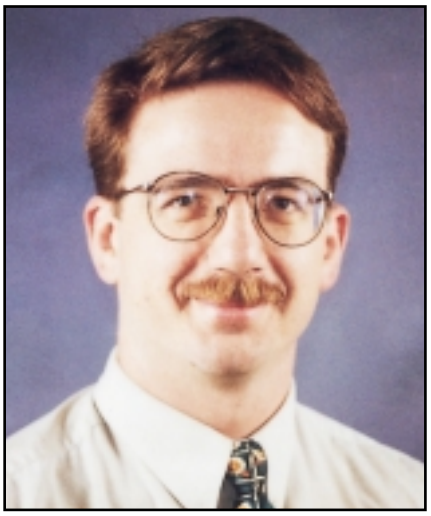
# KEEP 'EM STRAIGHT - KEEPS 'EM STRONG



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When installing trusses there are rules as to how straight and plumb trusses should be. These rules are set out in the Australian Standard for Installation of Timber Roof Trusses - AS4440 and the installation guides produced by the nailplate suppliers. (See Gang-Nail Guidelines No. 1)

A summary follows:

**Out of plumb:** at any point on the **truss Height/50 to a maximum of 50mm.** For example at a height of 1500 mm the truss cannot be more than 30 mm out of plumb, but a truss 3000 mm high cannot be more than 50 mm out of plumb.

**Bow Chord:** **Length/200 to a maximum of 50mm.** For example a chord of 2000 in length cannot have more than 10mm bow.

I would like to explain in this article why trusses have to be straight and what will happen to them if they are not.

When a truss is designed there are certain assumptions made. One such assumption is that the truss will be "in-plane". In other words all the members are in line vertically.

When a stick of timber is in compression, that is, being pushed from the ends, it is quite strong - until it starts to buckle.

This is because the force changes from just compression to a side ways bending action, which is aggravated by the compression force (See Diagram).

The effect of the compression force on the bending action gets worse as the offset increases.

So if a member starts to buckle, it wants to keep going while the load is maintained - that's where the restraint provided by battens and bracing members come into play.

You can easily see this effect by rolling a piece of paper into a cylinder and placing a book on top. Because the circular shape does not allow the paper to buckle it will support the book.

If the same piece of paper was not rolled, but simply stood on its edge the paper would buckle under its own weight. The result of a buckling member in a truss is that it will not perform as designed

Thankfully timber is a forgiving material and gives plenty of warning of a problem by bending, buckling, or deflecting - long before an actual collapse

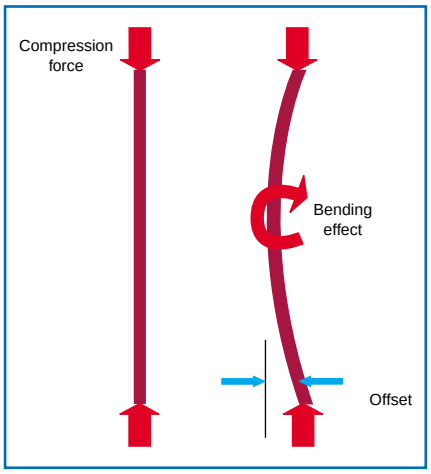
I have seen this effect in real life in the case of a girder truss carrying a large span of tiles. The top chord had not been nailed off to the tile battens and had buckled some 200mm out of plane and the bottom chord had deflected approximately 50mm below level. A prop had to be put in place to stop it going any further!

When I told the builder to simply straighten the top chord and brace it back to the adjacent trusses he was noticeably skeptical. However I visited the site the next day and spoke to the carpenters who had done the work.

As they had been forcing the top chord back out to straight with blocks and wedges against the adjacent truss top chord, there had been an almighty crash!

They looked down to see what had broken to find that the prop had simply fallen over. As they had straightened the top chord it had lifted the bottom chord off the prop and pulled the truss back to level!

This buckling can also occur in the horizontal top chord of a truncated truss. Try taking a piece of paper; hold it upright




and try to bend it in a vertical direction - the top edge wants to move across and the paper buckles.

In a truss system this is stopped from occurring by the rafters or trusses that cross the horizontal top chord. However, for this restraint to be effective, there must be a positive connection - the code (AS4440) calls for Framing Anchors (Trip-L-Grips or equivalent) to be used when the span exceeds 8000 mm or the setback exceeds 2400 mm, however this is seldom done.

Failure to adequately fix these over lying members causes a similar effect to that described above girder truss case, i.e. the truss will deflect downwards.

Another problem that can easily be avoided is twisting of trusses due to the fact that they are not put up straight. Similar to the buckling of an individual member, a truss as a whole is quite a flexible unit - try man-handling a 10m span truss in even a light breeze!

When a truss is not put up vertically, the load acts to bend the truss rather than simply pull and push along the members as the truss is designed to restrain. Again deflecting trusses are the result.

This is a time of apparently increased sensitivity to ceiling variations, so every effort has to be made to ensure that the trusses get the best opportunity to perform.

In this climate of high workloads and large numbers of roofs being installed, care must still be taken to get the trusses in right.