

Why roof trusses fail?

Truss roof system failure is the subject of many questions from fire and building officials and building owners after a structure, having a truss roof system, has failed. These questions are often asked after a fire or windstorm. The fact is that roof collapse is seldom the fault of the roof truss design or the roof truss installation alone. These events often have tragic consequences. The questions come to us, day after day. After time has passed and the mess has been cleaned up, critical evidence is hard to collect. In these situations, more often than not, the trusses are blamed.

As a summary of things to come..... improper design, deterioration of structural wood and support surfaces, overloading with roofing and re-roofing (overlays), inadequate repair, attic spaces used for storage and mechanical equipment, improper cutting or drilling for convenience and weather related influences are some of the most frequently seen contributors to the failure of a wood, or for that matter metal, truss system.

First let's look at some background. Pre-fabricated roof trusses rapidly increased in popularity in the United States during the 1960s. All modern roof and floor truss applications, fabricated using wood, are most properly termed "wood or metal plate connected wood trusses." All roof and floor trusses are designed as a part of a system, that is, each one of the components depends, in some way, on at least one other component piece of that integrated system, and the structural qualities thereof.

Roof and floor trusses, designed as a system are, when properly installed, a unit, or "hat" if you will, protecting and unifying the underlying structure. To make this potentially endless article shorter, and more to what I believe the problems most often are, I posit the following:

- ❖ Many older buildings still have "home-made," "home-designed," and/or "home-modified" trusses.
- ❖ Age, quality of original engineering, original materials, original installation, and use-environment have dramatic effect on every building material, including roof and floor truss system components.
- ❖ Roofs leak causing deterioration of wood and metal. In the case of floor trusses, plumbing leaks have a potentially disastrous effect on the underlying, and most often unseen, floor truss system.
- ❖ Human nature being what it is, the ample and inviting "attic" space that is provided by the web area of a roof or floor truss are, in most every case, misunderstood and misused for storage and/or mechanical systems (air conditioning units and water heaters) applications, to a disastrously dangerous extent.
- ❖ Overlaying an originally installed composite asphalt type roof shingle with tile or wood shingles, or another composite roof. causes a dangerously overloaded situation on the original roof truss system design. In heavy snow areas, this over-roofing adds insulation value to the roof system and can cause a drastic increase in the length of time that snow and ice build up on a roof.
- ❖ Everyone wants energy efficiency. Consider that the original engineering calculations used for your roof truss system assumed a certain heat loss, melting snow at a faster rate than at the present time with your new high-efficiency insulation. . . . which in itself adds more uncalculated load to the roof truss system.
- ❖ On the U. S. West Coast, most roof truss systems were fabricated utilizing native "west coast" species of wood, with all of the strengths and weaknesses inherent to those species.
- ❖ As we walk around typical homes and offices, we easily see parts of these buildings that may need maintenance. A roof truss or floor truss system is out of sight and therefore out of mind when it comes to maintenance. They are, in most cases, never inspected or touched for maintenance.

Having stated the foregoing, if there were to be a desire for a proper inspection, that inspection should be performed by a state certified structural engineer who is able bodied and has a comprehensive and working knowledge of metal plate connected wood trusses. The truss system must be inspected foot by foot, one component at a time. If there is a serious concern about the structural integrity of a wood truss system, we recommend that a document be produced stating flaws found in each component, giving a repair deadline.

There is one additional roof failure scenario that we see from time to time near a coastline area that is vulnerable to hurricanes. We also observe this in the Southwestern and Midwestern United States and in similar high wind prone areas worldwide. Wind, as it blows over and around an enclosed building, puts pressure on the outside of that structure. This externally applied and

potentially very powerful pressure can result in both positive forces (pushing) and negative forces (suction.)

When the force of a high wind gets inside of the building, a situation called internal pressurization is created. When a building is internally pressurized, wind forces try to push the walls out and the roof up from the inside. At the same time, the wind is still blowing around and over the building trying to blow the walls over and the roof off from the outside. Occasionally this tornadic chaos causes catastrophic failure.

Internal pressurization can cause the effective applicable wind pressure to nearly double on the building's walls and roof. Most buildings are not designed for this extraordinary loading. Massive destruction can start with the failure of just one structural connection, just like the first falling domino. To prevent this anomalous condition, protection of windows and doors is a top priority. As you watch television and see homeowners boarding up their windows and doors just before a hurricane hits, you now understand they are doing much more than preventing broken glass.

If you have a new home of building, built in the last few years, this condition was considered in original design. The risk in older buildings should, in our opinion, be professionally assessed.

Whether your building is along a coast where vulnerable to hurricanes or in the heartland of the United States or similarly vulnerable area around the world where tornadoes may strike, preventing internal pressurization of a building is important to maintaining its structural integrity during a windstorm. Wind resisting construction products are available.

TRUSS-FRAME SOLUTION..... until building inspectors and/or fire officials have the manpower, the time and the "guts" (political backing) to inspect truss systems that are older than a certain age for UN-ENGINEERED CONVENIENCE CUTTING and/or DRILLING, and/or STORAGE, _of any kind_ , that has not specifically been engineered/designed, avoidable tragedies will continue to be blamed on trusses. These suggested inspections are non-intrusive. Generally they require only a ladder, good eyes and a good light. No engineering is needed. No professionals need be retained. During these inspections the naked eye will very often see:

- spaces in the webbing of roof and floor trusses used for heavy and un-designed **storage**;
- mechanical systems such as air conditioning **equipment**, water heaters and water softeners;
- termite, carpenter ant, rodent and other **pest-caused structural damage**;
- rust, corrosion and other degradation of truss materials caused by **weather and environment**;
- un-engineered truss systems **modification** such as cuts and drilling for tenant convenience;
- post original-completion **construction installation** of decorative structures such as parapets and towers;
- **re-roofing** over an original roof without proper consultation and evaluation;
- **miscalculation**, by fire and building officials, of surface-to-mass ratio and concave roof space;
- disastrous dry rot and corrosion caused by **un-repaired roof leaks** over time.
- **added ceiling insulation** adds un-designed weight by itself and, in heavy snow areas, allows **snow and ice to build up** to a much greater extent and for a longer time than provided for in the original design; and,
- partially blocked or **clogged roof drains** on flat roofs, in heavy rain situations, can easily cause a doubling of the design roof load.

In summary, everything made by man can be misused by man. Wood trusses are strong and practical. Most every roof truss system failure, both primary and secondary, can be easily foreseen and cheaply prevented.

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Resources: [WOOD TRUSS ROOF FAILURE and ROOF COLLAPSE](#)