STRUCTURAL BUILDING COMPONENTS MAGAZINE (FORMERLY WOODWORDS)
June/July 2001

"Truss Plate Performance in Fire: One Person's Observations" by John E. Meeks, P.E.

Over many years' association with the wood truss industry, I have witnessed several fire tests, the purpose of which was to prove or disprove certain specific fire resistant assemblies. These are standardized tests, following approved methods of testing, so that new or improved fire resistant systems can be evaluated to meet required building code fire separations. These tests are very severe and anyone witnessing them cannot help but be impressed.

Wood is combustible, but it's also a good insulator. If subjected to direct exposure to fire, heavy timber will start to char at a rate of about 1-½" of depth per hour. Assuming the char to have zero strength, the wood beneath the char will lose strength in proportion to the temperature and the time of exposure. For heavy timber structures, some burned wood members may be rehabilitated by removing the char and a portion of the wood beneath the char and calculating the strength on the basis of the remaining section of undamaged wood. Reinforcing weakened members may also be done to improve sectional properties.

This process, however, is not usually acceptable for light frame construction using dimension lumber. Most engineers would agree that it is best to remove all traces of charred lumber as it is unacceptably weakened and replace it with new lumber. Some persons have presumed that connector plates on wood trusses act as “heat sinks,” attracting higher amounts of heat to the areas below or near the steel plates. The observations of this engineer seem to show the opposite. It appears to this engineer that sometimes the plate actually protects the plated joint to some degree until the char depth reduces the strength of the wood member to the point of failure. The plates are frequently holding truss joints together despite virtually no wood strength.

But what happens if a fire gets started while a building is under construction and before the fire protection has been installed? How does light framing perform under these conditions? Of more interest to the wood truss industry, how do connector plates perform when directly exposed to fire? Photo 1 shows 2x4 wood trusses exposed to severe fire. The 2x4 lumber is greatly reduced in cross section but the connector plates are still holding the charred members together. These truss remains are not capable of supporting much load, if any, but there was enough gripping strength in the wood beneath the connector plates to maintain the shape of the trusses. The truss members beyond the exterior wall show little damage.

