HAZARD ALERT No. 5

MiTek Asia Pacific

Large Diameter Screws into Narrow Edges of Truss Chords

A number of proprietary self-drilling screws of large diameters (approximately 8mm) have been introduced in recent times to be fastened into the narrow (most commonly 35mm wide) edge of truss chords.
This poses two major concerns for the structural integrity of the truss and is the reason why they are not be used in MiTek trusses unless specifically accounted for and noted in the truss design and certificate.

The Australian Standard for structural timber design, AS1720.1, places wood screws under two categories:

Small diameter self-drilling screws
Large diameter coach screws.

The largest self-drilling batten screw commonly used is the 14-gauge (approximately 6.3mm diameter) Type-17 screw. Larger screws are normally preceded by pre-drilling a hole.

Some of the proprietary screws that have recently been introduced and promoted for fixing into the edges of 35mm truss chords with or without pre-drilling are 8mm plus in diameter. These include truss tiedown screws and internal wall screws used to replace internal wall brackets. The following are some of the reasons why large diameter self-drilling screws should be avoided.

- Timber Splitting

  Larger screw diameters increase the potential for timber to split unless holes are pre-drilled. This is more likely when driven on the narrow edge of the section than on the broad face. Splitting may occur immediately during the process of driving the screw in, or potentially later when the screw is stressed under applied loads.

  Some timber species are more prone to splitting for example, hardwoods more than softwoods, cypress more than other pine species such as Radiata, and unseasoned timber more than seasoned timber as shrinkage occurs. LVL timber in truss chords could also potentially be more prone to splitting than solid timber when screws are driven into the thin veneers along the edges.

- Timber Cross-Sectional Area Reduction

  Self-drilling screws do drill a hole, so reduce the effective cross-section of the truss chord. The Timber Truss Design Standard, AS1720.5 permits up to a maximum of 15% loss in effective cross-section from fasteners before strength consideration must be taken into account. An 8mm screw in 35mm wide timber amounts to a significant 23% loss in cross-section, which equates to a 30% increase in timber stress that could lead to timber failure if the truss design does not take this into consideration. The strength reduction is worse when a pre-drilled hole of a larger diameter than the screw is formed. If a leading 9mm hole is pre-drilled in this instance, the timber overstress rises to 35%.

For example, there is a version of a truss tiedown screw which is driven vertically downwards from the top of the truss heel into the supporting wall below. Installed at this location, it has a significant effect on the strength of the truss overhang as the bending moment at the heel is critically high when a point live load from a worker on the roof is exerted at the end of the overhang.

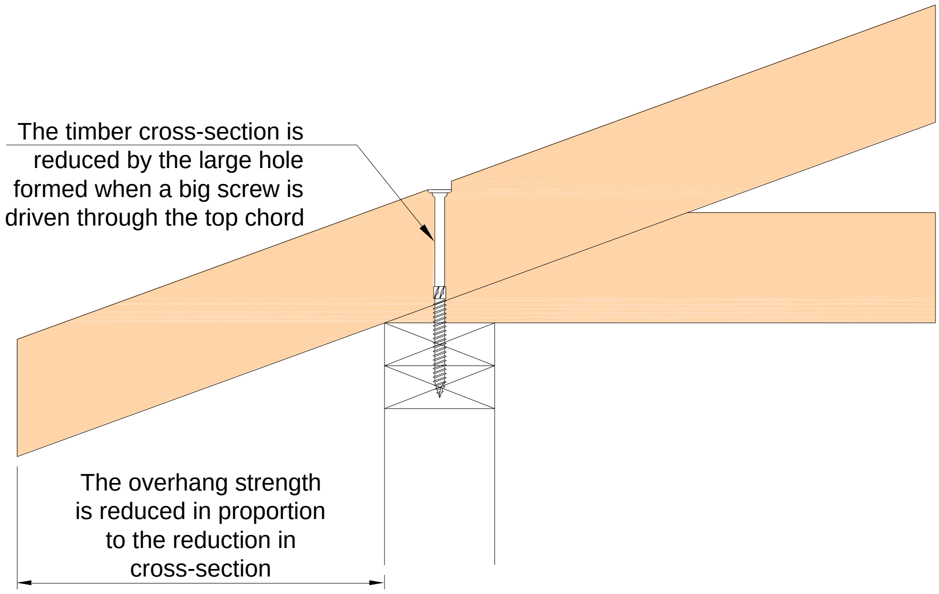

Figure 1: The effect of a top-fixed tiedown screw on overhang strength

You should expect to see a corresponding reduction in the maximum truss overhang when this system is employed.

