the MANAGER

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The Insurance Package for Government Subdivisions

School & Municipal Roofs

Inspect Them Now or Investigate Them Later

Every book has a cover; every building has a roof; and both have a story to tell. Like the book cover, the roof is there to protect its contents. Sometimes it fails.

Roof fails from wet snow overload at Claypit Elementary School in Wayland, MA, 2003.

The public media frequently remind us of the frailty of roofs. On the average, 3,000 roofs collapse each year. Some collapse from being overloaded, with snow, rainwater, ice, or equipment. Others collapse from faulty design, defective materials, or poor workmanship/ construction. Still others fail because maintenance was postponed or because there were no funds for inspection services. Whatever the reason, a roof collapse can be disastrous in terms of life and most certainly expensive in injuries, property damage and disruption.

School Roof Collapsed in Washingtonville, NY When Joist Failed

Schools and other municipal buildings are not immune to roof failures. In fact, there is a long

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Avoiding Snow Loaded Roof Problems

Property insurance will address most of the losses caused by winter storms. There are always hidden costs, however, that are difficult to recover. For example, some historical records may be damaged beyond recovery. Those that are not duplicated may be lost forever and insurance recovery, if any, will be limited.

Most public entities in the U.S. do more than buy insurance. They periodically study their risks and take action to remedy deficiencies. They have a respectable facility maintenance program and contract out work that requires special skills or tools. They know the limitations of their facilities and personnel, and don't knowingly allow those boundaries to be exceeded.

With winter storms quickly approaching, here are some general observations and guidelines that are worth following:

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Inside this Issue:

Happenings!

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presented by Terry Dowdy of the Law Firm Kopelman and Paige

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history of such failures in both public and private buildings. In the summer of 2004 there was a partial roof collapse at an elementary school in Washingtonville, NY, that received a lot of attention, not because people were injured – none were – but because the failure arose from a failed steel joist of a type common to a high percentage of schools in this country.

Faulty construction can negate architectural safe load calculations for water or snow accumulation, especially if there is roof-sag.

The failed roof support, a U-shaped joist commonly used in school construction throughout the U.S. from 1900 to the early 1970s, had thoroughly rusted through from years of exposure to water from a leaking roof. Professional engineers report that this failure wouldn't have happened were it not for the leaking roof. In fact, other parts of the building with non-leaking roofs, but with similar construction materials, sustained no damage.

Leaking roofs are common in schools, more so lately since schools have had to reduce costs amid state budget deficits. Repairing or replacing a roof is expensive and can often be put off for "next year" when funds might be more available. Next year sometimes doesn't come soon enough.

In the case of the 44-year-old Taft Elementary School in Washingtonville, rainwater had collected in the joist, which wasted away until it finally gave way. A plaster drop ceiling beneath the roof hid the damaged joists for years and gave no indication there was a moisture problem above the ceiling. Failure occurred on August 1, 2004.

The school had been inspected in 2001 and 2003. Both inspection reports noted unsatisfactory roof conditions. The original roof was a "tectum roof deck," a composite panel structure supported by steel joists, reportedly built around 1958-1960. More recent work may have been done in 1985. About half of the original joists were sloped to create roof drainage; the other half had no pitch, and drainage was achieved through a tapered lightweight fill over the 2-inch tectum roof deck.

Most of the joists used at Taft Elementary were type "SJI46," a U-shaped beam made from continuous formed plate, the top of which can trap water. The joists were spaced 36 inches-on-center. A problem arises in non-pitched areas if the steel joist deflects and water accumulates for long periods of time, eventually causing the joist to rust through.

The joists in the failed section of the Taft school building were not pitched. The collapse was the "result of a localized overload coupled with a decrease in roof joist capacity due to localized corrosion," according to consulting engineers for the school district, McGoey, Hauser, and Edsall, P.C. of Milford, Pennsylvania. There is no problem with the SJI46 joist design as long as there are no roof leaks, which is why roof and joist inspections and maintenance are critical.

