Built to Last

A Specifier's Guide to Weather-Exposed Engineered Structural Timber

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Introduction

Australia's harsh climatic conditions demand that structures deliver top performance and durability with respect to withstanding exposure and weather. Timber is a commonly used, chemically-stable building material that will not succumb to deterioration due to age alone.[1] However, timber is vulnerable to damage when exposed to specific elements and climatic conditions such as: sunlight and ultraviolet (UV) light exposure, which can cause the degradation and weakening of surface cells on exposed timber,[2] and extended moisture exposure, which can cause timber to mould and decay.[3]

When specifying engineered structural timber, it is critical to ensure that the performance and durability of the material is suitable for the application context. With the sheer volume and variety of engineered structural timber solutions on the market, specifiers must ensure that several key considerations are factored into the specifying process to ensure the best performing solution is identified.

One such engineered timber product is glulam (glued laminated timber), which is created by gluing together structurally-graded timber pieces (known as laminates) resulting in a wood product that is consistently stronger than solid timber. Glulam manufacturing technology and large-scale production has reduced costs and increased availability, making it cost competitive against other traditional exterior elements. Its improved performance characteristics compared to traditional solid sections of modern plantation timbers opens new opportunities for creating large open span designs that retain the natural beauty of timber.

In this whitepaper, the importance of proper specification of engineered structural timber is emphasised. It is only through the careful assessment of such timber products against performance and durability criteria that specifiers can ensure that weather-exposed structural timber is fit for purpose. We also explore how structural glulam timber delivers in a number of key performance areas, making it ideal for use in application contexts where weather exposure and contact with the ground are likely.

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Performance and Durability
What to Look For

High pressure treatment

Specifiers should look for timber products that have been subject to specific treatments that improve its ability to withstand elements. The treatment of timber through high pressure impregnation (or "full-cell" impregnation), for example, is one way of improving its performance and durability in certain environments and applications.[4] High pressure impregnation is a process whereby wood is treated with preservatives that impregnate the full wood cell (including the cell wall and the lumen or interior) with chemicals or substances that enhance its resistance to the elements, decay and pests.[5] Chemical coatings and preservatives are highly effective in enhancing the performance of timber in relation to weather, challenging climatic conditions and termite attack.

Timber products that have not undergone high pressure treatment are more vulnerable to the elements. For example, light organic solvent preservative (LOSP) low pressure treated Radiata Pine, a commonly used structural timber material, is not high pressure treated and accordingly has relatively lower weather resistance and durability. According to Wood Products Victoria, LOSP low pressure treatment is not suitable for applications that will make contact with the ground; unprotected, LOSP only provides short-term water repellence and dimensional stability.[6]

Compare this to high pressure treatment, such as water-based full-cell impregnation. This technique involves sealing the timber in a vessel capable of withstanding high levels of vacuum and pressure, and utilising various combinations of pressure, time and solution concentration to ensure maximum retention of the preservative.

Note that no treatment processes penetrate the heartwoods of timber. See AS 1604 Specification for preservative treatment for more information.

Dimensional stability

'Dimensional stability' is another key performance indicator for timber products, and refers to the ability of the timber to resist swelling and shrinkage when exposed to changing atmospheric conditions.[7] Solid timber will always want to twist and bow by reverting to its natural timber shape. Some species are more susceptible than others. Glulaminating timber removes stresses in the timber and provides longterm straightness. This is particularly important where the product is exposed to weather.

According to the Western Woods Product Association (WWPA), wood is composed mainly of cellulose and lignin, and shrinks as it dries, and swells as it absorbs moisture.[8] The WWPA notes that acclimating or drying wood to the appropriate moisture content best suited for the application context and use conditions will improve the wood's overall performance.[9]

Timber that has been 'wet sawn' – which is to say, has not been dried in a kiln or treated after being cut – has low dimensional stability. This is due to wet-sawn timber being prone to expansion and shrinkage, as well as cracking, as moisture levels and temperatures fluctuate. Domestically sourced or imported wet-sawn Radiata Pine is particularly susceptible to damage of this nature.

As it is manufactured from seasoned timber and thus less prone to movement, selecting a glulam product over solid sawn timber will improve dimensional performance especially relating to bowing and twisting over time. Glulam products may experience some dimensional movement from swelling and shrinkage, but this is due to natural timber movement caused by temperature and humidity fluctuations.

