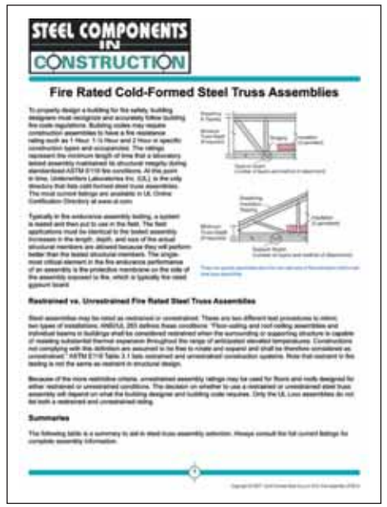
# Technical Q & A

## Installation of Insulation in Wood & Steel Truss Fire Endurance Assemblies

by WTCA Technical Staff

Fire endurance is a hot topic, especially when it comes to insulation.

At least once a week, WTCA receives a question about trusses and fire endurance assemblies. One of our goals is to provide the construction industry and fire service with accurate information regarding the fire performance of metal plate connected wood trusses. We have created a website (www.sbcindustry.com/fire.php) that contains a lot of useful information. Two of the most popular resources are the *Fire Resistance Rated Truss Assemblies* TTB and *Fire Rated Cold-Formed Steel Truss Assemblies* SSC, which include tables summarizing the fire rated assembly reports that were tested with trusses.


**What is plenum space?** Plenum space is the space that exists in the middle of the actual ceiling and the dropped ceiling, which is frequently made use of as an air duct for heating and cooling purposes.

The truss assemblies listed in these documents were tested with and without insulation. There are occasions when thermal and/or acoustical considerations require insulation in a floor-ceiling or roof-ceiling assembly that have been tested without insulation. To make a rational assessment of this modification, it is necessary to look at the properties of the insulation and the impact that its placement inside the assembly will have on the fire endurance performance of the assembly.

As is well known, the effect of insulation is to reduce the flow of cold air into heated spaces and the entry of hot air into air conditioned spaces. Since insulation restricts the flow of heat, its addition to a fire endurance assembly can facilitate heat build-up, which impacts the data produced from the test. Here's why.

The insulation will retard heat movement, and may also reduce the plenum space that was available for heat dissipation during the test. Because of this, it is likely that the protective gypsum layer will heat up more quickly resulting in an increased rate of hydration. This can lead to an earlier failure of the gypsum and consequent failure of the fire endurance assembly.

Does this mean that the installation of insulation should not be allowed in assemblies tested without it? Certainly not.

The logic path to adding insulation is:

- Since insulation will retard the flow of heat through it, incorporation of insulation in a rated assembly must be kept as far away from the gypsum surface as possible. This will minimize the heat build-up problem that causes premature hydration.
- Since the plenum cavity helps to dissipate the heat as it passes through the gypsum membrane, maintaining a plenum space that is greater than or equal to that of the tested assembly is critical to the field assembly's performance in a fire.

Therefore, to incorporate insulation into a tested assembly, an equivalent or greater plenum space should be maintained and the insulation must be held up and away from the gypsum surface.

As an example: A 12" deep truss assembly was tested and passes the 1-hour fire endurance requirement, with 5/8" Type X gypsum directly attached to the bottom chord and 5/8" plywood directly attached to the top chord. The resulting plenum space for this assembly is still 12". The actual truss application calls for an 18" deep truss to be used so this assembly with the added gypsum and plywood will still provide the tested fire endurance even though it is deeper.

If insulation is to be added to this hypothetical assembly without diminishing its fire endurance, consideration must be given to the following points:

- Pursuant to the UL Fire Resistance Directory – Design Information section, increasing the depth of an assembly does not adversely affect its fire endurance rating. In fact, increasing the depth may actually enhance performance through better heat dissipation properties, and through reduced chord stresses resulting from a larger moment of inertia for the truss section.
- The addition of insulation must be kept up away from the surface of the gypsum as previously explained and additionally there should be no additional weight on top of the gypsum that may contribute to a premature failure of the protective membrane.

Therefore, insulation can be added to this fire endurance assembly in the following manner:

- Per the example above, since the depth of the assembly has increased to 18", the "extra 6" of space" can be filled in with insulation.
- The insulation would need to be attached 12" above the gypsum membrane.
- The type of insulation could be:
  - Batt insulation attached with stay wires 12" above the surface of the gypsum membrane.
  - Rigid insulation attached to the trusses 12" above the surface of the gypsum membrane.
  - Rigid insulation attached to the plywood or OSB sheathing so that it maintains a 12" plenum area.
  - "Blown-in" insulation onto any type of membrane that will hold the insulation 12" away from the surface of the gypsum membrane.
- This is a conservative approach and will maintain the original test plenum depth.

An argument could be made for the allowance of insulation within the 12" free plenum space, but this should be dealt with on a case-by-case basis, since the final performance of the assembly is dependant on the insulation density, the type of gypsum used, the stresses developed in the chords of the trusses, etc. Obtain professional engineering assistance in situations like this.

Experience indicates that it is allowable to add insulation to an assembly provided that the depth of the truss is increased above what was tested to accommodate the depth of the insulation and that the tested plenum depth is maintained between the surface of the gypsum membrane and the beginning of the application of insulation. SBC

*To pose a question for this column, email technicalqa@sbcmag.info. For information geared specifically to fire service professionals visit www.sbcindustry.com/firepro.php.*

### at a glance

- ❑ To add insulation into a tested assembly, an equivalent or greater plenum space should be maintained and the insulation held up and away from the gypsum surface.
- ❑ Increasing the depth of an assembly does not adversely affect its fire endurance rating.

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