Courtesy Wayland, MA School Dept. Claypit Elementary School, 2003.

The cost to repair the roof for the conditions reported in 2001 and 2003 was estimated at $950,000. The

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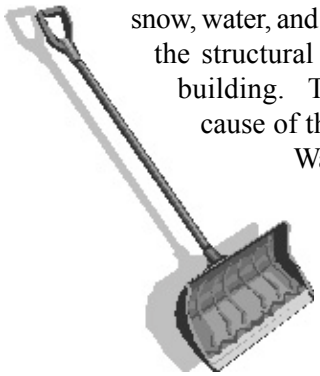
Observation: Snow and ice accumulation on flat roofs and roofs with a pitch of less than 4 inches/foot may cause roof collapse. Various other roof designs and configurations as well as faulty construction techniques may leave some roofs vulnerable to failure from excessive snow loading. Most roofs are designed to carry at least 6 inches of snow; but much more capacity may be applicable in snow country.

General Guideline: Each roof should be evaluated for ice and snow load capacities by a civil engineer, architect, or other qualified person. Ice weighs a lot more than snow, and that should be taken into account, as all types of weather conditions exist in the Northeast.

Observation: HVAC, emission controls, and other roof-mounted equipment added after the original roof design will reduce the capacity of the roof supports to handle live loads, such as snow.

General Guideline: An engineering inspection should be conducted to locate weak areas, leakage, damaged insulation, or cracked roof support members or joists. Roofs should be checked for areas of sag where water may accumulate, causing further weight and more sagging, potentially leading to eventual roof collapse.



Observation: Roofs may leak allowing snow, water, and ice to accumulate within the structural members or inside the building. This was the proximate cause of the 2004 roof collapse in Washingtonville, NY.

General Guideline: Any leaking roofs should be promptly repaired or replaced.

Observation: As a rule of thumb, at least two 6" diameter drains should be installed on flat roofs of 10,000 sq. ft. or less. Add another 6" drain for each additional 10,000 sq. ft. Scuppers with a diameter of 8 inches or more may be substituted for drains.

General Guideline: Measurements should be taken and calculations made to determine the correct number and size of drains for each roof segment. Drains and scuppers need to be checked and cleaned quarterly, after significant storms, and, if affected, after there has been a significant falling of leaves.

Observation: Normally maintenance staff aren't qualified to determine when snow removal is necessary unless conditions have been pre-established by a professional engineer or architect.

General Guideline: A professional engineer should determine when snow and ice should be removed. Specifications will depend on a number of factors, including the design and slope of the roof, equipment loading on various sections of the roof, spacing and size of drains, amounts of snow or ice accumulation, weather predictions, estimated temperatures, and the condition of the structure.

Work to remove any accumulation should begin at half the determined safe load since (1) the persons and equipment necessary to remove the accumulation will add temporary weight to the roof, and (2) additional snow and ice may accumulate while the work is underway.

Observation: Contractors should be qualified before they are hired to remove snow and ice.

General Guidelines for Contract Work:

- Make the arrangements months before the snow

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reports suggested, "replace roof with B.U.R." Neither report mentioned wasted roof joists. Subsequent to the failure, engineers recommended a complete roof and ceiling replacement. The new roof would consist of a new metal deck over new structural beams and would be pitched to the drains.

A quick inspection by a structural engineer can readily determine if this type of joist is used in your school or municipal building, and, if so, whether or not the joists are in good condition. With more than half of the nation's existing schools having been built before 1970, according to a Government Accounting Office census taken in 1996, other schools may well be in danger.

New York State's Education Department put out a structural advisory to schools statewide, and other states have given notice that buildings should be inspected for U-joist problems. Interestingly, New York had put out a statewide structural defects warning in 1996 without reference to this problem following the structural failure of a school cafeteria roof in North Syracuse; this specific joist problem was unknown at the time.

