ARC ADVANCE TIMBER HUB
PROJECT 6.1 - MILESTONE REPORT 2

OBJECTIVE 2 – FINAL REPORT

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EXECUTIVE ABSTRACT

This report summarises the key findings from the work undertaken for Objective 2 of the Australian Research Council (ARC) Advance Timber Hub (ATH) Project 6.1 - *Improving resource availability and utilisation for residential timber manufacturing and construction*. This project explores opportunities for the Australian frame and truss (F&T) sector to utilise greater volumes of softwood sawn timber with lower mechanical properties and/or quality than standard machine-graded pine (MGP) and the other non-MGP structural grades (F-grades) currently in use.

The overarching aim is to identify alternative, fit-for-purpose solutions that could help the sector respond more effectively to periods of high market demand and national timber shortages. A key expected outcome is the development of strategies that optimise the use of available Australian timber resources, enabling the industry to maintain supply continuity while improving resource-use efficiency.

Objective 2 specifically focuses on defining industry expectations for timber quality for proposed lower-grade timber applications, ensuring that any resulting products or approaches are acceptable to the F&T sector.

Thirty-three interviews, involving 47 participants in total, were conducted between August 2025 and January 2026 across Australia with F&T manufacturers, sawmillers, timber distributors, design software providers, equipment and connector manufacturers, the Frame and Truss Manufacturers Association of Australia (FTMA) and industry experts. These discussions explored expectations around timber quality for alternatives to MGP and non-MGP structural grades, including which downgraded utility characteristics (e.g., distortion limits, wane, want, splits, etc in AS/NZS 1748.1 [1]) might be acceptable , especially in high-demand conditions. Interviewees were also asked about the feasibility and industry appetite for introducing new structural grades that would enable greater utilisation of available sawn timber qualities, whether for general applications or specific fit-for-purpose solutions.

A clear and consistent message emerged: there is very limited interest in relaxing the existing utility quality requirements for MGP. Many respondents instead advocated for higher sawn timber quality. Reasons included:

- Current utility quality requirements in AS/NZ 1748.1 [1] are already viewed as too lenient, with many sawmills and F&T companies applying stricter in-house grading rules for timber intended for frames and trusses.
- Automation and robotisation in F&T plants generally require higher and more consistent timber quality than manual manufacturing.
- Straightness and limited stud distortion are critical to builders, while defects, such as wane, splits and knots can create manufacturing and safety issues for both F&T manufacturers and builders.
- Builders and consumers generally expect visually appealing timber frames and trusses.

Sawn timber is facing growing competition from steel and laminated veneer lumber (LVL), which provide straighter, more uniform products. Lower-quality timber increases waste and reduces

overall productivity efficiency because it usually requires more docking, defect removal, sorting, handling, and reworking. Eighty-one percent of the F&T manufacturers interviewed did not support any reduction in current F&T timber utility quality requirements. The remaining 19% indicated they would consider limited relaxation for specific characteristics such as wane and splits but only under two conditions:

1. The timber price was sufficiently favourable, and
2. Builders also agreed to the change.

Despite the reluctance to relax utility quality requirements in the majority of F&T companies interviewed, there was stronger interest (from 85% of F&T manufacturers interviewed) in developing alternative, fit-for-purpose grades or solutions that could increase utilisation of Australian softwood sawn timber in the F&T sector. These could include new sub MGP 10 general-use grades (e.g. MGP 6, 7 or 8) or grades tailored to specific F&T components, such as internal non-load-bearing studs or truss webs. Conditions identified for the acceptance of new grades included:

- Compliance with relevant standards and approval from engineers, detailers and design software providers.
- Acceptance by builders and consumers, supported by consistent quality and reliable supply.
- Competitive pricing relative to imports and existing MGP grades.
- Meeting, at minimum, current utility requirements, particularly distortion limits.
- Suitability for automated manufacturing, i.e., with suitable straightness and distortion limits.
- Acceptability and compatibility across the entire supply chain including for sawmillers and timber distributors.
- Clear differentiation from existing grades (e.g., F4 to MGP 15)

Concerns about introducing new grades included increased operational complexity, limited floor space for additional stock, potential for confusion or errors due to too many grades being used, and doubts about the stability and straightness of core-wood, which constitutes a large portion of timber not meeting a structural grade as targeted as part of this project.

The interviews also highlighted several alternative pathways to the objectives of the project to make better use of lower-grade material in the F&T sector:

- Expanding the use of engineered wood products (EWPs) manufactured from lower-grade timber, including LVL, finger-jointed members and laminated studs.
- Using wood-modification techniques, such as chemical or thermo-mechanical processes to enhance straightness, and also potentially stability, mechanical performance and appearance, of lower-grade timber.
- Adopting larger cross-sectional sizes to increase the suitability of lower-grade timber for structural applications.
- Integrating advanced technologies and equipment in F&T plants, such as AI-enabled systems, scanners, sensors, optimisation software and robotics, to improve detection,

classification and handling of lower-grade timber and support more efficient resource utilisation.

