



Risk Control Services Winter Roof Collapse Hazard

Snow is a fact of life in Canada and all areas are subject to regular accumulations and snow storms. Deep accumulations of snow can lead to roof collapse. In addition, rain combined with previous moderate snow accumulations can overload the structure and lead to collapse.

To the best of our knowledge, Canadian Building Codes are adequate to provide suitable structural strength for snow, ice and rain loading on buildings. However, building codes are only as good as the engineering and workmanship at the time of construction. Furthermore, building codes cannot predict additional loading of the structure by occupant use and/or poor maintenance. And, there is always a deterioration factor over time with any building. Thus, building collapses, while not necessarily common, do occur in Canada for the following reasons:

- Snow, ice and rain accumulations higher than those anticipated by the codes (i.e. freak weather events)
 - Drifting in isolated areas such as roof elevation changes or near large equipment which creates localized loads
 - Poor workmanship/materials in the construction
 - Inadequate engineering design
 - Additional loading on the structure by the occupant (i.e. hanging heavy loads such as temporary or permanent storage from the building joists or beams)
- Buildings most susceptible to collapse are those with:
- Roof elevation differences, especially those where the lower roof is older than the higher roof
 - Any additions (even if the roofs are of same height) since the connection point is usually a continuous line

that can be a weak point due to poor workmanship or differing materials

- Structural members that may have deteriorated over time or due to corrosive environments
 - Large equipment on the roof or extensive coverage of moderately sized equipment, especially those where the equipment was added after original roof construction
- Blocked primary and secondary drains
- Added loads on the structural members by storage or other loads suspended from the joists or beams
- Building owners and operators should take reasonable measures to monitor the snow accumulations and prevent building collapse. Some measures that can be taken are outlined below.

Before Winter

Know your building – When was it built? Were there any additions since then? Are there any elevation differences? Note where the lines of any additions and elevation differences are located.

Roof Equipment – Is there any very large or a lot of moderately sized equipment on your roof. These can represent snow drifting accumulation points and those areas should be noted.

Check your roof drains – Are they blocked with debris? Are the filter caps in place to prevent debris from accumulating in the drain pipe? Take immediate action to rectify any problems.

Check the interior structural elements (beams, joists, columns) – Any evidence of corrosion, cracking, damage? Are there any temporary loads (i.e. large amounts of hanging clothes, racks or shelving suspended from the joists, etc.)? Take immediate action to rectify any problems. These actions would involve facilities engineering and professional engineers to review any perceived problems with the structure and removing any loads from the structure which would have not been anticipated in the original design.

Prepare a plan to for safe removal of snow from the roof if necessary. - We recommend using qualified snow removal contractors who have adequate liability insurance coverage in place. This should be established ahead of time. If you plan to do this with employees, a detailed plan for removal should be developed; the employees should be fully trained; and the necessary tools should be on hand to accomplish this. Key points in a safe removal plan include:

- A snow removal operation should avoid producing any uneven or concentrated loading on the roof.
- Areas onto which snow will be dumped from a roof should be secured to prevent access.
- Workers on a roof must use fall-arrest or travel-restraint equipment in accordance with the fall-protection requirements of the Occupational Health and Safety legislation requires employers to ensure that workers are protected from falling when undertaking such work. This may be accomplished through the use of fall protection systems which may include fall arrest or travel restraint systems, guardrails and barricades, or other effective measures. Appropriate fall protection is required for work on all types of roofs, including flat roof structures.
- A civil or structural engineer should be consulted to:
 - » Determine whether snow loads are excessive;
 - » Determine whether there are signs of structural distress;
 - » Obtain a removal procedure that will not cause more structural problems; or
 - » Reinforce a structure that is overstressed.
- Snow removal should use tools and procedures that will not damage the roof cover, flashing, skylights, etc.

Periodically check the roof for snow accumulations. Note drifting snow near roof elevation differences, signs, facades, and large equipment. Note areas of unusual ice accumulations. Keep a record of any unusual conditions and report them to the facilities engineering.

Continue to check roof drains even if there is no snow on the roofs. Take immediate action to rectify any problems.

Note roof leaks and take temporary corrective action as necessary. Keep a record of the locations of leaks and report them to facilities engineering.

Review snow depth in your area against historical norms and maximums:

- The Weather Network's website <http://www.theweathernetwork.com/> provides easily accessible, understandable and useful information on current conditions and climate history. This information can be found under the "Weather" tab on their main page.
- Current snow depth for your area can be found at: <http://www.theweathernetwork.com/snow/>. Click on your Province and then on "Click Here" to find a weather station in your area.
- Historical norms and maximums for your area can be found at: <http://www.theweathernetwork.com/statistics/>. Click on the Precipitation Tab and scroll down to find your area.
- Keep in mind that ice, older snow or wetter snow will weigh more than new snow.

Periodically monitor the building and structure for evidence of overloading. Sagging beams, joists, trusses as well as sprinkler heads deflecting below suspended ceilings are warning signs. Be sure to check key areas near roof elevation differences, large equipment, etc.

When general snow accumulation or drifting appears large or there is evidence that the roof is overloading review with facilities engineering and professional engineers immediately. Take corrective action as needed to remove snow.

If collapse appears imminent, vacate the building and contact the utilities or contractors to shut down gas, water, electricity and sprinkler systems if it is safe to do so.

During Winter

After Winter

Review unusual conditions and roof leaks with facilities engineering. Excessive ice build-ups and ice dams could represent a problem in the design of the building, blocked drains or lack of drains where required. These conditions require corrective action. Otherwise they will persist annually and contribute to the eventual weakening of the structure. If the structure showed signs of overloading, have the entire

building reviewed by a structural engineer.

If it was necessary to shut down sprinkler or plumbing systems, have the systems review by qualified contractors or engineers to determine if there is any damage to the systems. Make sure all sprinkler systems are turned back on!

Review the service of snow removal contractors for preparation for the next year.

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