STRUCTURAL BUILDING COMPONENTS MAGAZINE
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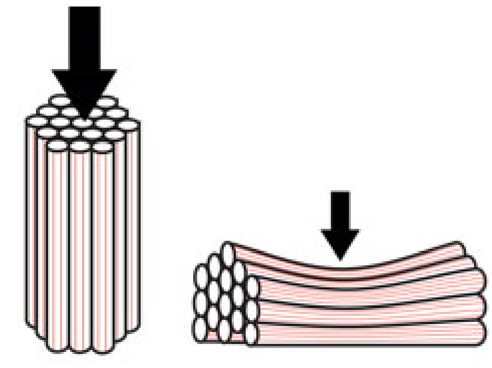
Frequently Asked Questions

Bearing Capacity by Rachel Smith



Wood Cells are like Drinking Straws Stronger Lengthwise than Crosswise

Wood, unlike concrete or steel, is sometimes considered a difficult engineering material due to its anisotropic nature. This means that it has different properties in different directions. The reason wood exhibits this anisotropic behavior is due to its cell structure. A wood cell is like a straw, it is long and hollow. Wood cells are bundled together and create the lengthwise grain of the wood. If you loaded up a bundle of straws on end, you can imagine that it could support more load than a bundle of straws loaded on its side.

These two load cases correspond to the strength of wood in compression parallel to grain versus compression perpendicular to grain. Depending on the wood species, the load capacity of wood in compression parallel to grain can be about three times higher than perpendicular to grain.

Trusses are usually designed such that the lumber on the bearing is perpendicular to grain. This is not a problem unless the truss reaction is too high for the available bearing area. The reaction force distributed over the bearing area creates a stress or pressure which should not exceed the established compression perpendicular to grain stress for that particular species and grade of lumber. The relationship between these three values is:

$$\text{Comp. Perp. Stress} = \frac{\text{Reaction Force}}{\text{Bearing Area}}$$

If the compression perpendicular to grain stress is exceeded, the lumber will crush at the bearing. The truss designer must prevent this from happening by increasing the bearing area, reducing the load, or using a species and grade of lumber with a higher stress capacity. A few methods are discussed below.

QUESTION:

How can I reduce lumber crushing at the truss bearing?

ANSWER:

Truss designers use several methods to reduce the compression perpendicular stress at the bearing to allowable levels, but they all fall into one of these three approaches:

- Increase the bearing area
- Reduce the load
- Increase the lumber bearing capacity

The most common approach is increasing the available bearing area by adding a ply (Figure 2), installing scabs alongside the existing bearing (Figure 3), or using a metal connector such as Simpson Strong-Tie's truss bearing enhancer (TBE) or USP's supplementary bearing plate (SBP) (Figures 4 and 5).

Reducing the load is not usually an option but in some circumstances the truss layout or design can be modified with this in mind.

Changing the lumber species to one with a higher compression perpendicular to grain stress (Fc⊥) will increase the lumber bearing capacity. Merely changing to a higher grade within the same species usually won't do the trick because, for the most part, the Fc⊥ value in a particular species is the same across the board regardless of the grade. Exceptions to this are the dense and nondense grades of some species and some of the high-end MOE values in machine graded lumber.

Another way to increase lumber bearing capacity is to run verticals through the bearing (Figures 6 and 7).

This takes advantage of the fact that lumber's compression parallel to grain value ($Fc_{||}$) is much higher than the $Fc_{\perp}$ values. Although with this method, you may only be succeeding in transferring the crushing problem from the truss to the wall top plate. It is a good idea to inform the building designer of this situation so that he or she can accommodate this condition into the design.

