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Roof Snow Loading and Removal

Introduction:

This guide is designed to provide practical assistance in evaluating exposure to roof collapse due to snow loading. Important issues are outlined to consider as part of your assessment, including risk factors, prevention, preparation and actions to take during and after storms.

Potential for Loss:

The first step in avoiding roof collapse due to snow load is to complete a roof survey. This should be done as far in advance of winter as practical, to permit enough time to make repairs or alterations. These risk factors should be used to identify and prioritize the facilities most in need of attention. Some factors, such as roof design, may be impractical to change. Consequently, additional precautions may need to be taken in terms of maintenance and actions during storms.

Construction Design High Risk Factors:

- Large, flat, open space roofs, such as garages, theaters, auditoriums, gymnasiums, bowling lanes, supermarkets and warehouses.
- Saw Tooth, Barrel, and other similar roof designs, which tend to allow snow accumulation in the low points.
- Flat roofs or roofs with slopes of less than 30 degrees (or a rise of 4 inches per foot), which reduces the ability for snow to slide off.
- Multi-level roofs, which allow snow accumulation in areas where high and low levels intersect.
- Curved roofs that may accumulate snow on the leeward (downwind) side of the eaves.
- Roofs of metal deck construction with unprotected bar joist supports. Unlike other types of roofs that tend to collapse by section, these light steel support systems can fail more suddenly and completely.
- Though most roofs can support a uniform blanket of snow, drifting of snow can cause a load imbalance and result in roof collapse. Areas that collect drifting snow should be identified. Also consider the direction of prevailing winds.
- Heavily insulated roof areas prohibit the escape of heat, which slows the process of melting snow.
- Pre-engineered (Butler type) buildings with “Standing Seam” versus “Lap Seam” roofs. Newer designs for these all-metal standing seam roofing systems are less stable under snow loading. Clips used to attach the standing seam roof (Lap Seam uses screws) do not aid in bracing the purlins, so braces or stiffeners may be needed to prevent purlins from rolling over.

Revised date: 08/2014

Condition/Maintenance High Risk Factors

- To determine the snow load that can be safely handled by the design load of the roof, consider hiring a civil engineer to perform this evaluation. This can assist you in determining at what point during a storm snow removal actions should start.
- Roofs that have poor drainage or no drainage at all. Two roof drains or scuppers (as applicable) should be installed for roofs of up to 10,000 square feet of roof area. Drain diameters of at least 6 inches (or scuppers of at least 8 inches) can accommodate roof areas of 15,000 square feet. Roofs with severely inadequate drainage and no overflow relief protection should be provided with additional drainage provisions. This is especially important for buildings with lightweight roof construction.
- Drains and scuppers should be inspected and cleaned out (as needed) at least every three months and following storms.
- Roofs that have new roof-mounted equipment (such as heating or air conditioning units) that add a permanent load not accounted for in the roof's original design. An engineering evaluation of the supporting roof framing and columns for the resulting dead load plus live load should be completed and reinforced as needed.
- Roof areas shaded from direct sunlight or wind permitting snow to remain on the roof indefinitely, resulting in heavier load because of snow freezing to ice.
- Roofs that have experienced previous collapses, indicating a weakness in design or condition.
- Roofs that have evidence of past or present leakage. Use of a thermograph, a device that identifies hot spots (temperature using infrared), detects the presence of wet insulation, which is evidence of a roof leak. Left unchecked, this can lead to water damage and roof collapse. This is best done prior to winter and following a heavy snow.
- The presence of "ripples" or bends in metal supports, cracks in wood members, or noticeable deformations in the roof.
- Where water now pools or ponds in areas of the roof where it never has before. As snow melts, it creates ponds in depression or alley roof areas. Ponding causes roof sag, making even deeper ponds, increasing the potential for collapse. This is the second most frequent cause of collapse.
- Construction weakens due to moisture, heat, and humidity. Wood bow-string trusses may deteriorate near the eave lines.

Preparation

If the national weather service predicts 6" or more of snow in a 4-hour period or a total accumulation exceeding 6", you should be prepared to implement your Severe Weather Plan. A safe maximum snow depth should be determined and you should be prepared to clear snow from the roof when one-half depth is reached. This allows sufficient roof load capacity to allow people and equipment on the roof. Preparation includes having the necessary resources and people in place.