Strength performance

Timber's inherent strength qualities have made it a sought-after and versatile building material for a wide variety of structural applications. For its weight, timber has superior strength performance as compared to other materials, which generally improves with density.[10] The emergence of engineered wood products like glulam have delivered even greater strength performance, with timber products now a viable option for constructing mid to high-rise buildings.[11] In fact, due to the laminating process, glulam has an excellent strength-to-weight ratio, with strength performance comparable to steel.[12]

While timber performs well in terms of resisting deformation due to loads and impact, specifiers should seek structurally graded solid or engineered timber for specific structural applications. Strength performance is determined by visual grading or machine grading, the durability rating of the species and – in the context of domestic construction – mechanical grading.[13]

For the purposes of specification, use the manufacture's span tables, which are available online. Generic span tables are also available.

Use in fire prone areas

As timber is a combustible material, compliance with guidelines for use of timber in fire prone areas is a major concern for designers and specifiers. Scientific tests and real examples have demonstrated the strong benefits of using large section glulam timbers against the ravages of fire. Glulam retains structural integrity after removal of the fire source; the timber undergoes charring but does not collapse like steel structures.

Understanding Aesthetics

Specifiers and designers should also carefully consider the aesthetics of any exposed construction elements to ensure overall visual consistency. The surface finish and level of resolution of structural timber needs to be carefully considered.

Different wood types and manufacturing methods can result in a variety of visual effects that may or may not be consistent or desirable with the overall aesthetics of the final structure. Domestic or imported sawn-treated pine can have an unattractive, unpainted finish that can detract from the facade or structure. Pre-primed timber products preclude a stained or natural finish, so design options are often limited to the available factory finishes. Crucially, LOSP low pressure treated timber can be prone to sap bleeding, which is unsightly and may result in staining.

Exterior glulam is typically supplied with a smooth, dressed surface, either natural or with a base primer coat. Note that exterior use glulam is a structural member. Finishing (that is, painting) on-site needs to be carefully considered. A painting contractor should be consulted for expert advice. All glulam can have some unsightly defects such as splits, staining, transport damage, resin bleed, broken knots or other blemishes.

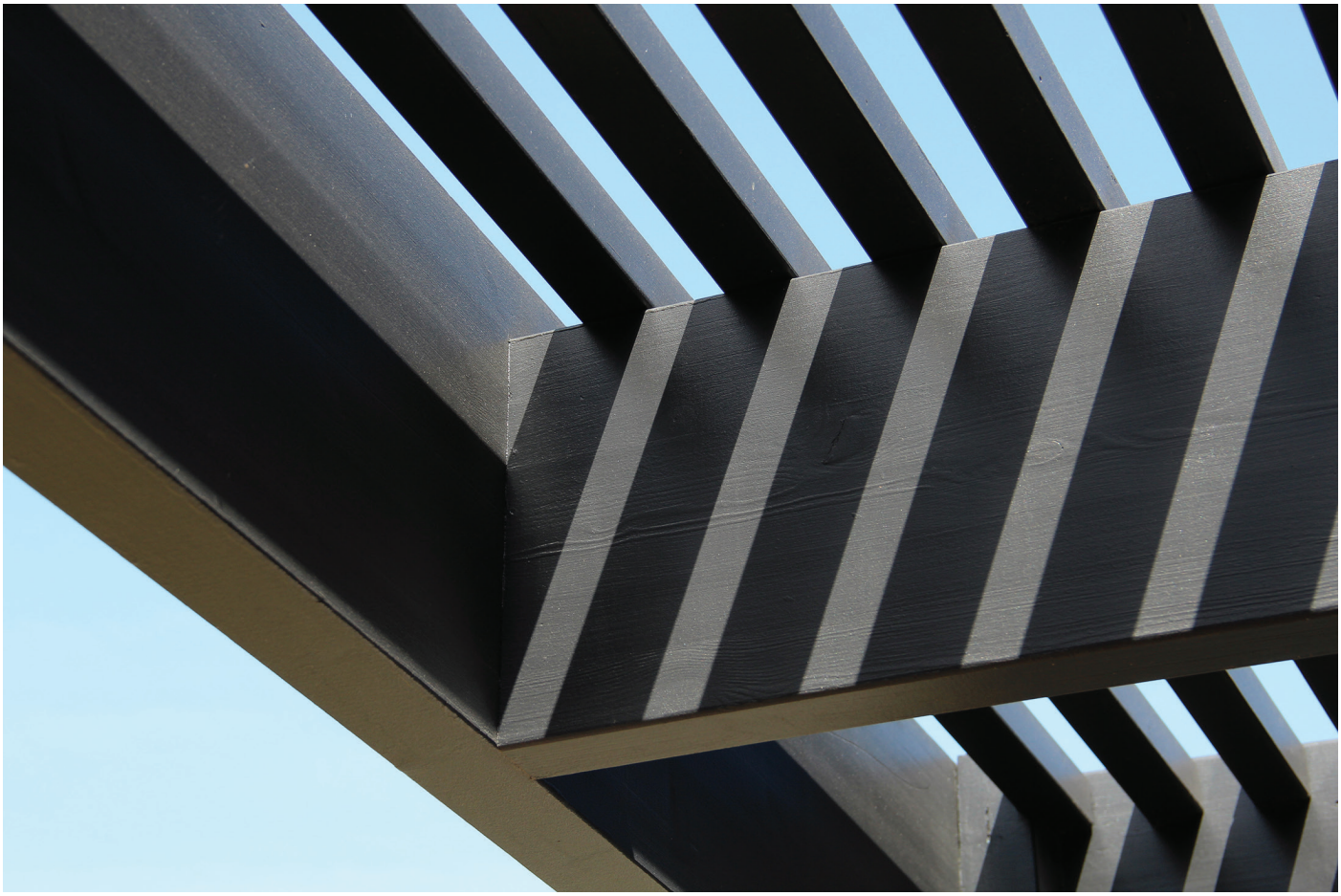
Appearance grading refers to applications where strength is not the primary consideration. Posts and beams are paint-grade quality only. Some filling may be required prior to coating. Posts are visually graded to three faces only, whereas beams are visually graded to one good face.