- Increase the use of nail plates and other steel connectors to compensate for lower timber qualities and enable the use of shorter or lower-grade lengths.
- Improving sawing and drying processes at sawmills to lift the quality and consistency of lower-grade outputs.
- Reviewing practices used in overseas F&T sectors and adopting relevant approaches where feasible in the Australian context.
- Updating relevant Australian standards and building codes to better accommodate the use of lower-grade timber products.

Interviewees also frequently emphasised the need for greater education across the F&T supply chain, including manufacturers, builders, building inspectors and homeowners about timber's natural characteristics and its fitness for purpose, even when visual imperfections are present.

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INTRODUCTION

This report presents the key findings from Objective 2 of the Australian Research Council (ARC) Advance Timber Hub (ATH) Project 6.1, *Improving resource availability and utilisation for residential timber manufacturing and construction*.

ATH Project 6.1 has two overarching aims:

- To develop a comprehensive understanding of how efficiently structural timber is currently utilised within the Australian residential construction market.
- To identify opportunities for utilising timber with lower mechanical properties and/or qualities than machine-graded pine (MGP) and non-MGP structural grades (F-grades), with the goal of providing alternative, fit-for-purpose solutions in response to high market demand and potential national timber shortages.

Currently, up to 50% of softwood sawn timber produced in Australia is unsuitable for the frame and truss (F&T) sector due to insufficient mechanical properties or grade-limiting characteristics such as distortion, knots, wane, want, splits and resin pockets [2]. Timber that does not meet structural-grade requirements is typically diverted to lower-value applications such as pallets, packaging, roof battens and fencing.

MGP used in Australia must comply with requirements in AS/NZS 1748.1 [1] and AS/NZS 1748.2 [3], which specify the physical/visual (utility) requirements and machine-grading processes, respectively. Under these standards, timber must satisfy physical or visual limits on characteristics such as distortion, wane, want, splits and resin pockets that may affect structural performance or manufacturability, as well as minimum mechanical property thresholds determined through machine stress-grading. The characteristic design values derived from this grading process are then used in accordance with AS 1720.1 [4], which provides engineering design methods for structural timber and is referenced by the National Construction Code (NCC) for compliance in building applications.

The primary expected outcome of Project 6.1 is to identify strategies that optimise the utilisation of available timber resources in the F&T sector, enabling the industry to continuously meet market demand while improving overall resource-use efficiency.

In this report, two distinct definitions are adopted to refer to timber not meeting a structural grade: “out-of-grade” and “lower-grade” timber. “Out-of-grade” refers herein, consistent with the definition by Cherry, et al. [2], to sawn boards failing to meet the MGP structural framing requirements in AS/NZS 1748.1 (2011) [1] and AS 1720.1 (2010) [4], either in terms of stiffness, strength, defects or distortion. “Lower-grade” refers to sawn boards failing to meet both MGP and non-MGP structural grades (F-grades) in relevant Australian standards. However, both “out-of-grade” and “low-grade” sawn boards still present desirable mechanical properties, as recently quantified by Shanks et al.[5] , where the average Modulus of Elasticity, and characteristic bending and compression strengths of 90 × 35 mm lower grade timber sawn boards were 42.0%, 32.9% and 38.3%, respectively, lower than those of MGP10 in AS 1720.1.

ATH Project 6.1 comprises five interrelated objectives. Objective 1, completed by Gilbert (2025) [6], delivered a comprehensive literature review to support the development of new out-of-grade products for the Australian residential market. The Objective 1 report (Milestone 1) provides an overview of the properties of out-of-grade timber, the type of out-of-grade structural products in national and international standards and the potential uses of such products [6].

This current report focuses on Objective 2 of the project, which is aimed at defining industry's expectations on timber quality for alternative solutions to both MGP and non-MGP structural grades, allowing any solutions resulting from this project to be accepted by the F&T sector. The report investigates through industry consultations:

- F&T manufacturers' expectations of timber quality for alternative solutions to MGP and non-MGP grades, including which downgraded utility characteristics from AS/NZS 1748.1 (2011) [1] (e.g., distortion limits, wane, want, splits) may be acceptable in high market demand.
- The feasibility and industry appetite for introducing new, alternative structural grades - either general-purpose or fit-for-purpose (e.g., tailored for specific applications or components such as internal non-load-bearing walls).

METHODOLOGY

Key representatives from the F&T sector across Australia, were interviewed between August 2025 and January 2026. Participants included:

1. F&T manufacturers
2. Software, equipment, and connector providers
3. Timber producers (sawmills) and distributors
4. Industry experts
5. The Frame and Truss Manufacturers Association of Australia (FTMA)

F&T manufacturers were selected to represent a range of operation sizes and were drawn from five different states and territories to ensure a broad national perspective. Most interviews were conducted in person and, for manufacturers, typically included a tour of the facility. Table 1 outlines the number of interviews conducted by industry category and location.

Given that several interviews involved more than one participant from the same company, a total of 47 people took part in the interviews, including 31 representatives from F&T companies, as shown in Table 1. The interviews were facilitated particularly by key project industry representatives, MultiNail and AKD. This project also collaborated with the Australia Forest and Wood Innovations (AFWI) funded and University of Tasmania (UTAS)-led project *Future Lightweight Timber Framing*. The required interviews for both projects were often run concurrently. The FTMA also assisted in selecting and setting up F&T companies to be interviewed.

