RiskTopics

When to initiate a roof snow removal plan
December 2015

Removing snow from a roof is a challenging task. It is important to develop a safe and reliable practice for manually or automatically monitoring your roofs so action can be implemented quickly and effectively when needed.

Introduction

Determine roof snow load design specification – Structural drawings of the building should contain roof snow load specifications. A separate document detailing the design snow load calculations may also be available. If documentation for the building is not available, the services of a structural engineer should be retained to develop the snow load carrying capacity of the roof.

The design snow load will not be the same for all roofs at a site, and it may even change for various sections of an individual roof. Areas where a roof is exposed to drifting snow should possess higher design snow loads.

Drifting snow can be caused by features such as:

- Walls of attached or even nearby taller buildings
- Higher nearby terrain
- Parapet walls
- Rooftop equipment

Discussion

Determine actual roof snow load – A method that is accurate and avoids the safety issues associated with a person being on the roof is an approach proposed by the National Weather Service[i]. This alternative involves collecting a core sample of the roof snow from any accessible point. This may be near a roof access door, hatch, window, fixed ladder, or other safe means of approaching the roof area. See Annex A for guidance on this recommended approach to estimating roof snow loads.

(Note: A frequently mentioned approach to determining the actual roof snow load is to collect and weigh all snow from a one square-foot area of the roof. This approach often involves a person going onto the roof to remove a heavy sample of snow to determine if the roof is safe. An obvious concern is the unknown exposure to the person collecting the sample.)

Guidance

Consider other roof load factors – The design load for a roof will be a combination of the dead load (weight of the building materials and fixed equipment), live loads (loads due to workers, tools, and equipment on the roof), wind loads, and snow loads. All of these loads, except the snow load, can be present year round.

Changes to roof loads during warm weather can lead to a surprise during a future cold weather snow event. Any change that increases the dead load will reduce the available snow load capacity.

Dead loads can increase by recovering a roof without removing the old roof cover. Likewise, dead loads can be increased by adding new fixed equipment on a roof or suspending new fixed equipment inside from a roof.

Changes can also occur that affect the amount of snow that develops on a roof. The addition of an attached or nearby building with a taller roof could lead to uncompensated increases in snow loads due to drifting on the lower existing roof. This addition of a taller building should include a re-evaluation of the snow load capacity of the existing building.

The change management plan for roofs should include a review by a structural engineer to guide any needed structural upgrades. Without careful management of change, when snow arrives, the available snow load capacity may not be adequate to accommodate the anticipated snow event.

Decide on course of action – A variety of audible and visual signs may be present that indicate a safe roof snow load has been exceeded. If any indicators are present, one should assume the roof is unsafe and subject to failure. Immediately evacuate the building.

Secure the services of a structural engineer to evaluate the integrity of the building before allowing personnel on or under the roof. These visual and audible indicators include:

- Building steel that is visually deformed
- Wood structural members that are cracked or split
- Sprinklers pushed down below ceiling tiles
- Doors that pop open or no longer operate correctly
- Utility pipes or conduits that are bowed out of normal position
- Structural noises including creaking, cracking, or popping sounds

The activity of removing snow from a roof is an arduous task. To handle the task safely requires reasonable work conditions and careful attention to safety. It is important to understand that snow removal is not considered safe and is not recommended during a snow storm.

Once a snowstorm is over and the building is not showing adverse visual or audible indications that a safe snow load has been exceeded, it is time to evaluate the need to take action. Is there a need to implement a roof snow removal plan?

Deciding to initiate a roof snow removal plan requires careful consideration. There is a need to compare the "roof design snow load" to the "actual roof snow load." If the actual snow load exceeds the design snow load, one should assume the roof is unsafe and subject to failure. See Annex A for guidance on a recommended approach to estimating roof snow loads. Immediately evacuate the building. Secure the services of a structural engineer to evaluate the integrity of the building before allowing personnel on or under the roof.

If there are no adverse visual and audible indicators and the estimated snow load does not exceed the design snow load, evaluate if there is a need to remove snow from the roof.

First, when it is safe to access the roof following a snowstorm, clear roof top drain inlets and outlets. Clear drains will help remove water from melting snow. Clogged drains can lead to severe ice accumulation. This can contribute to roof failures during a later snow or rain event.

Second, if the estimated roof snow load is approaching the roof design snow load, it is important to take proactive steps to safeguard critical assets and operation through snow removal.

Third, roof areas that accumulate drifting snow may warrant action to remove snow in the drift exposed areas. The deeper drifts will take more time to melt and drain away. This increases the likelihood that another snow or rain event can add to the actual roof snow load in these drift exposed areas.

