ENSURING STRONG JOINTS

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Most truss plants are very aware of the need to use the correct grade of timber and have QA systems to ensure that timber with large knots and other unacceptable timber defects are excluded from their trusses.

However this diligence is not often applied to ensuring that there is no similar strength reducing defects at joints. After all - a truss is only as strong as its weakest point.

A truss may be manufactured using the highest quality timber but still may be inadequate for the task because the joints are not capable of restraining the design loads.

In a previous article (Guidelines 27) Adam Dennaoui discussed how the use of the correct timber types is important in obtaining the designed joint strength. In this article I would like to discuss other important aspects that affect the performance of nailplated joints.

A simple comparison that helps to understand how a nailplated joint works is to imagine a nailplate as a group of nails driven through a thin steel plate. So let's firstly look at a "normal" nailed joint.

Whenever I hammer in a nail, it seldom goes in straight and often bends over before it is fully home (must have a dodgy hammer). The result is that the nail isn't deep enough into the timber to achieve its full capacity.

Another feature of nailed joints is that when there is a gap between the members being joined, the nail transferring the load to the lower member is allowed to bend, which is weaker than if the load was transferred in shear. (See Diagram 1)

When nailplates are affected by these problems they are said to have – "insufficient embedment".

Both of the above issues are also important with nailplates – to develop full capacity the entire tooth must be embedded in the timber, there must be no gap between the plate and the timber.

If a gap exists the plate performs in a similar manner to the nail in Diagram 1. That is, the teeth slowly start to bend which causes them to start to pull out of the timber, allowing more of the tooth to be exposed and allowing more bending, etc.

When this happens the plate looks like it's peeling out of the timber. In fact this "peeling" appearance is often the first sign of an overloaded plate regardless of whether it is properly embedded or not.

The main causes of insufficient embedment include:

- Poorly maintained or inadequate pressing equipment.
- Insufficient care in pressing.
- Exposure of joints to repetitive cycles of wetting and drying.(See GN Guidelines 42)
- Varying timber thickness at a joint.

The use of timber with different thickness in the one truss was the cause of a number of BC splices failures in a house I inspected last year. In that case the timber varied up to three mm in thickness resulting in the sequence of events set out in Diagram 2.

Varying timber thickness is usually due to mixing of timbers at a joint. This occurs when:

1. Timbers of different types or from different suppliers are used which have different finished sizes, as in the case above. There are some engineered products in the market place that are not the same thickness as the sawn timber. I have seen cases where there have been variations of up to five mm in thickness.
2. Using timbers of differing moisture content resulting in one piece shrinking more than the other. This is the reason that mixing seasoned and unseasoned timber within the same truss is not permitted.
3. Mixing species of green timber that have different shrinkage rates. This is difficult to accurately quantify but in general terms unseasoned hardwood has a higher shrinkage rate than unseasoned softwood.
4. Using materials that perform differently under adverse conditions. For example if one material swells significantly when wet, there is a risk of pulling the plate out of the material that does not swell as much.

Other items to keep an eye on to ensure joint integrity are:

- Plate selection; always use the nominated size and type. The nailplate type is critical to correct performance. In some cases substituting a thicker plate will reduce the strength of the joint, as the tooth density on the thicker nailplates may be less and hence a larger size is required to achieve the same number of teeth in each member.
- Plate placement; ensure that they are located on the joint as specified by the design so that each member has the correct number of teeth.
- The angle the plate makes to the timber is also very important. Even though a nailplate is square it is usually crucial that the nailplate is oriented correctly. The design will nominate whether the tooth slots should be vertical, horizontal, or some other specified angle.

As I mentioned above, joint strength is just as important as timber quality in producing quality trusses. A failed joint will be just as traumatic and costly as a failed timber member.

However more diligence is required to ensure joint quality, as the factors, which affect joint strength, are not as obvious at the time of manufacture.

A two or three mm gap may not seem much but for a fully loaded joint it could be fatal. As joint strength is time dependant, it could take many years for a faulty joint to fail.

So do not be complacent just because you have not experienced any problems. Remember a tight joint is a strong joint.

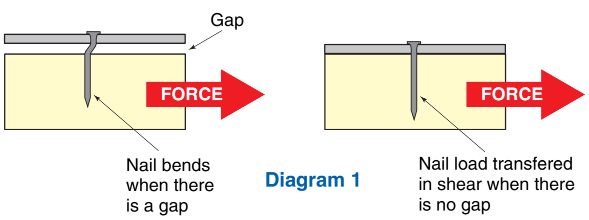

Diagram 1

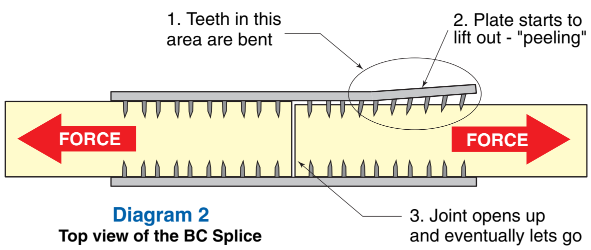

Diagram 2
Top view of the BC Splice