The names of all companies and people that were involved in the interviews have been kept confidential in accordance with the research consent ethical approval processes, agreed to with the project participants.

Table 1: Summary of Interviewee Numbers per Industry Category and Location

Category	**Qld**	**NSW**	**Vic**	**ACT**	**WA**	**Australia-wide**	**Total Interviews**	**Number of people interviewed**
F&T manufacturers	5	6	4	2	4		21	31
Software, equipment, connector providers						3	3	4
Timber suppliers (producers and distributors)						5	5	7
Industry experts						3	3	3
FTMA						1	1	2
Total	**5**	**6**	**4**	**2**	**4**	**12**	**33**	**47**

Interview questions were developed in consultation with the ATH Project 6.1 steering committee and other project participants. The general information sought from the interviews was:

- In the case of F&T manufacturers only, background information on the interviewees – e.g. role and experience; and on the company – including products, market, structural grades used, number of employees, customers, size/scale, level of automation, timber species, use of engineered wood products (EWPs), challenges, development plans and strategic direction. Such background questions were not asked for the interviewees not directly working for a F&T manufacturer.
- Thoughts on possible relaxation of the timber quality requirements in relation to the utility requirements in AS/NZS 1748.1 [1], consisting of which characteristics, if any, could be relaxed or adjusted?
- Thoughts on the possibilities and mechanisms for introducing new alternative structural grades in the F&T market.

- Suggestions on how greater quantities of out-of-grade/lower grade timber could be used in frames and trusses.

The detailed interview questions adopted are provided in Appendix A.

Interviews were conducted in a semi-structured manner, designed primarily to encourage open conversation rather than to collect standardised data. Consequently, the discussion of results focuses on qualitative insights rather than detailed numerical analysis. However, where appropriate and supported by the responses received, quantitative summaries are provided.

KEY FINDINGS

Frame and Truss Manufacturer Background Information

Figure 1 illustrates the proportion of interview participants by role across the F&T manufacturers. The most common role represented was Owner & Director, followed by General Manager. The remaining F&T interviewees held positions across operations, production, technical, procurement, design and detailing.

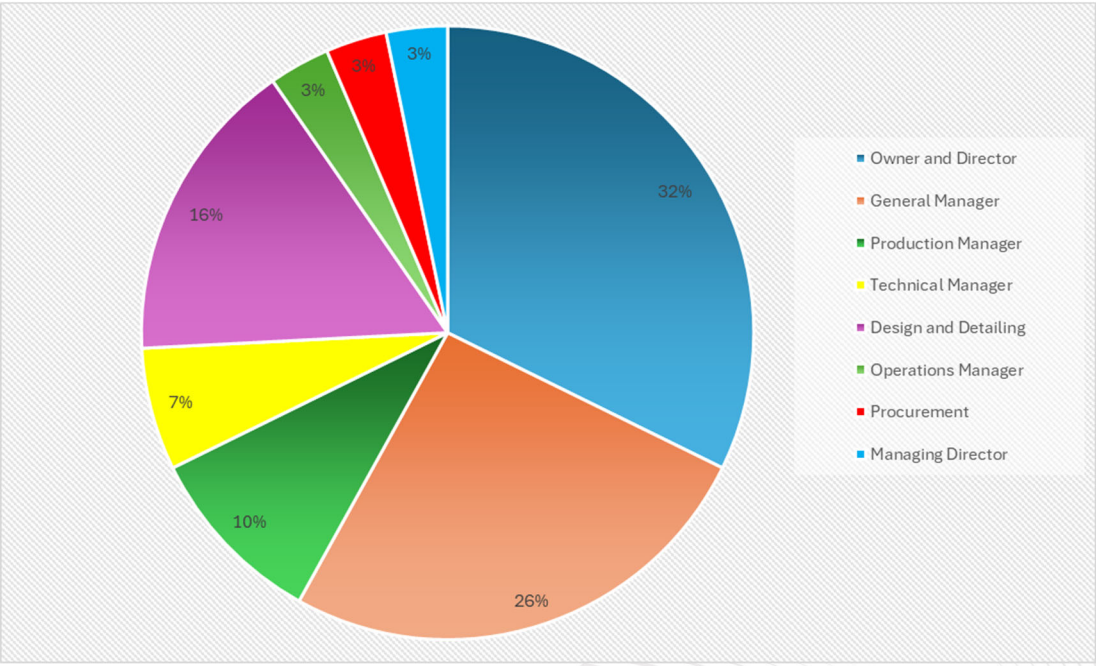

Figure 1: Proportions of interview participants by roles in F&T manufacturers

Figure 2 illustrates the proportion of interview participants by work background across the F&T manufacturers. The most common backgrounds represented were carpentry and F&T manufacturing as the interviewees' sole prior work experience. Other backgrounds included building and engineering.