School Roof Failures More Common Than Commonly Thought

The GAO noted that a third of the schools it surveyed in 1996 needed extensive repair or replacement of one or more buildings; among the most pressing concerns were roofs that needed patching or replacing.

Schools have experienced roof collapses, from a variety of proximate causes. In 2000 the entire roof over the gym of East High School in Cleveland collapsed injuring three students and two adults. The supporting walls remained standing. The culprit in this case was a crack in a supporting beam.

In Utah, heavy rains in September 2004 are believed to have caused a section of roof to fail at the Ogden Preparatory Academy. The roof had been under construction at the time. In Newark, Delaware, in February 2003 a 30-ft x 30-ft section of roof at the Leasure Elementary School collapsed over the main office under the weight of 40 inches of snow and ice. Students were relocated while repairs were made.

The post-accident engineering findings regarding the roof collapse at Taft Elementary School provide us a critical opportunity. Every school district with school buildings constructed prior to 1980 should be inspected for potential roof failure. Engineers should determine if U-shaped steel joists were used in the construction of the building; and, if so, has their integrity been retained. Rusted joists should be analyzed by a professional structural engineer and replaced or repaired as necessary.

Snow and ice have collapsed school roofs all across the northern tier of the country, from Caton, Michigan, to Foxboro, Mass.; from Genoa Township, Minnesota, to Buffalo, New York; from Gresham, Oregon, to Dalton and Napoleon, Ohio. A roof collapsed under a foot of snow at the University of Northern Iowa in 1994. In Springfield, Virginia, a foot of snow and gusting winds caused the failure of a roof covering a church high school

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season.
- Check their references.
- Ensure that the contractor has current certificates of insurance for general liability and workers' compensation, with adequate limits for the work.
- Review the list and availability of equipment they will use on your roof.
- Determine how quickly they will respond to a call for snow removal, as they likely will have several other clients who will need their attention at the same time that you do.

Snow and ice removal should begin before the accumulation reaches 50 percent of the designated safe working load.

General Guidelines for Roof Workers:
- Review safety training of all personnel involved in roof work.
- Review all operating procedures to encompass safety concerns.
- Make certain that roof workers are secure from falling while on the roof. Follow OSHA guidelines.
- Provide workers with a current roof plan. Include wiring, piping, vents, drain/scupper locations, skylights, hatches, roof-mounted equipment, the location of load-bearing walls, antennas, piping and valves, etc. Include the location of isolation or shut-off valves for all utilities, and procedures for the workers to follow to gain authorized access to them in an emergency.
- Keep heating systems on at normal levels during and after a storm to promote even heating and melting on the roof.
- Have braces installed in weak areas before snow removal begins.
- Have workers first clear all drains/scuppers (use salt if necessary) and heavy accumulations due to drifting.
- If snow blowers are used, ensure that the workers set the deck high enough so as to prevent contact between rotating parts and the roof.

Observation: Roof damage may exist before the winter season begins.
General Guideline: The roof may be damaged before the winter season starts. If so, repair it as soon as possible, before real cold weather sets in. If damage occurs during the winter, remove snow and ice from the area, and make either temporary or permanent repairs to prevent further property damage, injuries, or theft. If torches or other heating devises are used, make sure that a fire extinguisher is present and that a fire watch is posted inside the structure if sparks can get inside. Keep an eye on the area, inside and outside, for at least a half hour after hot work is completed to catch any smoldering embers or an incipient fire. If systems have been shut down to effectuate work, be sure to return them to normal condition before finishing the repair work. Test those systems to ensure that they are functional.

Following these guidelines will considerably advance your chances of preventing a roof collapse due to snow and ice, a structural fire, or an impaired utility system.

For additional advice, contact the Massamont Loss Prevention Department.