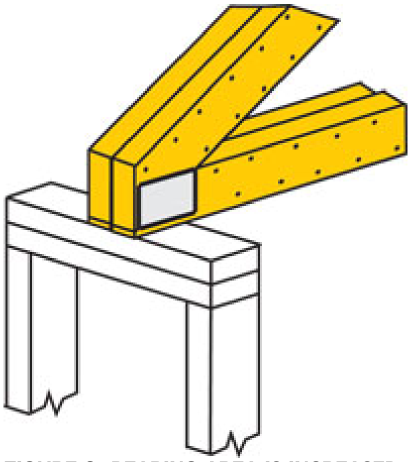


FIGURE 2: BEARING AREA IS INCREASED WITH ANOTHER PLY

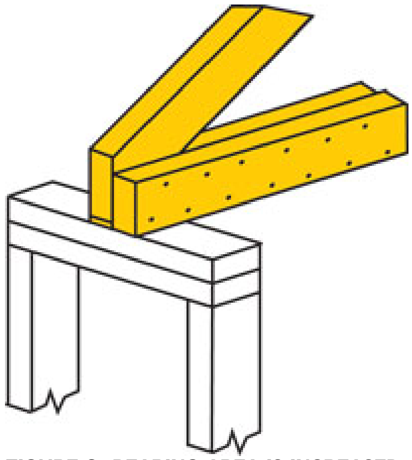


FIGURE 3: BEARING AREA IS INCREASED WITH SCAB BLOCKS

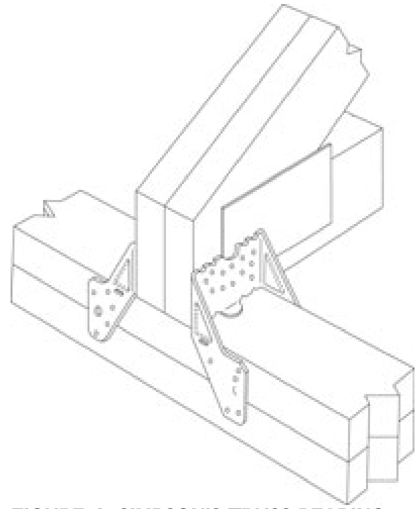


FIGURE 4: SIMPSON'S TRUSS BEARING ENHANCER

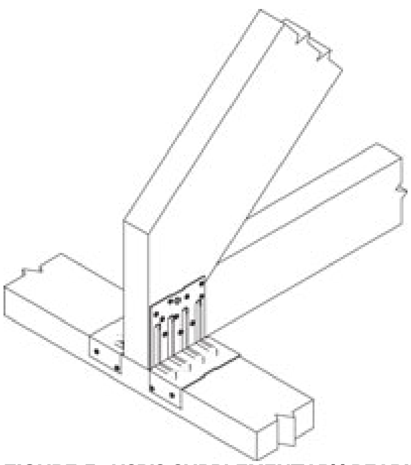


FIGURE 5: USP'S SUPPLEMENTARY BEARING PLATE

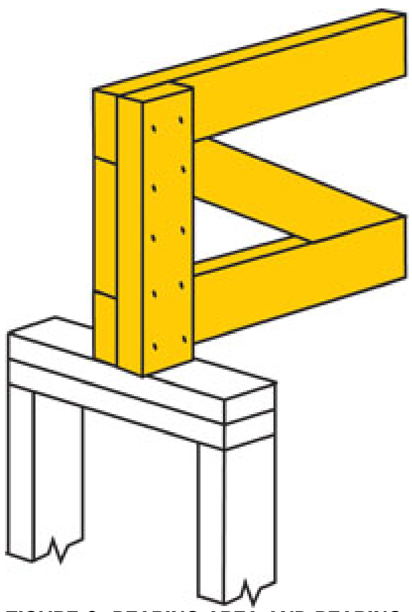


FIGURE 6: BEARING AREA AND BEARING CAPACITY IS INCREASED WITH AN END GRAIN BLOCK

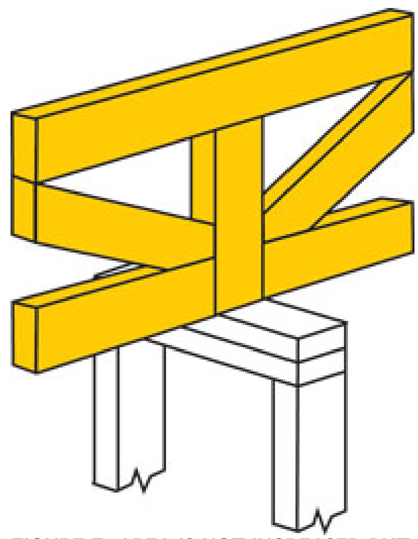


FIGURE 7: AREA IS NOT INCREASED BUT CAPACITY IS WITH THIS END GRAIN WEB RUNNING THROUGH THE BOTTOM CHORD TO BEARING

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