FTMA TECH Talk

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KEEPING AN EYE ON CUMULATIVE/GLOBAL DEFLECTIONS WHEN DESIGNING ROOF TRUSSES

On a recent site inspection to investigate reduced roof truss clearances over various internal walls, I came away thinking that if a bit more attention had of been paid to the potential for cumulative deflections at the time of detailing, (this particular job contained a girder truss to girder truss support scenario which is shown in Diagram 1)) then changes to the girder truss design/truss layout could have been made, which would have improved the truss to wall clearance situation in the problem area. Now like most jobs the reduced truss to wall clearances were not solely because of the roof truss performance, but more a combination of differing wall elevations in conjunction with accumulating truss deflections. Nonetheless this article will focus on the conditions which can lead to less-than-ideal global deflections and the truss improvements which could have been made while detailing to minimise these long-term cumulative deflections in a girder truss to girder truss scenario.

Before I clear up what cumulative/global deflections are, I should point out the deflections referred to herein are the truss bottom chord dead load deflections which directly influence the truss clearance over internal walls.

The global deflection of a connected member system is the maximum overall deflection which results when the connected member system is loaded.

It is comprised by adding the individual long-term deflections of the supporting members at the connection locations, with the maximum deflections of the supported members. If we relate this to diagram A, we have the girder truss deflection (GT1) at the girder to girder truss connection location Δ_1, we have the deflection of the supported girder (TGT2400) at each of the standard truss connection locations Δ_2, and we additionally have the deflection of each of the supported standard trusses Δ_3.

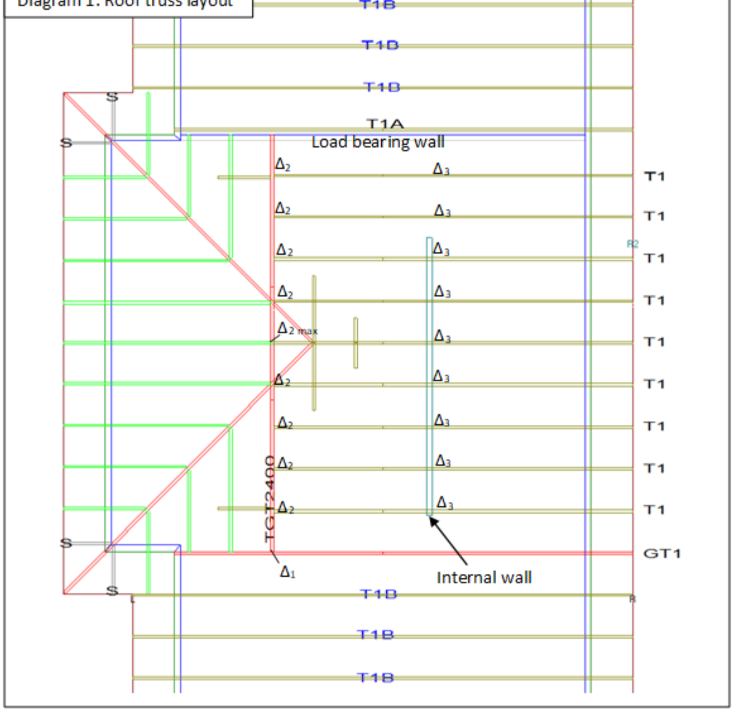

Diagram 1: Roof truss layout

To understand the maximum global deflection of the connected member system over the internal wall, we add Δ_1 to the greatest Δ_2 truss connection deflection (occurring near the centre in this case due to symmetry - Δ_{2max}), and finally add the greatest Δ_3 deflection from the supported standard trusses (all the standard trusses are the same design/geometry in this instance, so have identical deflection results). By adding these deflection components together $\Delta_1 + \Delta_{2max} + \Delta_3$ we obtain the magnitude of the greatest global deflection of the connected member system **assuming** that the wall supports for the girder trusses and standard trusses are all at a consistent elevation.

The above theory for obtaining the maximum global deflection of a connected member system will hold true for most connected member systems. Advantageously timber roof trusses are pre-cambered, to offset the permanent dead load deflections. So, the magnitude of the final global deflection in a timber roof truss system will be reduced depending on the amount of precamber achieved at manufacture.

So, what combination of conditions should a timber truss detailer by mindful of which could indicate that global deflections may be a problem and warrant further review of the joint deflections?

- Multiple girder trusses being supported by one another,
- Heavier loads being supported which is indicative of the weight of roof material and span supported,
- Supported trusses not coinciding with webs in girder trusses lending to panel deflections,
- Trusses requiring impractical unachievable pre-camber due to: high span to depth ratios, or non-triangulated web profiles (ref GN Guidelines #106)
- Supported girder trusses being located at a position of lower truss stiffness such as towards a heel.

Referring back to the job onsite, some of the truss improvements which could have been made at a detailing stage to reduce the cumulative/global deflection included:

1. The inclusion of a truss web in GT1 to pick up the TGT2400 connection location in order to minimise the bottom chord panel deflection in this zone.
2. Increasing the station of TGT2400 so that the supported girder truss is shifted to a section of GT1 which has a greater physical depth and hence stiffness.
3. By increasing the station of TGT2400 the height of the truss will increase which will improve its span to depth ratio and should decrease the amount of precamber required.
4. Utilising “stronger” web profiles/stronger materials/and or increasing the number of truss plies where necessary in order to reduce the amount of panel deflections and pre-camber required.

For more assistance in helping to reduce the cumulative/global deflections of complex roof truss systems, please contact your local design office.