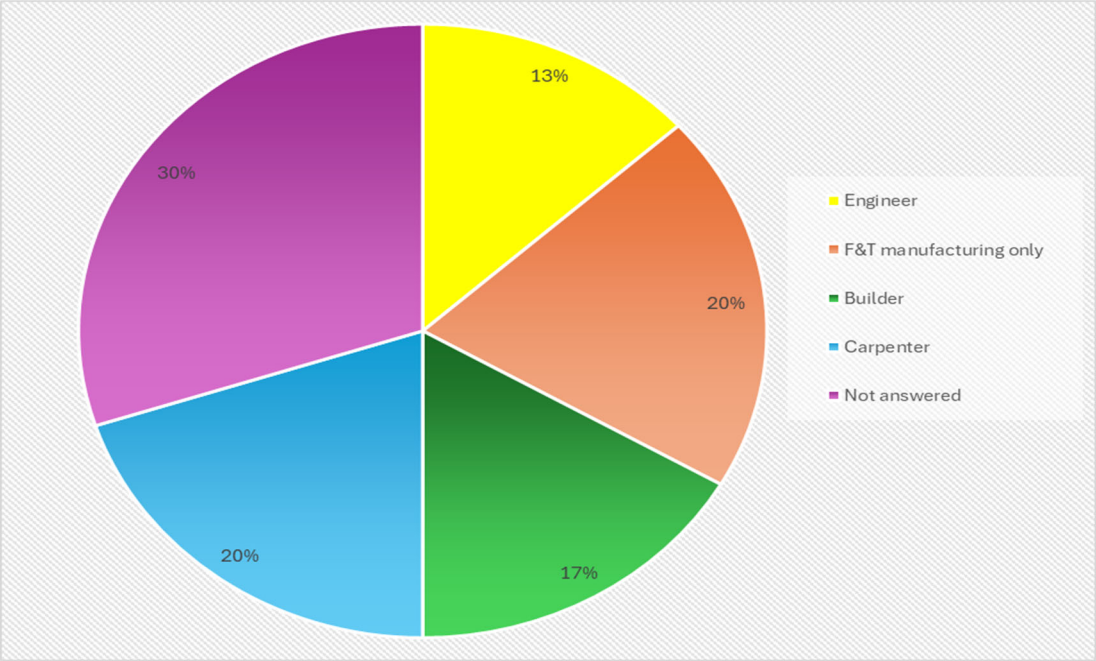

Figure 2: Proportions of F&T interview participants by work backgrounds.

Figure 3 shows the distribution of F&T manufacturers interviewed by years of operation, ranging from less than 10 years to more than 50 years. The most common categories were companies operating for over 50 years (25%) and those operating for 30–39 years (25%).

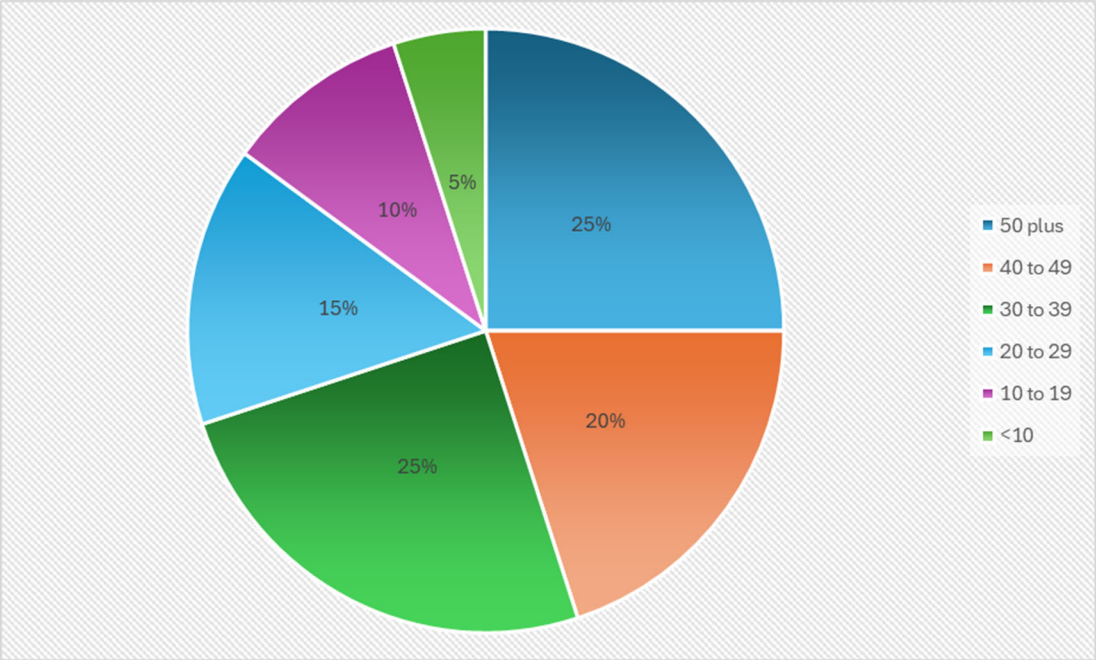

Figure 3: Distribution of F&T companies interviewed by years of operation

Figure 4 shows the distribution of F&T manufacturers interviewed by number of employees, ranging from fewer than 19 to more than 100. The most common category was companies with over 100 employees (29%), followed by those with 60–69 employees (19%) and 20–29 employees (19%).