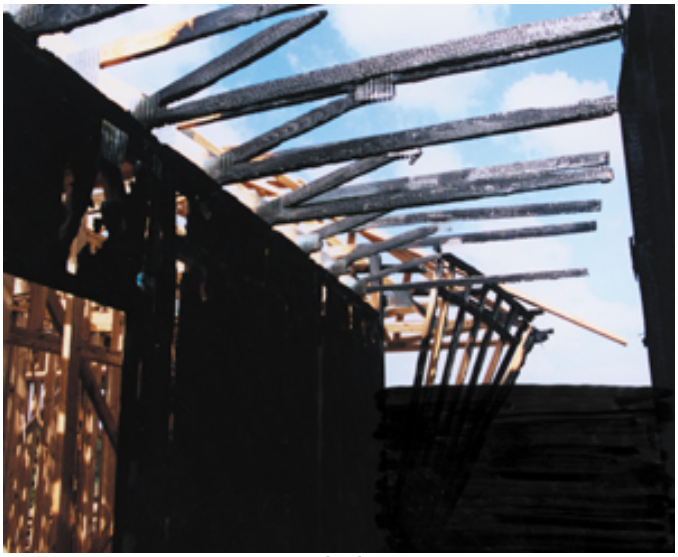

PHOTO 1
CLICK ON IMAGE FOR LARGER VIEW

PHOTO 2
CLICK ON IMAGE FOR LARGER VIEW

PHOTO 3
CLICK ON IMAGE FOR LARGER VIEW

PHOTO 4
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PHOTO 5
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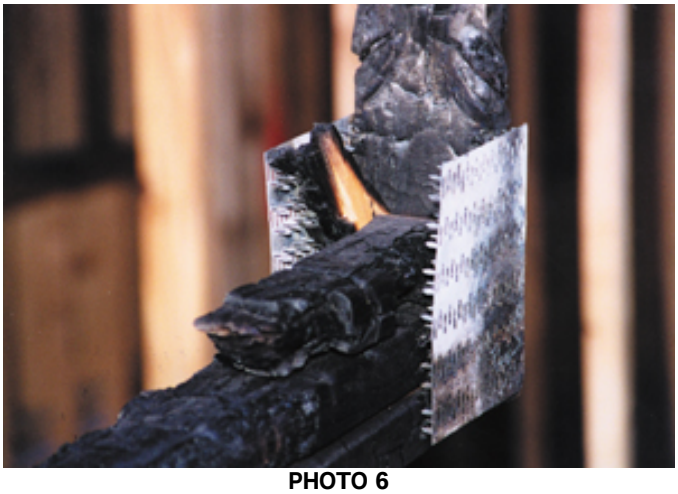

PHOTO 6
CLICK ON IMAGE FOR LARGER VIEW

PHOTO 7
CLICK ON IMAGE FOR LARGER VIEW

PHOTO 8
CLICK ON IMAGE FOR LARGER VIEW

After every fire there is an abundance of debris. It is usually difficult to identify the burned sections and to find meaningful evidence. In photo 2 there are numerous connector plates that appear to have been burned completely away from the trusses. The plates themselves appear to have minor damage, but of course are not re-useable. There is also a close look at a spliced 2x4 with a plate missing from one side. But note that the remaining plate is firmly attached to the 2x4 and, most importantly, the lumber appears to have been somewhat protected by the connector. The protected wood is visible at the splice point.

More debris on the floor slab in photo 3 shows the bottom chord splice of a 4x2 flat chord floor truss. A heavy gauge splice plate (probably 16 gauge) has protected the lumber where it is in contact, but the lumber burned all the way through just a few inches from the splice. A few inches from the splice plate there is a double cut 4x2 flat chord floor truss web member. Teeth marks from a missing connector can be seen at a well-protected joint. The web is severely charred just beyond the protection of the connector.

As if to prove photo 3 was not a mistake, a similar bottom chord splice in a 4x2 floor truss was found a short distance away (photo 4). The heavy connector plate remains on one side only, the other side having had a greater exposure to the fire. A close look verifies that the wood seems intact directly beneath the connector plate, though charred all the way through just beyond the protection of the plate.

Photos 5 and 6 show the bearing end of a 4x2 flat chord door or window header remaining after being subjected to severe fire damage. The truss appears to have been designed to have a double bottom chord and compression first diagonals. The truss has severe fire damage. The end vertical of the truss has lost a great deal of lumber cross section. The connector plate appears to have protected the bearing joint and the first diagonal web shows a small section of bright lumber where it was broken away in falling to the floor. The end connector appears to have backed out of the wood, but in all likelihood the wood shrank away from the plate as it charred. The plate is still holding the charred wood parts together.

The flat chord, 4x2 floor trusses shown in photos 7 and 8, are supported on load bearing wood stud partitions and were subjected to intense fire, which burned through the plywood sub-floor sheathing. Scabbed vertical 2x4 members and strong back stiffeners were installed between adjacent trusses. The bottom chord splice was burned through from the top but the bottom splice plate was still holding. It is bent down by the failure of the bearing wall at the other end. The bottom chord lumber appears to have been protected to some extent by the bottom plate of the spliced joint. Also, note the double cut 4x2 web member nearby.

It appears to this engineer that truss plates protect the lumber beneath the plate for some time during a fire. If the fire is brought under control in short order, there is probably little damage at the plated joints. If the fire has had time to become severe, or the exposure time lengthened, lumber will char between the plated joints with increasing depth. It appears that the lumber between the plated joints may become charred to the point of failure before the lumber beneath the plated joints chars sufficiently to cause a joint failure. However, it is understood that until a method of on-site testing is available, wood trusses that shows char on any lumber surface due to fire should be removed and replaced.

John E. Meeks, P.E., is a Consulting Engineer in Fort Lauderdale, FL.

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