Due to the high pressure impregnation process, some cracking and splits are unavoidable and not considered a defect. Some minor surface delamination, and other imperfections such as broken knots and small holes, are allowed. Surface cracks do not affect the performance of the product. According to best practice, painting contractors should specify the level of preparatory work required to meet the client's needs prior to final coatings being applied.

Minimising Environmental Impacts

Specification of engineered timber products such as glulam occurs against the backdrop of a market increasingly concerned with minimising environmental impact and promoting sustainable practices. The architecture and construction industry and end users alike require solutions that are produced in a sustainable manner, have a small environmental footprint, and result in more efficient energy use.

While it's accepted that the timber industry can have a negative impact on the environment,[14] wood as a building material has many positive environmental characteristics including low embodied energy, low carbon impact, and high sustainability.[15] Numerous studies have also shown that the amount of energy needed to produce wood products is significantly less than that required by similar products made out of other materials.[16] In addition, wood is a renewable resource and, through proper, sustainable management of forests, the production of wood products can be continued indefinitely.[17]



Chain of Custody – AS 4707

Designers and specifiers must ensure the chosen wood product is from responsibly managed and processed manufacturers. Timber sourced from forests with third party sustainability certification should be preferred. Such third-party certification may come from the Forest Stewardship Council or the Programme for the Endorsement of Forest Certification.

The AS 4707:2014 standard sets out the requirements for the chain of custody of forest products with claims of certification under AS 4708:2013, the Australian Standard for Sustainable Forest Management. The wood or forest products certification chain provides a record of all wood or forest products originating from certified forests through the supply chain to the end consumer.

Independent certification against the Chain of Custody standard provides an assurance that the wood or forest product in question has been produced to meet a set of clearly defined performance requirements and are sourced from certified forests that demonstrate sustainable forest management.

Treatment Standards – AS/NZS 1604

The AS/NZS 1604 series specifies the industry standards for timber preservation required to protect timber used in Australia from local species of decay organisms and insect pests. Under AS/NZS 1604, preservative-treated timber must be marked with an alphanumeric code providing a treatment plant number (indicating the place of manufacture), preservative code number, hazard class number and hazard suffix code.