Unless there are personnel on staff with experience to safely remove snow from a roof, one should secure the services of a qualified contractor to handle this task. It is further recommended to review detailed safety rule regulations with all contractors and secure contractor signatures indicating they have received this training. Consider having contractors provide Certificates of Insurance verifying adequate levels of insurance for both Workers' Compensation and General Liability. Also, verify coverage is provided for property damage or bodily injuries caused by contractor's employees or their operations.

Plan and prepare for next winter – Being in a position to act effectively requires advance planning. A formal roof snow removal "safe work plan" is an essential product of the advance planning. OSHA fall protection guidelines should be incorporated in the safe work plan.

Retain a qualified contractor to implement the roof snow removal "safe work plan." This is a job for those with experience working safely at significant elevations above ground.

Confirm:

- The contractor is fully aware of all safety expectations.
- The contractor has provided Certificates of Insurance verifying adequate levels of insurance for both Workers' Compensations and General Liability. Verify coverage is provided for property damage or bodily injuries caused by contractor's employees or their operations.

Safely removing snow from a roof is an expensive undertaking. Therefore, if you will be periodically faced with making a decision to clear snow from a roof, it may be cost effective to consider a roof deflection monitoring system that can alert you when action is needed. Examples of companies* that can provide roof

deflection monitoring systems include Safe Roof Systems http://saferoofsystems.com/ and Sensing Systems Corporation http://www.sensing-systems.com/. It is essential to evaluate available systems against the criteria of your particular situation.

There are several conditions that can increase the need for clearing snow from a roof. They include:

- Buildings housing high value equipment or stock where there is little desire to take chances with these high values.
- Buildings exposed to drifting snow due to roof height changes, parapets, or roof top equipment.
- Buildings designed to the 1993 or earlier edition of ASCE 7 "Minimum Design Loads for Buildings and Other Structures" which are designed to a lower roof snow load requirement than today.

For these situations, consider the cost-benefit case for a roof deflection monitoring system. These monitoring systems can provide clear criteria for when it is time to act. Avoiding one unnecessary snow removal effort may pay for the roof deflection monitoring system.

Conclusion

For further guidance or to discuss questions, contact your Zurich account team.

Annex A – One approach to estimating roof snow loads**

This recommended approach to estimating the roof snow load is intended to be applied without personnel going onto the roof. This alternative involves collecting a core sample of the roof snow from any accessible point. This may be near a roof access door, hatch, window, fixed ladder, or other safe means of approaching the roof area.

The core sample can be collected using a pipe of any diameter. An interesting element of the approach is that the pipe diameter does not impact the calculations. To keep the weight of the sample as light as possible, select the smallest diameter pipe available that will effectively collect the core sample.

To collect the snow core sample, use a capped section of clear plastic pipe having a length that exceeds the snow depth. Stick the pipe vertically down into the snow, and collect a full depth sample. When taking the sample, note the depth of the snow at the sample location. This can be accomplished by marking the sampling pipe.

Take the collected sample into a heated area and allow the snow to melt inside the pipe. Once the snow has melted, measure the height of water in the pipe. Using the following formulas, calculate the "estimated roof snow load" and the "estimated snow density" at the sample location.

(1) P = 5.2H, where

P = Estimated roof snow load in pounds per square food

H = Height of water in the pipe in inches

(2) D = 12 P/S, where

D = Estimated roof snow density in pounds per cubic foot

P = Estimated Roofs now load in pounds per square food

S = Measures snow depth at the roof sample point

To estimate the roof snow load at another location on the roof, there is a need to identify the depth of snow at that location. This can be accomplished by using the heights of known rooftop features such as equipment parapets, and penthouses. Pre-marking walls and equipment with elevations or measuring sticks can also facilitate identifying snow depths. The overall objective is to visually identify the snow depths without actually going onto the roof.

Once a snow depth is identified at another location, the roof snow load at that location can be estimated using the following formula:

(3) P = D S/12, where:

P = Estimated roof snow load in pounds per square foot

D = Estimated roof snow density in pounds per cubic foot

S = Estimated snow depth at the desired point on the roof

As a caution, any ice present under the measured snow layer may go unaccounted if care is not taken to include the ice layer if present. Each inch of ice represents an added roof load of 4.8 psf.

**Neither of these companies is a subsidiary or affiliate of Zurich or its affiliates (Zurich) and use of their products and services are independent of, and not included within, the any Zurich policy or any other Zurich product or service. Zurich expressly disclaims any and all damages and other costs that may arise related to the use of or reliance upon the products, services, representations or warranties made by or on behalf of these companies.*

References

[i] Curtis, Joel. "Snow Loads." *National Weather Service, Juneau, AK*. NOAA, 21 Jan. 2009. Web. 14 Jan. 2016. http://pajk.arh.noaa.gov/Articles/articles.php

The Zurich Services Corporation

Risk Engineering

1400 American Lane, Schaumburg, Illinois 60196-1056

800 382 2150 www.zurichna.com