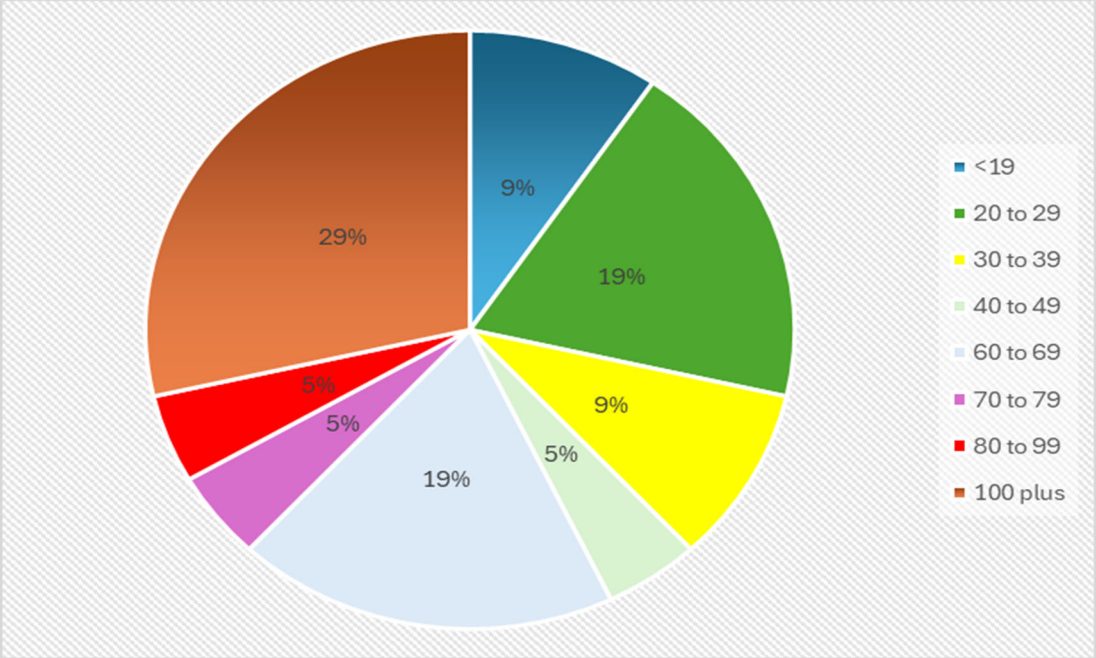

Figure 4: Distribution of F&T manufacturers interviewed by numbers of employees

GENERAL INDUSTRY OVERVIEW INSIGHT & MARKET DYNAMICS

GENERAL OVERVIEW

There are over 280 F&T plants in Australia which supply structural timber components for about 85% of new homes and also process about 2.5 million m^3 of sawn framing annually [7]. Timber framing is the dominant construction choice in Australia's detached and semi-detached housing market [8].

The demand for timber frames and trusses in Australia moves in line with housing starts, population growth, immigration, household income and employment [9]. There is a linear relationship between housing completions and sales of timber products based on Australian Bureau of Statistics (ABS) building activity data and Forest and Wood Products Australia (FWPA) timber sales volumes [10]. Government stimulus measures such as First Home Buyer grants and the recent HomeBuilder Scheme are also important drivers of growth [9].

The sector is pre-dominantly prefabricating wall frames, roof and floor trusses to design specifications (Figure 5). However, most suppliers also provide ancillary building materials. F&T manufacturers mainly cater to the residential market, producing systems for one- and two-storey detached homes, and in some cases for buildings up to four storeys. They also supply

commercial projects such as schools, childcare centres, hospitals and correctional facilities [9]. The manufactured frames and trusses are transported to site and are usually installed by builders. Most F&T plants are now using specialised engineering and layout software, principally provided by MultiNail, MiTek and Pryda in Australia, for structural design and optimisation. Also, many companies are using automated saws and CNC systems for high-precision cutting and assembly.

Figure 5: Timber wall frame (L). Timber truss being assembled (R)

COMPETITION AND SHIFT IN MATERIALS

The interviews revealed that some key challenges for the sector include competition from non-timber systems, such as steel framing (Figure 6), and brick (particularly in Western Australia). In particular, steel competition is rising, especially in ACT and Queensland, due to:

- Increasing cost competitiveness.
- Improved straightness, uniformity and absence of defects.
- Advantages to builders as no rectification of the frames (out-of-plane straightness) is required onsite, especially an advantage given labour shortages within the industry.
- Termite resistance promotion.
- Simplified supply chain compared to timber.
- Much less complexity compared to timber in terms of the number of grades and other product variations.

Figure 6: Steel house frame

There is also a rising trend in the use of steel webs in floor trusses (Figure 7). Also, in some regions in Australia (e.g. NSW), I-joists appear to be currently more competitive than pre-fabricated floor trusses.

