Winter Weather Preparation:
Preventing Roof Collapse

IARW® International Association of Refrigerated Warehouses

Introduction

The problem of snow and ice accumulation is real for all properties and especially so for warehouses. Due to the potential loss exposure in areas prone to heavy snow accumulation, IARW has been reminding members of snow procedures since 1978. We recommend this problem receive your priority attention during the winter months so as not to induce stress on warehouse buildings or place lives at risk.

Determining Roof Capacity for Live Loads

According to IARW Warehouse Attorney John Horvath, "roofs are designed to carry live and dead loads. The dead load is the weight of the roof and everything associated with the roof. The live load is anything else that puts weight on the roof such as people and snow."

"Each affected member should determine what live load the roof was designed to carry and what the live load currently is based upon weight of the snow. The weight of snow varies based on the type of snow and should be available locally. Other factors include any roof areas that create a potential for the snow to gather in one area which would place more weight on the roof in that area. The determination of the live load should be done before allowing anyone into the warehouse from an employee safety point of view."

"If the weight of the live load is close to the designed live load, the member should consult with a contractor to determine what can be done to reduce the live load on the roof. To the extent possible each member should make sure roof drains are functioning and not clogged to allow the water to run off the roof freely."

Steps to Prevent Roof Collapse

1. Inspect roofs and drains frequently.
2. Clear snow before it packs through freezing and thawing (if this can be done without causing damage to or compromising the integrity of the roof and without placing human lives at risk).
3. Be especially alert to multi-level rooflines.
4. Take reasonable steps to keep drains clear of ice and snow.
5. Develop a snow and ice removal procedure.

Remember that 50,000 square feet of water only one inch deep weighs 258,333 pounds. (In metric terms, 4,645 m2 of water only 2.5 cm deep weighs over 117,000 kg.)

Low Roof/High Roof Junctures

Storm problems have emphasized the great danger at the juncture of a low roof and a high roof (such as a dock roof joining a warehouse with a high roof). Large flat roofs generally do not have large accumulations of snow because it will blow off, melt, or evaporate; but drifts can occur at these low roof and high roof junctures. The drifts are compounded by the shade formed by the high wall. The low roof-high roof junction requires constant inspection and should be the first area to receive snow removal. The problem here is generally one of shear and not deflection; therefore, snow removal should be concentrated at the point against the high wall. High drifts should be attacked first and removed. Snow should never be moved from a high roof to a low roof but should always be removed to ground level.

Snow Removal and Structural Systems

The effect of snow removal depends to a great extent on the design of the structural system. Remember, human safety is the number one priority. The following are some general guidelines for various types of roofs:

1. Flat Roofs – Simple Beams. Removal of snow at any one point generally does not cause increased stress or deflection at other points. The snow at mid-span has more significance than snow at the edges. However, generally speaking, most snow removal starts at the edges and progresses toward the center. Where very heavy snow loads are on the roof, consideration should be given to cutting a path to mid-span to remove this snow first. If beams show signs of deflection, a prop near mid-span can be wedged in place under those beams showing the greatest deflection. Usually whatever type of material is at hand can be used. Although desirable, the prop doesn't have to carry the whole load. Frequently, the prop has to take only a small portion of the total load to prevent collapse. When large pieces of timber, pipes, or steel sections are not available for props, success can be had in making "T" shaped props out of two-by-sixes or two-by-eights nailed together to form a "T."
2. Flat Roofs with Cantilever Beams present another problem. If snow is removed from one section of the cantilever, it can create higher loads in the other end of the member. For cantilevered members, snow should be removed equally from each bay in order not to cause excessive stresses due to unbalanced loads. For larger structures with many cantilevered or continuous beams in a row, we would recommend having an engineer draw up a plan of snow removal specific to the building so as not to cause increased stresses. Most buildings are designed to carry unbalanced loads, but in cases where snow loads are at or above design levels, some additional overstress can be caused by improper snow removal. In any event, the

removal of the snow from one section can cause additional stresses in other parts of the roof system.

3. Roofs with Bowstring Trusses are especially sensitive to unloading snow from end panels of the trusses. Again, we would recommend that an engineer develop a system of snow removal for each building.
4. Flat Roofs in general may be susceptible to ponding. One of the worst conditions is when a combination of rain, snow, and ice occurs. The snow and ice can clog up the drains and a severe ponding condition can be set up. Thawing and freezing snow should be checked frequently for potential ponding problems.

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