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GN GUIDELINES No.202

ANOTHER MITEK ADVANTAGE – MAY 2014

AIR CONDITIONING/HEATER UNITS

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I am often asked for advice on how best to accommodate the installation of a ducted air conditioner or heater unit into the roof space of an existing residence.

To address this request a number of factors need to be considered, the first being the weight of the unit.

Additional loads will increase the forces throughout the truss and increased forces can lead to existing members being overstressed. In addition, care also needs to be taken as to where the load is being applied.

Is the unit sitting on a platform on the bottom chord, or is it suspended from the top chord or webs? The trusses would need to be checked for the additional loads applied and their locations.

Additional loads also mean increased deflections. When the trusses were originally designed, they allowed for dead loads from the roof and ceiling materials as well as self-weight for the truss and battens.

The trusses would then have been manufactured with a camber to allow for the long term deflections that were calculated from these design loads. Increasing the load applied to the trusses will increase their deflections and may result in uneven roof and ceiling lines.

The next issue to arise is when the unit or ductwork will not fit into the existing area and installers have to remove a couple of webs.

It should be emphasised that those webs were put there in the first place for structural purposes. The webs are required to transfer forces throughout the truss and to hold the truss profile. And as previously discussed by Robert Tan in GN Guideline No.106, a truss that is fully triangulated will perform better than one that is non-triangulated.

So what happens if one or more webs are removed?

The initial effect is that the altered forces will be distributed differently through the truss and may result in existing members being overstressed.

One of the principles of truss triangulation is that the chords and webs carry predominately axial forces (tension and compression). A truss that is not triangulated will create more bending moments and all of sudden it is acting more like a frame or beam than a truss.

The triangulation also helps significantly with the stiffness of the truss. Break that triangulation and the truss will deflect more than allowed for in the original design.

This can be illustrated by the deflection diagrams in Figures 1 and 2 which depict a triangulated and non-triangulated truss respectively.

Although they started off as identical trusses, the magnitude of deflections of the cut truss in Figure 2 is approximately 5 times greater than its original because of disrupted triangulation. This is likely to result in unsightly roof and ceiling lines.

So when we have additional loads already overstressing the truss and causing it to deflect more than originally designed being compounded by the removal of webs creating a non-triangulated truss that forces a change in the load path and distribution, the combined effect will be a massive deflection.

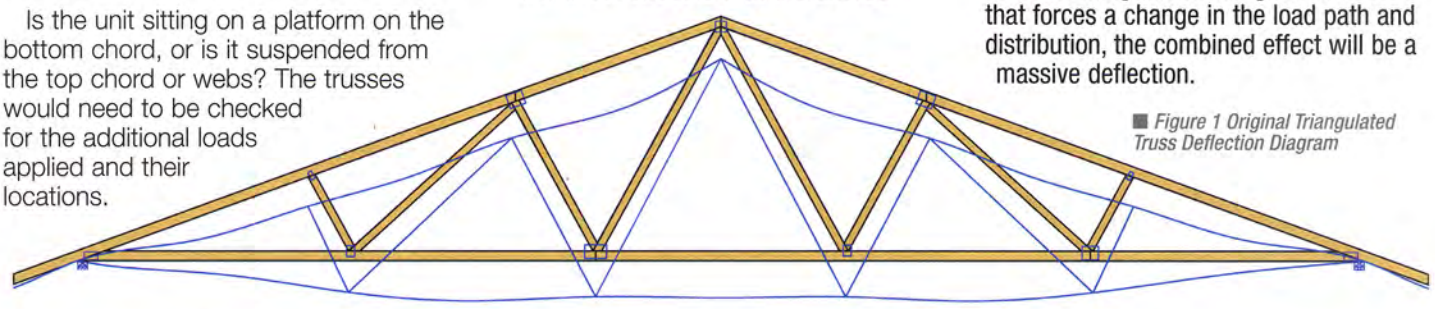

Figure 1 Original Triangulated Truss Deflection Diagram

It may be possible to carry out rectifications to overcome the overstressing of members and even use additional members such as hanging beams to transfer the load to other trusses; however it is likely that deflections will still be noticeable.

So next time someone wants to modify some of your trusses, it would be worth investigating if the unit can be relocated to another area of the roof, or preferably not in the roof at all, so that the integrity of the trusses are not affected. Please consult your local nail-plate supplier's engineers for further assistance. TTN

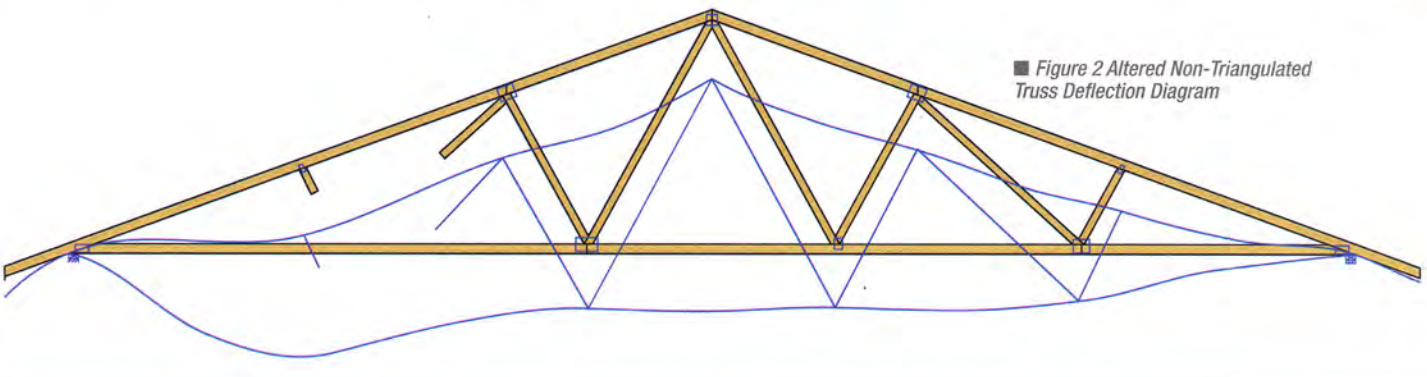

Figure 2 Altered Non-Triangulated Truss Deflection Diagram