Some F&T companies, especially the larger ones now provide both timber and steel frames and trusses to give their clients the options for both.

Figure 7: Floor trusses with steel webs

Additionally, LVL use (Figure 8 and Figure 9) in the Australian F&T sector is growing rapidly, increasingly displacing sawn timber mainly because of:

- Improved straightness, uniformity, stability.
- Increasingly competitive prices from imported materials.

All the F&T companies interviewed were using LVL, with their reported estimated LVL usage as a percentage of the total frames and trusses they manufacture shown in Figure 8.

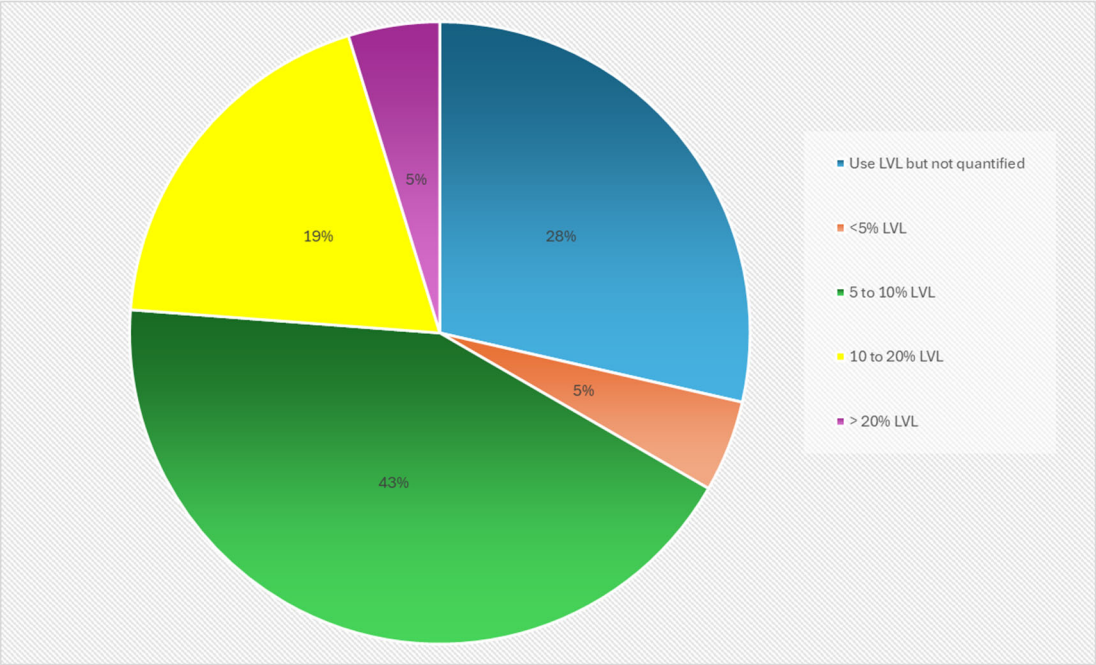

Figure 8: Percentage of F&T companies reporting different proportions of LVL used in F&T manufacturing from <5% to >20%

One F&T company reported that approximately 25% of the total timber used in their frames and trusses is now LVL. However, as shown in Figure 8, most F&T companies indicated that LVL currently accounts for less than 20% of their total timber usage. Several interviewees also noted that some builders are now specifying LVL for all wall frames, replacing traditional sawn timber, with LVL increasingly preferred over MGP 12 and MGP 15 (see next section). LVL is predominantly used in wall frames and roof trusses, with more limited use in floor trusses. This increasing shift to LVL represents a significant challenge for the traditional Australian sawmilling sector.

Despite its growing adoption, 9 F&T interview participants (43%) and 2 timber suppliers expressed concerns regarding LVL, particularly its higher weight, sharper edges, and the presence of some lower-quality imported products that have exhibited performance issues such as delamination, swelling when exposed to weather, and splitting during fastening. Notably, three of these nine F&T manufacturers reported that after securing more reliable, better quality LVL suppliers, these quality issues were no longer occurring.

Figure 9: LVL being used in the F&T sector

Glulam (Figure 10) is also used by the F&T sector, however to a much smaller extent (not quantified in this study) compared to sawn timber and LVL.

Figure 10: Hardwood Glulam at F&T plant

OTHER CHALLENGES AND AUTOMATION

Other challenges noted by interviewees included periodic supply-chain pressures, such as fluctuations and competition between sawn timber, LVL and steel pricing, along with periodic limited or no availability of required timber grades, and manufacturing capacity constraints. Ongoing shortages of skilled labour were also identified as a persistent concern across the sector.

It was reported that automation and robotics adoption (Figure 11) is increasing, driven by:

- Safety concerns and rising insurance costs.
- Labour shortages (particularly skilled labour) and high wages.
- Productivity gains.

