The snow loading and roof collapse preparation guide

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Snow loading and roof collapse

As winter approaches, most businesses plan ahead for snow and severe weather conditions; winterizing vehicles, contracting for snow-plowing and so on. But all too often, they neglect to plan for one of most serious winter threats: roof collapse. Even a partial roof collapse can be devastating in terms of property damage, business interruption and possibly loss of life.

When the weight of accumulated snow and ice exceeds the live load capacity of the roof structure, the roof will collapse. Rain falling on accumulated snow is especially dangerous, because it can quickly triple the weight of the snow. This was the case in the winter of 1996, when multiple storms dumped three feet of snow over much of New England. Almost immediately, the weather warmed up, heavy rains came in, and the accumulated snow became so heavy that roofs were collapsing all over the region.

Even the warmer regions of the country cannot ignore this hazard. In fact, they may be more susceptible in an unusually severe winter storm, because they are less accustomed to and less prepared for the extreme conditions. Building codes that permit lower live-load specifications for roof structures can also increase susceptibility to roof collapse from snow loading.

Planning, preparation, and prompt action to remove accumulated snow will help minimize the risk of snow loading and roof collapse.

Planning and preparation

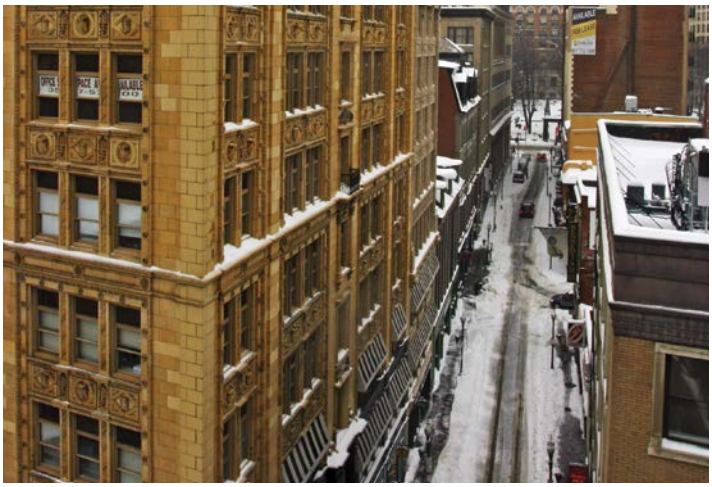
- Be sure your Emergency Response Program covers winter emergencies, including appropriate response procedures for excessive snow loads.
- Determine the maximum "safe" snow depth for the roof, based on:
  - The roof's live load capacity (indicated by building plans and specifications or by engineering analysis of the roof design)
  - The properties of accumulated snow for the area
- Inspect the roof structure for damage or deterioration, and repair or reinforce it as needed.
- Inspect all roof drains and down spouts, and clean any accumulated debris from the roof to prevent clogging of the roof's drainage system.
- Look for evidence of roof water ponding and eliminate the causes.

When snow accumulates

- Regularly monitor snow depth on the roof, paying particular attention to areas where snow tends to drift:

  1. In roof valleys; in low roof sections adjacent to higher sections or structures,
  2. On the downwind side of pitched roofs,
  3. Against parapets more than two feet high and
  4. Against penthouses or other large roof structures more than 15 feet wide.

- Remove snow accumulations from the roof before the snow reaches 50 percent of the "safe" maximum depth. Do not send employees onto the roof once the snow load approaches the roof's live load capacity. Remove snow during a storm only if the forecast indicates that the total snowfall will result in dangerous accumulations.
- Remove snow in layers uniformly across the roof to prevent unbalanced loads, which might cause a collapse. Avoid making snow piles on the roof during the removal process.
- Clear snow and ice from storm drains and catch basins. Recheck the roof drainage system to make sure that it is not clogged with ice or debris.
- Prevent roof cover damage by using care with snow removal equipment (shovels, ice spades, snow blowers, etc.). It is not necessary to clean completely down to the roof surface as long as melting snow and water can freely flow to drains.



Is roof collapse preventable?

Many times throughout a winter season losses arise as a result of severe ice or snowstorms. Much of the damage to a building structure can be attributed to over-loaded roof members that fail and collapse. In most cases, the cost to repair the roof is a fraction of the cost to repair building utilities, replace the contents, and compensate for lost income. Can these types of losses be eliminated or minimized? A review of recent losses reveals that these events may be foreseeable and preventable.

Loss scenarios

During the course of one week several snowstorms had produced over 20 inches of snow in the central region of the United States. All three losses identified experienced a structural collapse that interrupted operations.

- On a Sunday evening, a 2,400 sq. ft. roof section collapsed at an idle bottling plant. The collapse severely damaged a main conveyor system and impaired both the electrical supply and the fire protection for the entire facility. The point of collapse was where a 20-foot roofline butted up to a 30-foot high building section.
- A 125,000 sq. ft. building houses manufacturing and distribution of insulated wire products and power cords. A 4,000 sq. ft. section of the roof collapsed while the facility was idle. There was damage to finished goods and production was interrupted. The point of collapse was where the two building sections joined together. The difference in roof elevation between the two sections was approximately four feet (24 feet vs. 20 feet). Upon investigation it was noted that the estimated snow load on this portion of the building was over twice what the roof structure was designed for.
- A food processor had a portion of their roof collapse in the production area. The collapse damaged processing equipment including a labeling machine, processing tanks and conveyor systems.
- In total, it was estimated that these losses would exceed $5 million.

Analysis of loss

In each of the cases above, management did not establish or implement an emergency plan that recognized the hazard of snow accumulation or the measures necessary to eliminate excessive snow loads.

All of these losses occurred while the facilities were idle (over the weekend) and no one was present to evaluate the snow accumulation.

All building structures had at least one addition or a portion of the building with a roof height significantly higher or lower than the adjacent building. When additions were built, the building design failed to consider the impact of potential excessive snow loads on the existing structure where the building sections meet. It is very common for snow drifts to accumulate on the lower level of multi-level roofs or for snow to slide off a sloped roof onto lower roofs.

Lessons learned

The following factors could have reduced the extent of the losses:

- A licensed structural engineer should evaluate any changes or additions to the structure. This would include equipment that is suspended or placed on the roof structure. The concern is to verify that the original snow load design has not been compromised by the additional load placed on the roof by equipment or suspended mechanical structures, i.e., moving cranes, conveyors.
- Adjacent building structures that vary in height need to be evaluated for proper snow load design. Structural roof members of a lower structure immediately adjacent to a higher structure need to be designed for a much greater snow load.
- Management needs to recognize what the adverse effect snow can have on a structure. Developing an emergency plan to monitor and possibly remove snow from susceptible roof sections would be an appropriate action during a winter storm. The snow removal plan should be put into effect immediately after snow begins to fall. This plan should be in effect 24 hours a day until snow loading is considered acceptable.
- Rooftops should be checked regularly as part of a preventative maintenance program.

For additional information and emergency preparedness resources, please call 866-262-0540, visit www.cna.com/actnow or contact your local independent agent or broker.

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