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in 1996. In 2003 heavy snow in Herndon, Virginia, contributed to the nighttime collapse of the roof of a new parish hall even though the structure was designed to carry two to three times the snow load. The hall was part of a nearly completed $8 million project that was to house a kindergarten and elementary school. To add insult to injury, the collapse caused the failure of the sprinkler and hot water heating systems, leaving four feet of water in the basement.

Three days of water-soaked snow and ice in 1996 caused several roofs to fail in Bremerton, Washington, including those of a high school and a library. Ninety roofs failed in Beckley County, West Virginia, in 1998 after nearly four feet of wet snow fell in a two-week period; six people were killed, and many persons were injured.

In 1996, tons of snow caused the roof of a building in Bay Shore, New York, to sag. A half-hour before roofers arrived to repair the structure, the roof failed, killing one worker and injuring two others. A warehouse roof collapsed in Carlstadt, New Jersey in 1994, when a weather-weakened roof couldn't support replacement materials. Three workmen were injured when they fell 25 feet.

Heavy snow accumulation, followed by drenching rains, is merciless on flat roofs. Roofs with long spans under such conditions are accidents waiting to happen. Rains that last for several days, heavy rains such as those that accompany thunderstorms, and clogged drains have been responsible for roof failures all around the country.

In 2004, at the Homosassa Elementary School about 100 miles north of Tampa, Florida, inadequate roof attachments, missing and improperly placed roof welds, and walls that lacked strengthening steel and grout were noted by a volunteer structural engineer after a construction worker reported that the roof on an old section of the school was sagging and had a "4-inch bounce" to it. A sagging roof accumulates rainwater, and the weight of the water causes it to sag further, eventually causing the roof to fail. At the time of the discovery, two new buildings were being constructed. The new construction project engineer declared that there was no problem with the old roof, and plans were proceeding to install heavy air conditioning equipment on the old – "bouncing" – roof. During a subsequent onsite visit, the volunteer engineer found defects in the new roofs as well. Fortunately, the defects were confirmed by an independent lab and corrected before there was a roof collapse.

Contractors may be in a hurry to meet schedules and budget. They may not be qualified to judge if a defect is serious or negligible. Therefore, architects and competent, independent engineers are vital to the long-term safety of construction projects.

In Traverse, Michigan, the roof of a three-year-old high school collapsed early in 2004, allegedly because the architects failed to design the structure with proper truss bracing, failed to supervise the construction, and failed to inspect the premises upon completion of the job, according to court documents. Before the collapse, the roof was declared unsafe due to snow loading, and the school was vacated. Eventually, when the weight of the snow caused the trusses to bend and break, the roof collapsed. About 430 students completed the school year in other local facilities, including a church. The failure was due only in part to the snow loading, the property insurer – who paid a share of the loss – claimed. The lawsuit filed against the architects was for the bulk of the $350,000 loss including the renting of temporary facilities, additional student transportation, legal fees, and some of the repair costs.

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Strange Experience in Canada

While we in the insurance business tend to take things very seriously, on occasion even we have to chuckle. Take for instance the report of a roof failure in Kimberley, British Columbia, Canada, a ski town 500 miles east of Vancouver. The roof of the Kimberley Middle School, formerly the McKim Theater, collapsed mysteriously around midnight on March 5, 1999. A couple of hours before the roof failed a witness saw strange colored lights "hovering" over the building, shimmering like the northern lights. Then the lights spread out like a mushroom, right over the school roof.

Around town other witnesses saw strange lights at about the same time. Four independent witnesses claimed to have seen a diamond-shaped UFO enshrouded in flashing lights drifting over the trees near town. One witness claimed to have seen UFOs before – in Norway, Austria, Calgary (Alberta, Canada), and once before in Kimberley. For the other witnesses, this was their first sighting. The Canadian Royal Mounted Police in Kimberley received several telephone calls that night, but could not confirm the sightings. Shortly thereafter, the school roof collapsed. Cause: unknown.

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