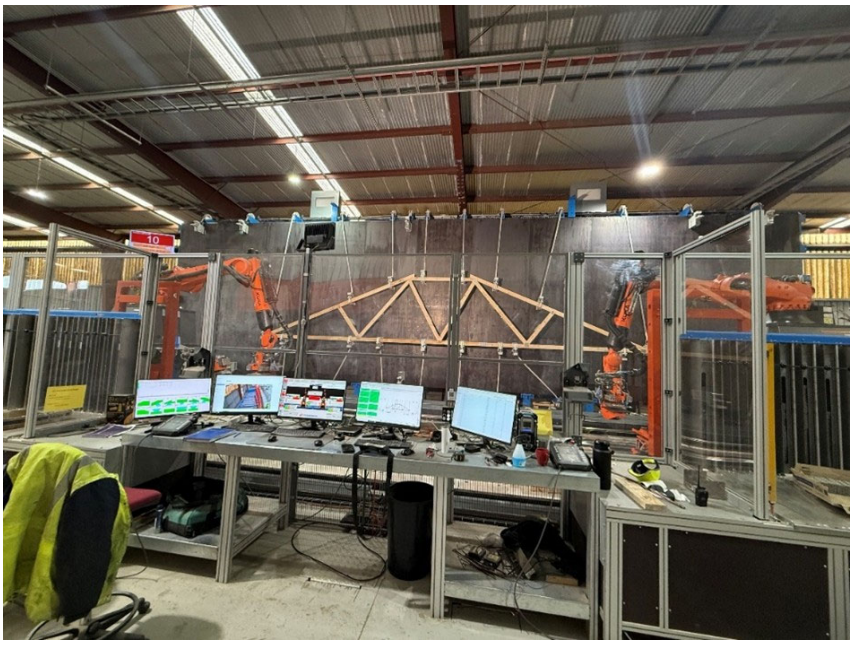

Figure 11 Robotic assembly of roof trusses at an Australian F&T plant

It was observed that roof & floor truss production is commonly more automated than wall frames. This is because wall frame manufacturing is harder to automate and usually requires more human intervention because of the placement and positioning of different types of studs, noggings and other components.

FUTURE MARKETS

The F&T sector is also looking to move beyond just detached and semi-detached housing and looking to capitalise on opportunities for the use of light weight timber framing in the mid-rise sector [11]. There also appears to be a general trend towards modern methods of construction (MMC) and interest in more off-site pre-fabrication, potentially encompassing semi-closed and fully closed panels [7].

CURRENT TIMBER USAGES & GRADES

CURRENT USAGES

Local softwoods (e.g. radiata pine, southern pine, maritime pine) dominate supply, supplemented by a significant use of imported sawn timber such as Baltic pine. The reported range in use of imported timber by the F&T manufacturers interviewed varied from 0 to over 50%, as illustrated in Figure 12. Apart from sawn timber, the majority of F&T companies interviewed also reported that they were buying imported LVL.

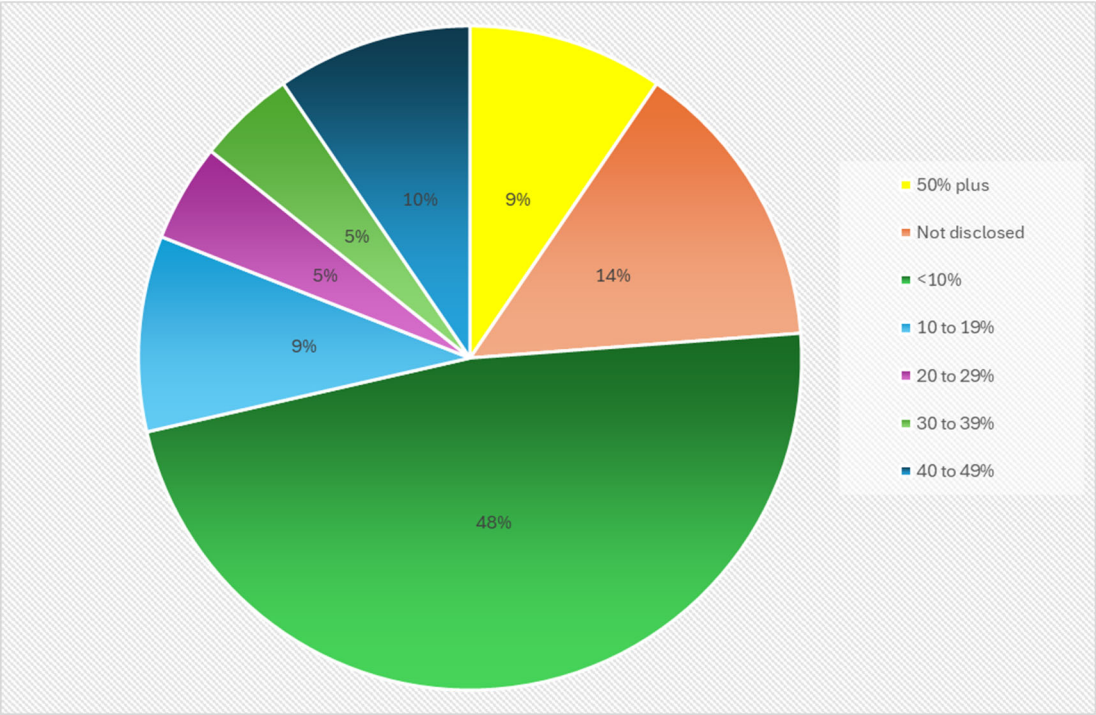

Figure 12: Percentage of F&T manufacturers reporting different proportions of imported timber usage from <10% to 50% plus

One of the reasons for using imported timber is that F&T companies like to diversify their timber supply to ensure resource security and continuity. Eight F&T manufacturers (38%) commented that they would like to be able to use more local timber, however they often struggle to be able to get consistent supply of required grades from local producers. They also like to keep imported timber supply chains open so that they are always in place for situations when there is extremely high demand for timber.