An updated version of the Standard has been flagged that changes the term “treatment plant number” to “unique identifier”, enabling products to be labelled with the company name rather than the plant number.[18] The Timber Preservers Association of Australia provides a list of treatment plants, assisting consumers to see who has treated the product but there is no regulatory power to test whether the products being delivered by these plants meet specifications. Nevertheless, branding a product is tantamount to making a claim that the product complies with the treatment standard. Reputational damage and liability for remediation costs may follow if this claim proves false.

Hazard class should also be noted as it specifies the service conditions to which the product is exposed and the level of treatment or level of protection that must be applied to the wood. Timber in Australia is treated to six levels, from H1 (wood that may be used indoors, under cover and in a well-ventilated area) to H6 (wood that is in contact with sea water). The intended conditions and application for the treated timber should match the hazard class.

Note that glulam products are supplied in either the natural unpainted state or factory coated primer. Where sold as H3A for use in weather-exposed situations, the glulam product requires a surface coating to be applied and maintained.

Wright Forest

Wright Forest has led the Australian market in high quality timber and timber technologies for over 160 years. Representing several of Europe's most prestigious timber processors and manufacturers, Wright Forest is a specialist importer and distributor of Nordic timbers nationally.

All products are manufactured from Nordic Redwood (Pine) or Nordic Whitewood (Spruce). These species are sourced from prized regions in Finland and Estonia. World class logs are supplied from sustainably-managed native forests. In Finland, most logs are grown and owned by families on private land and are managed over generations. Custodial ownership and strict environmental regulation with increasing supply is why Wright's have focused on supply from this region as global leaders in softwood timbers over generations.

With a broad catalogue that includes the flagship brands, Polkky® Giant, Raitwood®, Lunawood®, Permapine® and Luviawood® lines, Wright Forest offers a solution to suit any design application. All Wright Forest products are supported by comprehensive customer service, including thorough and detailed technical advice at the design and construction stages. All Wright Forest products are backed by a 15-year limited guarantee.

Pölkky Giant

Wright Forest stock a range of high quality Pölkky Giant impregnated glulam posts and beams, which are available in standard Australian metric sections for structural softwoods.

Stock sizes and lengths (millimetres)

- Posts: 90x90, 115x115, 140x140, 190x190, 240x240.
- Beams: 45x90, 140, 190, 240, 290 and 63x240, 290.

Special purpose sizes and lengths can be ordered direct from the factory. The possibilities are almost limitless.

Pölkky Oy is the largest private Pine and Spruce softwood processing company in Northern Finland and operates sawmills and processing facilities in Karelia, Finland's best raw material region. The timber sourced from this region is known for its slow grown fine grain and small knots, qualities that make it an ideal solution for the manufacture of structural glulam, joinery for doors, windows and mouldings.

Pölkky glulam delivers natural beauty, high performance, and durability with key benefits over traditional products for weather-exposed engineered beams, including:

- high pressure impregnation that penetrates all the vulnerable sapwood;
- LVL alternative;
- unpainted and dressed surfaces increases the flexibility of the design featuring the exposed natural timber;
- impregnated for weather exposure with emission-free water-based Koppers Celcure® C4 with integrated brown colour;
- engineered glulam using premium slow grown Nordic Redwood for strength and durability;
- large sections and long length of GL 10 engineered for straightness and long-lasting dimensional stability;
- resistant to decay and pests, with a 15-year guarantee against rot and insect attack;
- suitable for use in termite susceptible areas; and
- sourced from certified raw materials and processors.

Pölkky glulam posts and beams are specially kiln dried for the Australian market to 12% moisture content, ensuring maximum dimensional stability. Optical grading technology is used to assess each timber piece and ensure it meets the requisite grade specifications and minimises waste. All Pölkky products are A-level Quality (otherwise known as US (I-III and I-IV)). Pölkky structural timber and glulam have been tested by independent third parties and declared fit for use respectively as a permanent structure or part of a permanent structure in buildings, or as load-bearing structures.

Applications

Pölkky glulam is suitable for a wide variety of applications including fencing and partitioning; pergolas and arbors; playgrounds; structural members; hand railings; post; beams (exposed and unexposed); frames; ground contact; upper story constructions; bolt together trusses and beams; sub-floors and more.

Sustainability

Pölkky wood meets the criteria of sustainable development and is acquired from Finnish forests according to principles of sustainable forest management. At each phase from procurement to production, Pölkky products have minimal impact on the environment.

"Due to the laminating process, glulam has an excellent strength-to-weight ratio, with strength performance comparable to steel."

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