

Helping prevent snow/ice load roof collapse

Winter storms can bring a whole array of exposures to your buildings and operations. Some regions of the country have experienced record-breaking snowfalls in recent years, which in turn has increased the hazard of roof collapse. All properly built roofs need to be built to withstand snow and ice loads. Building codes and roof loads vary across the U.S. and are based on historical data, such as the expected frequency and severity of snowstorms in that particular region.

This guide is intended to assist you with:

- Recognizing the hazard of a potential snow load roof collapse
- Preparing and planning for the next winter storm
- Taking action to limit damage to building and contents

The following steps should be taken to help prevent potential roof collapse:

Preparing for the next winter storm

Can your building withstand large snow or ice accumulations?

- You should know how much snow your buildings can safely handle. Be aware that building codes vary across the U.S. and also between building types. Code requirements have generally increased over the years, so older buildings may be designed to lesser requirements or none at all. Also recognize that they're created to protect human life not necessarily property. You should contact a structural engineer or qualified builder to assist you in determining the snow load design for your buildings, and determine if any improvements are needed to prevent a future collapse.
- Consider weight that may have been added to the roof, which will reduce the available live load or roof design. This could be the result of new or heavier roof-mounted equipment (e.g., HVAC units), installation of a new roof covering or hanging equipment from the roof steel. A structural engineer should be consulted prior to adding any additional weight to the roof.
- Be aware of drifting snow potential that could result from new additions of different elevations, large roof-mounted signs, etc.
- Inspect the roof and structure (inside and out) for any damage, cracks or corrosion. Contact a qualified builder/roofer to help you assess the damage and the necessary repairs.
- Inspect all roof drains and gutters to ensure they are clear of any debris. Ice accumulation along the eave is a contributing factor to roof collapses.
- Check windows and doors to ensure they continue to open and close as designed. Any change in their operation should be investigated by a qualified builder. This change in operation might be the first indicator that structural members or the foundation is moving and could fail under a heavy snow load.
- If your building has a standing seam metal roof and was built before the year 2000, there may be a design weakness present. See the Travelers bulletin "Standing Seam Metal Roofs" or contact a structural engineer.
- If your building has a wood bowstring truss roof, this type is historically prone to failure, particularly due to truss deterioration where it meets the wall. A structural engineer should inspect such roofs on a periodic basis.

Develop a plan to safely remove the snow

- Start with a monitoring system to assist you with determining when to start snow removal. Action points need to be established so that the snow load isn't allowed to get so high that it becomes unsafe to get on the roof. This is why it is important to know the snow load for your buildings.

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- Decide whether you will remove the snow or if you will hire a contractor to perform the work. If you have any question about the requirements for your staff to safely do this, it would be better to use a contractor. If you decide to do the work, you need to ensure you have appropriately trained individuals on hand to safely perform this work and the proper equipment to avoid damaging the roof covering. If you decide to have a contractor do the work, have them sign the contract early and make sure they can respond quickly to your call. Make sure the contract has appropriate risk transfer language and that the contractor has adequate insurance coverage to do this work. Your insurance agent or broker can help you determine what is adequate for your exposure.

Develop a contingency plan

- Prepare for the worst and develop plans to protect your building and equipment, including business continuity plans to identify other locations or organizations that could help keep your business operational.
- Have enough tarps on hand to protect goods and equipment if they need to be temporarily moved outdoors, or have plans to move them inside another safe building or structure.
- Clearly identify shut-off valves for utilities, such as gas, water and electricity.
- If the building is protected by automatic sprinkler systems and the system needs to be turned off, it is important to eliminate all possible sources of ignition, contact the fire department and your property insurance company.
- After the plan has been put in place, evaluate the effectiveness and make any necessary changes.

During the winter storm season

- Monitor weather conditions
- Monitor roof conditions
 - > Monitor snow and ice accumulation across the entire roof of all buildings
 - > Monitor the amount of snow drifting along long ridge lines or on lower roof levels
- When deemed safe, implement the Snow Removal Plan and monitor snow depth on roofs.
- A snow removal plan should be reviewed by a structural engineer and roofing contractor to ensure that it does not increase the danger of collapse or cause damage to the roof covering, and is conducted in a manner that is safe for those working on the roof. For example:
 - > Use of equipment such as large snow blowers on an already heavily, snow-loaded roof may present an excessive load. Or if the snow blower is not capable of throwing the snow off the roof in one pass, without a good plan, it could redistribute the snow and create areas where the load capability of the roof is exceeded.
 - > Snow removal should be done in a manner that keeps the roof load as symmetrical as possible. This may mean removing deep snow in layers and removing snow on both sides of a low-pitched roof as you go, rather than one side completely, then the other, etc.
 - > Use of metal shovels or ice chippers could damage the roof covering and allow leakage, wetting of insulation and damage to building contents.
- Be cautious of where snow is placed when removing it from the roof. Do not block building exits. Also, do not bury equipment such as fire hydrants, fire department connections, sprinkler, gas and other utility valves. Lastly, do not place piles where melting snow can cause seepage or flooding inside the building.
- Be aware that wet snow and ice are far heavier than fresh light snow and that the visible depth of the snow may be deceiving, as indicated in Table 1.
- Be aware of any warning signs that the building structure may be under significant stress and perhaps in danger of collapse.
 - > Inspect interior structural members for any sign of deflection or cracking
 - > Inspect interior and exterior walls and ceilings for signs of cracks that have recently developed

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- > Look for cracked or broken windows
- > Inspect and test doors and windows, and make sure they continue to operate as designed
- > Look for any sprinkler heads that are pushed down below dropped ceiling tiles
- > Listen for any unusual creaking or popping sounds
- If there are signs of deflection or damage to the building's structure, a qualified structural engineer should be contacted for an immediate inspection. Building evacuation, temporary shoring or similar forms of support may be warranted. Shutdown of gas mains and sprinkler systems may be advisable if the roof condition deteriorates and collapse is considered likely.
- Implement contingency plans if collapse is imminent or has occurred

After the storm

- Inspect your property for damage and implement your contingency plan
- Prepare for the next storm and make changes to your snow removal and contingency plans as necessary
- Report any damage and claims promptly to your insurance agent or broker

Density Information				
	Light/Dry Snow	Heavy/Wet Snow	Ice	Water
Snow density (lb/cu ft)	3.12	20.81	57.25	62.43
% of water weight	5%	33%	92%	100%
Equivalent Inches				
Design Snow Load (lb/sq ft)	Light/Dry Snow	Heavy/Wet Snow	Ice	Water
5	19.2	2.9	1.0	1.0
10	38.4	5.8	2.1	1.9
15	57.7	8.6	3.1	2.9
20	76.9	11.5	4.2	3.8
25	96.1	14.4	5.2	4.8

Table 1 is used with permission from the *Ice and Snow Accumulations on Roofs*, Dr. Karl VanDevender, University of Arkansas.

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