Construction Concerns: Truss Failure
Article and photo by Gregory Havel
December 29, 2008

When a truss collapses, it is usually because of the failure of either the top chord (in compression, unless a cantilever) or the bottom chord (in tension, unless a cantilever). If a truss buckles or overturns, it is usually because of the failure of an adjacent truss or its bracing. A steel truss in a fire may buckle and overturn because of expansion or weakening from the heat.

Most truss failures are the result of broken connections. Photo 1 shows a set of parallel-chord wood trusses supporting a plywood floor deck. Note that the bottom chord of all of these trusses is made of two pieces of lumber spliced together with gusset-plates. The bottom chord of a truss (unless it is cantilevered) is in tension. If the connector at one of these splices loosens because of fire, rot, corrosion, or improper installation, this truss will become unstable and collapse because of the live and dead loads it carries.

The top and bottom chords of a truss are separated by its web members. Struts are web members in compression. Ties are web members in tension. The connection between a truss chord and struts or ties is called a panel point. In the trusses in photo 1, most of the web members are in compression, and the panel point connections are gusset-plates.

The top chord of a truss is in compression (unless it is cantilevered), and behaves under load like a column even though it is not vertical. (A column that is braced rigidly at its midpoint can carry four times the load that it can if it is not braced. Doubling the length of a column by removing rigid bracing at its midpoint reduces its capacity to 1/4 of its original capacity.) If a connection at a top-chord panel point fails because of fire, rot, corrosion, or improper installation, the length of the column section doubles and its capacity is reduced by 3/4. Since most trusses do not have a safety factor of 4:1, this weakened truss is likely to fail because of the live and dead loads it carries.

Fire Engineering, December 29, 2008
The sagging or collapse of one truss will in turn cause the progressive collapse of the adjacent trusses because of the eccentric load transferred to them by bracing and bridging. This bracing and bridging is installed as part of a truss-deck system for lateral stability, to transfer loads from one truss to another, and to keep the trusses from buckling and overturning under load.

Truss failure does not give firefighters much warning. The time between the first sign of impending collapse (strange sounds from the building, the beginning of the sag in a floor or roof) and the building’s collapse may not be long enough for evacuation even if the signs are recognized and action is taken.

In the past, we have behaved as though the roof or floor beneath us will remain stable. We must begin to assume that we will be able to work for only a short time because we are working on a surface that is already unstable, or about to become so. Even if the building and its void spaces are fully protected by an automatic fire sprinkler system, we have no guarantee of the condition of the truss’s connections before the incident.

**Gregory Havel** is a member of the Burlington (WI) Fire Department; a retired deputy chief and training officer; and a 30-year veteran of the fire service. He is a Wisconsin-certified fire instructor II and fire officer II, an adjunct instructor in fire service programs at Gateway Technical College, and safety director for Scherrer Construction Co., Inc. Havel has a bachelor’s degree from St. Norbert College and has more than 30 years of experience in facilities management and building construction.

- [CLICK HERE](#) for more 'Construction Concerns' articles!