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UNDERSTANDING PARALLEL VS. PERPENDICULAR PROPERTIES AND SPLIT RISK IN SHORT MEMBERS

Selecting the right timber material is crucial in structural applications, particularly when considering strength differences in parallel and perpendicular orientations to the grain. Additionally, mitigating the risk of splitting in short members when pressing nailplates is essential in timber construction. This article explores how to make informed material choices, comparing machine-graded pine (MGP) and laminated veneer lumber (LVL), highlighting their respective advantages.

Parallel vs. Perpendicular Grain Strength Properties

Timber exhibits significantly different mechanical properties depending on the loading direction relative to its grain:

- Parallel to the Grain: Timber is strongest in this direction due to the alignment of cellulose fibres, offering high tensile and compressive strength. This property is critical for elements subjected to axial loads, such as chords in trusses and beams in bending.
- Perpendicular to the Grain: Timber is weaker in this orientation. Compression perpendicular to the grain often leads to crushing, while tension perpendicular to the grain increases the likelihood of splitting. This is particularly relevant when nailplates are pressed into the timber, as they induce forces that may exploit natural weaknesses such as knots and grain deviations.

From Table 1 below, it can be found that the bearing capacities of MGP in parallel to grain orientation is three times greater than in perpendicular. Also, it showed a significant difference in tension properties as well.

Table 1 – Characteristic values for design – MGP stress grades (partial) from AS1720.1 Tb.H3.1

Stress grade	Section size		Tension		Bearing	
	Depth (mm)	Breadth (mm)	Parallel to grain (f't)	Perpendicular to grain (f'tp)	Parallel to grain (f'p)	Perpendicular to grain (f'tp)
MGP10	70 - 140	35/45	7.7	0.5	30	10
MGP12	70 - 140	35/45	12			

Comparing MGP and LVL for Smart Material Selection

Both MGP and LVL have their own strengths and are best suited for different applications:

- MGP: As a solid-sawn timber, MGP pine is widely used in structural applications due to its cost-effectiveness and high strength-to-weight ratio. It performs well when strength parallel to the grain is the primary design consideration. However, its natural variability in grain structure and the presence of knots can make it more susceptible to splitting when pressing nailplates, particularly in short members.

- LVL: Laminated veneer lumber is an engineered wood product made by bonding thin layers of wood veneers. Its uniform density and grain orientation reduce weak points and improve resistance to splitting. LVL excels in applications where tension perpendicular to the grain is a concern, making it a more reliable choice in areas prone to stress concentrations, such as nailplate connections in short truss members.

Selecting Timber Material for Different Design Constraints

If a component experiences significant forces perpendicular to the grain, such as compression at bearing points or nailplate connections, LVL would be the superior choice due to its consistent mechanical properties and reduced risk of splitting.

In roof trusses, especially where short members are used at cut-off ends, LVL offers advantages due to its uniform grain structure minimizes weak points, making it more resistant to splitting when pressing nailplates. MGP can be a viable option in longer members where grain alignment minimizes perpendicular stress concerns, ensuring a balanced approach to material selection.

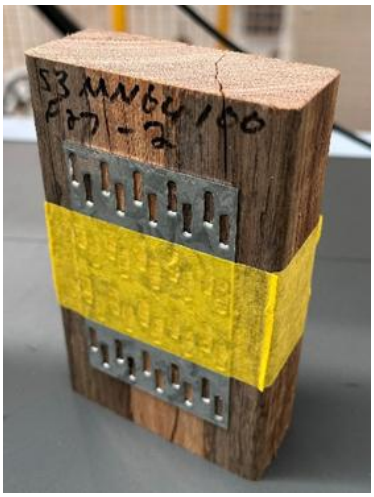

Figure1 – Splitting in short swan timber member after pressing

Both MGP and LVL have distinct advantages depending on the design requirements. MGP is a cost-effective option where strength parallel to the grain is the primary concern, while LVL offers superior performance in applications requiring resistance to perpendicular stresses and splitting. By understanding these properties, engineers and designers can optimise material selection to enhance the performance, durability, and safety of timber structures.

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