Snow Removal Equipment:

- Snow shovels (plastic shovels help avoid damage to roof covering)
- Light duty wheelbarrows
- Snow blowers and surplus fuel supply (usually gasoline, in U.L. listed safety containers)
- Plastic tarps

Other Equipment/Supplies:

- Arrangements for emergency power and surplus fuel supply (in U.L. listed safety containers)
- Fuel supplies for heating system
- Additional portable heating devices (maintained and operated per manufacturer specifications)
- Salt for clearing drains

Provisions for sufficient staffing and/or arrangements for the services of a snow removal contractor:

If a contractor is engaged, this should be done early. When you have need of the services of a snow removal contractor, so do others. Maintaining a good relationship may result in faster service when they are needed. For contractors, certificates of liability and workers compensation insurance should be secured and updated upon expiration.

Roof Plot Plan with Photographs to Prepare for Snow Removal Process:

- Identify protrusions such as skylights, hatches, drains/scuppers, vent pipes, utility wiring.
- Location of load bearing walls.
- An up-to-date roof plot plan is essential, especially when using a snow removal contractor. Whether contractor or employees do the work, the roof layout and configurations should be confirmed before starting snow removal activities.

Heating System:

- Ensure system is in good repair and properly maintained.
- System may usually be shutdown or run at lower temperatures (such as during off-hours and weekends). When a snowstorm is expected, run the heating system at regular levels, 24-hours. When individually controlled building space heaters are used, it is especially important that all of the units are kept in operation. Shutting off certain units may result in uneven melting of snow on the roof.

During and After the Storm

There should be onsite monitoring of roof conditions for signs of overstressing of the roof and other concerns. The individual responsible for monitoring needs a reliable means of transportation to the site (site must be kept accessible) and a reliable means of communication at the site.

Snow Removal must be safe, practical and reliable to be effective. Whether employees or contractors do snow removal, those performing the task should be knowledgeable and experienced. As you will see below, there are decisions that need to be made with regard to the method and priority of removing snow from a roof.

- Begin snow removal BEFORE the condition becomes critical. This will permit time and flexibility in the remaining roof loading capacity to allow personnel and equipment on the roof. A safe maximum snow depth should be determined and you should be prepared to clear snow from the roof when no more than one-half of this depth is reached.
- Snow removal can be a very gradual process. It is not usually necessary to clear all snow from all portions of a roof. The top three areas that should be cleared (in order of priority) are:
  - Identify areas where immediate roof bracing/support is necessary.
  - Remove snow accumulation around drain(s). Salt can be used to keep from freezing.
  - Removing large accumulations due to drifting and in long expanses of unsupported roof area.
- Do not attempt to remove ALL snow down to the roof covering. This will help avoid damaging the roof membrane.
  - Snow blowers: units should be adjusted or operated to avoid contact of the rotating component with the roof surface.
  - Plastic shovels.
  - Plastic tarp: for use in filling with snow and releasing the contents over the side of the building. Avoid overloading isolated areas by not overfilling the tarp, and fill tarps on roof areas that have already been cleared.

Other Actions

1. Roof drains should be inspected regularly during the storm to ensure they are working.
2. Clear snow accumulations from exterior roof drains at the ground level outlet (which is often due to snow plows). In an emergency, the insulation can be removed from the interior roof drain risers to permit building heat to penetrate and prevent ice plugging.
3. Continue to monitor roof conditions, especially for drifting. Consider the direction of prevailing winds. Be cognizant of freezing rain following snow, which can contribute significantly to roof loads.

Minimizing Additional Damage in the Event of Collapse

- Call the necessary contractors for shoring/bracing and structural evaluation.
- Call local utilities.
- Shut off damaged water, gas, process, and electrical systems to avoid further damage.
- Relocate storage and equipment susceptible to low temperatures to areas where sufficient heating is present.
- Close/cover all building openings to prevent penetration of snow.
- Secure the damaged area to prevent further damage and to reduce the potential for injury to or theft by unauthorized personnel.

- Shut off as little of the automatic sprinkler system as possible in order to continue to provide fire protection to the undamaged and heated portions of the building.
- Take extra precautions to avoid fire hazards in unprotected areas (i.e., do not perform operations with flammables/combustibles, or operations involving potential ignition sources).
- Provide increased heat to safely thaw frozen equipment/systems. Avoid using open flames. In the event that an emergency dictates the need to achieve thawing using a torch or other open-flame device, the following precautions should be strictly observed:
  - All reasonable moveable combustible materials should be removed from the hot work area and floors swept clean. Wood floors should preferably be covered by metal or wet down.
  - A fire extinguisher having a minimum rating of 2A, 10 BC should be maintained nearby.
  - A fire watch should be maintained for at least 30 minutes after hot work operations are completed. This is especially important in buildings of large size, complex configuration, or other factors that may provide an opportunity for fire to develop undetected.
- Contact vendors to obtain new or temporary replacement materials, supplies, and equipment on a priority basis.

Alteris Insurance Services, Inc. Revised date: 08/2014