



White Paper:
**Fire Load Performance Characteristics of
Metal Gusset Plate Trusses
vs. Finger Joint Glued Trusses**

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INTRODUCTION

The question most firefighters have, “Are trusses with no gusset plates as safe as trusses with gusset plates while being exposed to a fire?”

Pre-engineered wood trusses are designed by truss engineers for light-weight construction. The use of metal plate connected trusses in construction is popular because of cost effectiveness, versatility, and ease of construction. Pre-engineered trusses are also manufactured which saves time during the construction process as compared to conventional trusses.



http://www.minnesotafireservice.com/pubs_open/trusses_no_gussets.pdf

Trusses that do not use metal plate connectors are called, “Open Joist 2000,” which are manufactured in Canada and are distributed through Universal Forest Products, Inc. The Open Joist 2000 is a parallel chord truss being widely used in light-framed construction. These trusses are used to span longer distances and are less labor-intensive because of their light weight.

METAL GUSSET PLATE TRUSSES

Generally most pre-engineered metal plate truss systems use 2x4 Spruce-Pine-Fir No. 2 or better throughout the entire truss assembly which are connected with metal gusset plates (16, 18, or 20 gauge galvanized steel). The gusset plates are 0.062in thick, 0.05in thick, or 0.038in thick with teeth on one side that range from 3/8in. to 1/2in. in length that are punched into the truss members.



<http://www.preengineering.com/resources/tenconn/gussetw.jpg>

The advantages of a metal gusset plate’s behavior while being exposed to extreme heat conditions from a fire include the fact that the galvanized metal plates can be exposed to higher temperatures for a longer period of time than the wood it is connecting. The results of a fire test conducted by the National Institute of Standards and Technology (NIST) shows that the wood behind the metal plate actually chars slower than the wood surrounding the plate. Also, the metal truss plate reflects some of the heat away from the wood slowing down the charring process.

The disadvantages of a metal gusset plate’s behavior while being exposed to extreme heat conditions from a fire include the fact that the galvanized metal gusset plate’s teeth do not penetrate the wood all that deep. The wood the plates are connecting, have a charring rate of 1/40 inch per minute. The truss plate’s teeth have a minimum depth of 3/8 inch. So during a typical fire, the wood will lose 3/8 inch of its body in approximately 15 minutes leaving the teeth of the metal truss plate completely exposed. This will then cause the metal truss plate to fall off allowing that joint to lose its integrity. Once a joint on a truss is compromised, the weight it previously carried will be transferred to the next closest joints. These joints in return

can not carry the additional load while being exposed to the fire causing them to lose their integrity resulting in a complete failure of the truss assembly. Whereas, the adhesive used for the glued finger-jointed truss will maintain its structural integrity longer than the truss members.

FINGER JOINT GLUED TRUSSES

Generally, finger jointed glued trusses are composed of top and bottom chords made of 2x3 or 2x4 visually graded spruce-pine-fir No. 2 or better. The diagonal web members are made of nominally 2x2, 2x3, or 2x4 visually graded spruce-pine-fir No. 2 or better and the vertical web members are made of nominally 2x8 visually graded spruce-pine-fir No. 2 or better. The main difference is that these members are held together with glued finger-joint cuts which uses a fabricated adhesive, “Phenol-Resorcinol Formaldehyde” to hold them together.



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The advantages of the glued finger-jointed trusses while being exposed to extreme heat conditions from a fire include the adhesive used to hold the finger-joints together is a phenol-resorcinol formaldehyde. This adhesive is used in I-joists, LVL, and glulam beams. This product is a thermosetting adhesive that gets harder when exposed to high temperatures. The char rate for this adhesive is equal to or better than the char rate of the wood that it is bonding. Phenol-resorcinol formaldehyde autoignition temperature is 1130°F (608°C) as compared to 880°F (470°C) for wood. This adhesive conforms to the specifications stated in ASTM D2559, *Standard Specifications for Adhesives for Structural Laminated Wood Products for Use under Exterior (wet use) Exposure Conditions*.

In tests conducted by Forintek Canada Corporation, the glued finger-joints maintain their integrity until the wood itself is turned into char. These tests were conducted and passed the one-hour fire test per ASTM E119-08 and UL 263. It was also observed that members of the truss do not dislocate when other web members or chords fail. According to the results of the one-hour fire test, the bottom chord and the web members burn through first, then the assembly sags significantly while supported by the top chord and the floor sheathing.

Glued finger-joints are used in many types of wood structural building components such as glulam beams, I-joists, ceiling joists, rafters, and trusses. Because of their interlocking characteristic, they can have up to 90% of the tensile strength of clear wood. Typically the finger-joints are cut with a slope of 1 in 8 for structural components.

The disadvantage of the glued finger-jointed trusses while being exposed to extreme heat conditions from a fire include the fact that there is no plate protecting the wood and slowing down the charring process. The truss will lose its structural integrity once the members of the

truss are charred completely through. Also, the members of the truss sometimes have a smaller cross-section compared to the pre-engineered truss which means that the members can be charred completely through quicker.

SUMMARY

So when asked the question, "Are trusses with no gusset plates as safe as trusses with gusset plates while being exposed to a fire?" the answer is .. neither are safe while being exposed to a fire.

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