



Photo by author.

BEWARE THE ROOF

BY RAY DOWNEY

Since the beginning of the fire service, collapses have been a particular concern for responders. Building structures, regardless of the materials used in their construction and design, are susceptible to collapse for a variety of reasons. Hurricanes and tornadoes have a devastating effect on structures. The impact from fires and explosions certainly can add to any building's instability. Building failure is usually the most destructive effect of earthquakes. Failures of building components such as walls, floors, columns, and roofs resulting from overloading or

uneven distribution of loads are other common reasons for collapses.

COLLAPSE CAUSED BY THE BLIZZARD OF 1996

The Blizzard of 1996, which struck many parts of the United States, resulted in numerous roof collapses that caused many injuries and a number of deaths.

On Long Island, New York, for example, the roof of a 50,000-square-foot, one-story commercial building used as a recycling center collapsed, killing one worker and injuring two others. Ironically, the roof collapsed only a half hour before a roofing company was to begin repairing the damaged section of the roof.

Six weeks earlier, a truck backing into the building struck a steel support column, leaving a section of the roof approximately 30 feet by 30 feet unsupported. As a temporary measure, a vertical shore was installed alongside the damaged column to provide support for the sagging roof area. Complete repairs were to be started as soon as possible. Investigators still are trying to determine if the actions taken provided the necessary support and who, if anyone, authorized these measures.

The problem was that the temporary

"shore" supported only the sagging roof. It did not raise the damaged roof assembly back up to its normal level with the undamaged sections of the roof. During the six-week period from the time of the original damage to the time of the collapse, there were a number of heavy rainfalls and an extremely heavy snowfall followed by frigid temperatures. During this time, the damaged section of the roof actually became a collecting point for the rain and snow, adding a substantial amount of additional weight. Without any drainage outlet, this additional weight placed a tremendous strain on the damaged roof. It was estimated that the entire roof area had accumulated almost 18 tons of water and snow. Often, the roof drainage systems become clogged or blocked by debris and, in freezing temperatures, are closed by the ice. This occurred most often in the flat roof designs of most of the one- and two-story commercial buildings that were victims of the Blizzard of 1996.

Just prior to the collapse of this Long Island commercial building, workers heard a loud cracking noise. The roof and ceiling sections then crashed down into the interior of the building. Falling debris

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The snow load caused the collapse of each of these buildings. (Photos by John Norman.)

killed one worker. Workers nearby were spared and received only minor injuries. The investigation continues into why the repairs were not completed sooner and why the building was occupied at the time of collapse.

SUPERMARKET COLLAPSE

In a similar incident, a section of a supermarket roof collapsed after a heavy snowfall, injuring 25 workers and customers. One female worker was trapped at her checkout counter and was successfully extricated during some very tense moments while the building's stability was in question.

She was fortunate to receive only minor injuries. As in the case above, heavy snow had accumulated on the roof, although a crew had attempted to remove it. In addition, all the building's air-conditioning units were located in the area of the roof that collapsed. State and local codes require "minimum snow load" protection, but the record-breaking snowfall of 1996 proved too much for many of the area's one- and two-story structures. The supermarket collapse

occurred after the snow removal crew had left for the day. The store was occupied by workers and a few customers. Normally, the store would have been crowded with Friday night shoppers, but many were snowbound in their homes.

Just prior to the collapse, workers heard creaking and cracking as the ceiling and lights began to fall. Snow, water, and debris fell into the store with the roof section. The entire load came crashing down and broke the gas line, causing additional concerns for victims and rescuers alike. Except for the trapped worker, all the victims were able to free themselves and exit safely to the street.

Investigators are leaning to the theory that the additional weight from the large snow accumulation caused the collapse.

OTHER COLLAPSES

In other sections of Long Island, the roofs of a beauty salon, a toy store, a clothing store, and a vacant building—all one-story commercial buildings—collapsed. Fortunately, these collapses occurred when the buildings were closed or unoccupied.

That was not the case in Pennsylvania

when a section of a lawn and garden center roof collapsed and a barn roof beam fell. In each incident, one person was killed.

In New Jersey, a number of roof collapse incidents occurred. One involved the successful rescue of a victim who had been trapped for hours. Preliminary reports indicate that many of the states affected by the blizzard had building and roof failures at some point.

OTHER STRUCTURES AT RISK

Flat roofs on one- and two-story buildings adjacent to taller buildings can be at particular risk when heavy snow accumulates on the roofs of the smaller buildings. This scenario usually occurs when the snow accumulates in one area due to a drifting pattern that allows a buildup created or caused by the building configurations.

