be made for maximal effectiveness to reduce the potential for ice dam formation.

The church does not have any truss space ventilation. Truss space ventilation can help to diminish the temperature differential between the roof peak and the eaves by allowing the heated air to escape from the truss space. The most effective way to eliminate heated air from a truss space area is to combine a ridge vent with soffit vents. A ridge vent is a continuous opening along the entire ridgeline of the roof. The soffit vents must be installed on opposite sides of a building to allow for effective truss space ventilation. With appropriate truss space ventilation, the heat is vented out of the truss space creating a colder roof surface and diminishes snowmelt from the roof surface to refreeze on the eave area, diminishing ice dam and icicle formation.

Due to the age of this building, there are not any soffit overhangs, making the installation of conventional soffit inlet vents impossible. New products are available that provide inlet air at eaves without overhangs, by bringing the air in from behind the gutters, and under the shingles and sheathing.

- Increase truss space insulation to minimize heat loss from the building below.

To minimize building heat loss through the truss space floor into truss space area, the church should increase the amount of insulation (higher R-Value) in the truss space. Michigan climates should have at least R-38 (about 12 inches of fiberglass or cellulose). The additional insulation will keep the building warmer, with the ultimate goal of keeping the truss space cooler. By keeping the truss space colder, the chance of truss space heat causing roof snow to melt is reduced. Although this site does not have soffit vents, where soffit vents are present, the inlets should not be covered when installing additional insulation.

- **Identify and seal ceiling openings that allow heat to escape from the heated area of the building to the truss space.**

Sources of heat entering the truss space area should be identified and minimized or eliminated if possible. Significant volumes of warm indoor air can pass into the truss space through small openings in the ceiling. To air-tighten existing buildings, use urethane spray-foam (in a can), caulking, packed cellulose, or weather stripping to seal all ceiling leaks. Some examples of ceiling openings include: wire penetrations, plumbing penetrations, ceiling light fixtures, truss space hatches, chimneys, bathroom exhaust fans, intersection of interior partitions and ceiling. Also make sure that the insulation

covers as much area as possible. Don't cover lights unless they are rated for it but make sure that other things (plumbing and wiring) don't displace insulation.

Many Agricultural Extension offices have information on the Internet about ice dam formation and prevention recommendations. The Minnesota Department of Commerce Energy Information Center website contains many practical solutions to fix ice dams. On-line brochures on the causes and prevention of ice dams and identifying and fixing ceiling openings are available. Other information is available, including energy tips and newspaper articles. The website address is:

http://www.commerce.state.mn.us/pages/Energy/InfoCenter/IceDam2.htm

- **Use proper tools and removal techniques to remove accumulations of snow on the roof or other methods to minimize ice dam formation.**

Truss space ventilation, insulation and minimizing heat entering the truss space deal with the root cause of ice dams – heat loss. The suggestions below can be used to minimize the development of ice dams, but do not address the root cause of ice dam development.

Remove Snow from the Roof

Do not climb up on the roof to remove snow and do not use a snow blower, chainsaw, ice pick, etc. on the roof. When possible, reduce the snow load on the roof with a long handled device marketed as a “snow rake” or “roof rake”. These rakes allow users to stand on the ground and pull the snow off the roof. Be sure not to stand beneath the area where the snow/ice is falling.

Heat Tapes

Heat tapes or roof de-icing cables can be used to help prevent ice dam formation on the eaves. Disadvantages to heat tapes or de-icing cables are that they are heated by electric power, are expensive to install and use, and can leak water through loose fasteners. At times, the electric cable creates an ice dam just above it. A qualified contractor is recommended for installation of heat tapes and/or roof de-icing cables.

Sheet Metal Ice Belts

A sheet-metal ice belt can be strung along the edge of the roof. Ice/snow belts are sold as 32”x36” pieces with additional fastening hardware and can be installed on existing structures. This is an eave flashing system, and it tries to do what metal roofing does: shed snow & ice before it causes a problem. A problem with ice belts is that often a secondary ice dam develops on the roof just above the top edge of the metal strip.

REFERENCES:

Wolfert, C.K, Henrichs, H.S. Fundamentals of Residential Attic Ventilation. hc products co., P.O. Box 68, Princeville, IL 61559.

Larson, t., Hendricks, L., Huelman, P. Ice Dams. University of Minnesota Extension Service. **www.extension.umn.edu/distribution/housingandclothing/DK1068.html**

MIFACE

Investigation Report # 01 MI 006

Evaluation

To improve the quality of the MIFACE program and our investigation reports, we would like to ask you a few questions regarding this report.

Please rate the following on a scale of:

Excellent	Good	Fair	Poor
1	2	3	4

What was your general impression of this MIFACE investigation report?

1 2 3 4

Was the report…

Objective?	1	2	3	4
Clearly written?	1	2	3	4
Useful?	1	2	3	4

Were the recommendations …

Clearly written?	1	2	3	4
Practical?	1	2	3	4
Useful?	1	2	3	4

How will you use this report? (Check all that apply)

- o Distribute to employees/family members
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Thank You!

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