In another application, internal wall screws are driven from beneath the top plate into the underside of the bottom chord. The MiTek structural laboratory recently conducted tests to assess the bending strength reduction of 90x35mm pine sections when an 8mm screw is partially driven a short depth in. An average reduction of 15% in bending strength was observed. Imagine how much more the strength reduction would be if the screw was driven deeper, and if bending strength reduction was to be combined with tension strength reduction in the bottom chord! As it is usually unpredictable as to which truss, and where along the bottom chord the screws will be installed, a strength reduction has to be applied to the entire length of the bottom chord member of every truss in the job to compensate for the use of these screws.

Figure 2: Typical bending fracture pattern of unmodified solid timber

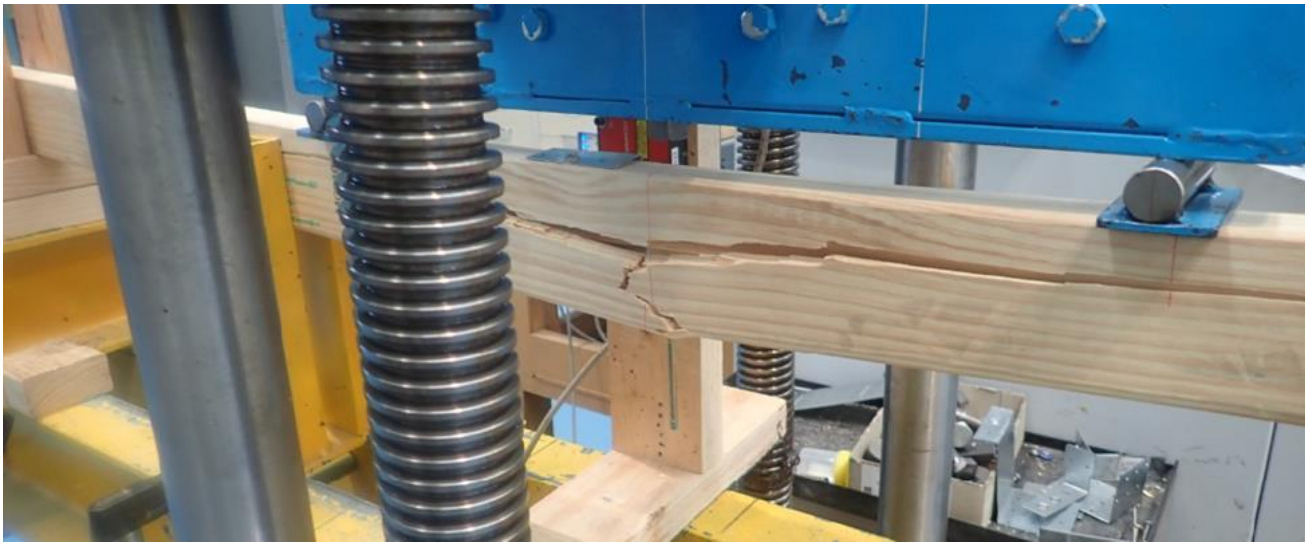

Figure 3: Typical bending fracture pattern demonstrating the weakness created by a large screw partially driven in from underneath the timber.

Summary of Hazards

To avoid any misconception, the issue is not that screws cannot be used in narrow edges of truss chords. The hazards being alerted to are:

1. Timber splitting is an important consideration, especially when large diameter (over 6.5mm) self-drilling screws are employed. Timber species and other limitations should be prescribed in the specifications.
2. A spacing limit for large screws should also be made clear and imposed.

3. The real world effects of installation misplacement or misalignment tolerances have to be clearly defined and factored into the screw capacity. The tolerance should also be readily capable of being inspected and verified. Any perceived advantage or expectation of speedy installation is quickly lost if it requires an unduly high level of care and accuracy.
4. A timber strength reduction from loss of cross-sectional area has to be factored into the truss design. Without this qualification, such screws should not be used in this fashion. Certifiers should be wary of situations where these screws are used in trusses without due consideration of their impact.

MiTek's NCC code compliant software considers all such strength reductions in their truss designs where MiTek screws are nominated in the outputs. MiTek's design certifications will be annulled if other screws are used in these applications.

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