Roofs are constructed in a number of different ways and are classified as flat, hip, gambrel, gable, mansard, and so on. The construction materials used vary from solid sawn rafters and beams to metal deck, steel or wood truss, plywood, and so on. As soon

as modern technology finds a new material, a new roof product is introduced. Firefighter safety is affected not only by the design of and material used in a roof but also by the additional loads often added to it.

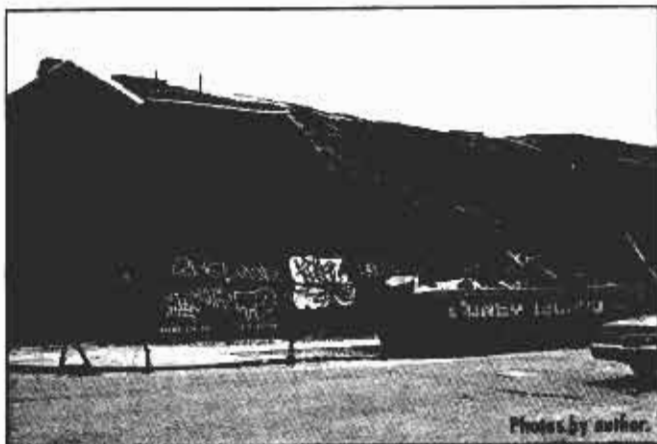
There are two types of loads—a dead load and a live load. A dead load is the weight of the building itself and any equipment permanently attached or built-in, such as air-conditioning units, water towers, and so on. A live load is any load other than a dead load—for example, firefighters operating on a roof, water, ice, snow, and so on.

A major concern when operating on roofs certainly is the live load. Buildings are designed with this in mind. The concern is when these loads are exceeded. Do not disregard the fact that when additional dead loads are added to the roof—for example, the permanent addition of another structure or air-conditioning unit—the beams or columns supporting the roof must be increased accordingly. In this day of “do it yourself,” this can present a major concern.

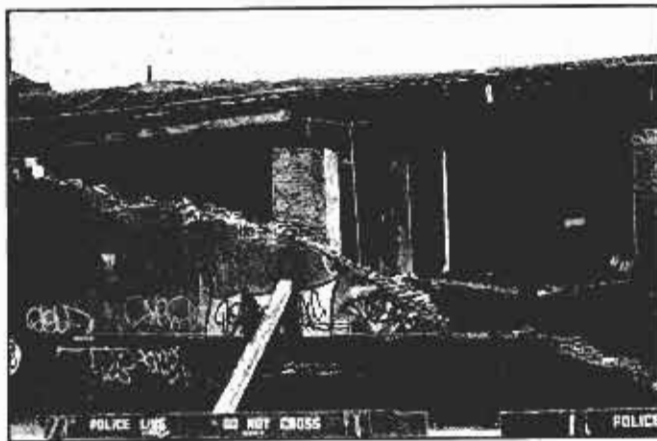
SAFETY PRECAUTIONS

When operating in or around structures with roofs that might have their stability and integrity in question, take the following precautions:

- Conduct a visual inspection of the interior and exterior. Look for sagging, cracking, or other unusual signs. This should be done from inside and outside.
- Remove snow from the roof with a shovel. Remove water by clearing drains or by using pumps or hoses. Before stepping on a roof, make sure the roof is safe to stand on.
- Always check the drains and gutters. They are the means of relieving the weight



Photos by author.



on a roof from rainfall or melting snow.

- Remember that flat roofs are more susceptible to overloading from rain or snow.
- During winter operations or times of heavy rainfalls, consider that the roof may have an additional load.
- If there is any doubt about a roof's stability, evacuate the building. Call for a building inspector, and ensure that everyone is out of the collapse zone.

History has shown how dangerous roofs can be for firefighters, especially during firefighting operations. Unfortunately, too many firefighters have lost their lives as a result of roof collapses. If the Blizzard of 1996 has taught us any lessons, one certainly is that we must be aware of roof hazards not only during firefighting operations.

Noted author Francis L. Brannigan, author of *Building Construction for the Fire Service, Third Edition* (National Fire Protection Association, 1992), has coined the phrase “Beware the truss” when referring to truss roof construction. I would caution you to “beware the roof,” especially when the additional loads from snow, rain, and ice increase the potential for disaster, as evidenced by the Blizzard of 1996. When in doubt, get out. ■

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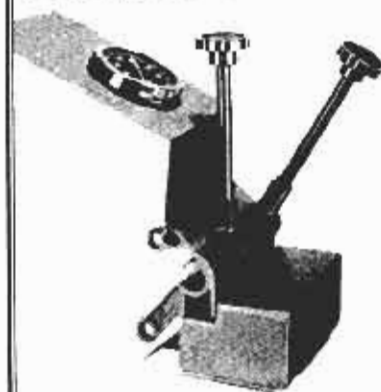
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