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Construction Concerns: Trusses

Article by Gregory Havel

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Sometimes we get the impression from news stories and even from firefighting textbooks that the truss is a recent development in construction, and that the bowstring truss (photo 1) is the most hazardous in a fire.

A truss is a structural component that is made up of smaller members that are arranged in triangles and connected at their intersections. Individual truss members are either in compression or in tension. Trusses are usually used to span distances that are too long

for conventional beams; or, in smaller dimensions, to reduce weight and cost during construction.

The structure in photo 1 was built around 1960, and used the bowstring truss so that there would be a large unobstructed floor area for retail sales and so that the roof would easily shed rain and melting snow. These trusses are usually built of either wood or steel, although some have wood for the top and bottom chords and steel for the web members. Bowstring trusses were originally designed for bridges, but became popular during World War II to support the long roof spans of aircraft hangers and manufacturing facilities.

Throughout past decades, fires in buildings with bowstring truss roofs have caused catastrophic structural failures that have claimed the lives of firefighters. Among these were the 1988 Ford dealership in Hackensack, New Jersey, and the 2012 theater fire in Abbotsford, Wisconsin. Search the Internet for “bowstring truss”; “bowstring truss fires”; “Hackensack Ford fire”; “Abbotsford Theater fire”; and similar. Also visit the NIOSH firefighter fatality website http://www.cdc.gov/niosh/fire to review reports of these and other firefighter fatalities.

Trusses have been in common use in North America since before 1800. Some truss designs were developed for bridges and adapted for use in buildings. Photo 2 shows a timber roof truss in a “mill” (the ancestor of modern Type IV or heavy timber) building from 1840. The compression members of this truss are of wood, ranging from 8 x 8 inches to 12 x 12 inches (20.3 x 20.3 cm to 30.5 x 30.5 cm). The tension members of

this truss are wrought-iron rods. Search the Internet for “trusses” for information on their history and design.

Photo 3 shows the trusses supporting the ceiling and roof assembly of a church, built in the late 1800s. The ceiling in this church is attached to the bottom of the same rafters that support the roof. These trusses are not only decorative—they support the ceiling and roof.

Wood trusses were in use in Europe for centuries before they appeared in North America; and were in widespread use during the Middle Ages. The roof of Westminster Hall in London, England was completed in the late 1390s, and is supported by “double hammerbeam trusses” with a span of 66 feet (20.12 m).

Wood trusses were used by the Greeks and Romans, more than 2,000 years ago, in large public buildings. Archaeologists have dated the earliest of these to the 5th century BCE.

The modern wood truss made of wood and metal gusset plates was developed in the 1950s, was widely used by the 1970s, and is common today in both new construction and remodeling. Steel bar joists are common is both buildings with masonry load-bearing walls and in buildings with structural steel frames. For more information on these common types of trusses, visit www.fireengineering.com and search for “trusses”.

The bowstring truss is neither the most common type of truss nor the type most likely to kill firefighters. Trusses of any age or design have common characteristics:

- they use the least amount of material to achieve the greatest strength for long spans
- they have a smaller cross-section and considerably less mass than a solid beam of the same strength, resulting in less inherent fire resistance and early failure in fires
- failure of a single connection can cause the failure of the entire truss
- failure of either the top chord or bottom chord can cause the failure of the entire truss

For our own safety, the use of trusses and other lightweight structural components in the construction or remodeling of a building deserves a note in a preincident plan.

If the structure to which we are dispatched does not have a preincident plan, for our own safety we must assume that trusses and lightweight components are present until that assumption has been proved wrong.

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