Six F&T manufacturers (29%), two timber suppliers and one software/equipment/connector provider stated that they considered imported Baltic pine to be of superior quality to locally produced timber, particularly with respect to straightness, stability and knot characteristics. However, views on this issue were mixed: six other F&T manufacturers (29%) expressed a preference for the quality of local timbers (stating that Baltic pine was more prone to splitting), while a further three (14%) reported seeing no meaningful difference between the two sources. Most F&T manufacturers commented that there was significant variability in the quality of timber amongst both local producers and importers. It was also frequently mentioned that Baltic pine is not commonly used for trusses in Australia because of its different joint group and nail plate requirements. Therefore, local sawn timbers appeared to be more commonly used in trusses than imported sawn timbers.

In the F&T sector, the predominant sawn timber dimensions are 90 × 35 mm and 90 × 45 mm, while 70 mm-wide timber remains a common choice in Queensland.

Small amounts of sawn hardwoods (not quantified in this study) are used for specific applications (e.g. for high strength or aesthetic reasons), but this appears to be rapidly declining due to price and declining availability compared to other options such as softwood timber, LVL and glulam.

The most common softwood sawn timber grade used by the Australian F&T sector is by far MGP 10 with all of the F&T manufacturers stating that it was the most common structural grade that they use. This finding has also been recently reinforced by the work undertaken by Gattas et al. [12] which showed that in a study of wall frame and roof truss production in Queensland and NSW that timber consumption is dominated by MGP10-grade material in 90 x 35 mm sections.

The following observations were made:

- MGP 12, MGP 15, F5, F7 and F4 are also used, but in lower volume, with F4 seeming to be mainly used in noggings.
- LVL is however often used as a substitute for MGP 12, MGP 15 and higher grades, with 3 F&T manufacturers (14 %) reporting that this was because they often struggle to get reliable and continuous supplies of these higher sawn timber grades. This increases reliance on LVL.
- Four F&T manufacturers (19%) mentioned that they often had trouble sourcing consistent supplies of F7 and F5 from sawmills, given the production focus on MGP 10, and this was another reason why they didn't use grades less than MGP10. These F&T manufacturers also mentioned that they often had to use higher structural grade timber than necessary according to the design requirements because they couldn't source lower grades reliably.

Another comment mentioned by five interviewees (1 industry expert, 3 timber suppliers and 1 software/equipment/connector provider) was that interest in and demand for sub MGP 10 grades will grow substantially during periods of major housing demand and MGP supply shortages.

All F&T manufacturers interviewed also reported that they commonly use more than one structural grade in wall frames.

Based on the interviewee responses, in Queensland, NSW, ACT and WA most of the timber used in frames and trusses is treated (Figure 13) – usually to H2, H2F or H3. The Victorian F&T manufacturers interviewed only reported that a small proportion of the timber that they use was treated.

Figure 13: Packs of treated sawn timber at a F&T manufacturer

Challenges encountered with sub MGP 10 grades

Challenges noted by F&T manufacturers with attempts to use greater quantities of out-of-grade grade sawn timber (sub MGP 10) included:

- Quality concerns (distortion, instability). Historical problems with F5 quality were reported by 11 (52%) of the F&T interview participants, with the perception of quality problems still persisting.
- Nine F&T manufacturers (43 %) and 1 timber supplier also commented that many modern builders do not want to spend time re-working or correcting quality problems, such as distortion in the timber, that they believe to be more common in grades less than MGP10. However, this varies within the industry and regions, with some builders happy to use grades lower than MGP 10, such as F5, in wall frames.
- Limited price advantage of F5 (or other sub-MGP 10 grades) over MGP10, making it not worthwhile for many F&T manufacturers.
- Complexity in stocking multiple grades, increases risk of misuse at F&T plants, especially with unskilled labour and language difficulties with some workers.

F5 use was reported across most states to be often used for on-site stick-built framing as opposed to off-site pre-fabricated frames and trusses.

F&T plants often cut short studs, noggings, blocks, webs and packing pieces as recovery products using timber that is rejected from other F&T components during manufacture (Figure 14). Therefore, these product items are often sourced from the lower quality pieces/parts and offcuts.

Figure 14: Blocks cut out of reject boards from MGP 10 packs

RELAXATION OF UTILITY REQUIREMENTS

The interview process revealed very strong opposition from 81% of F&T manufacturers to relaxing the AS/NZS 1748.1 [1] utility standard requirements and many F&T manufacturers advocated for better timber quality. The key reasons for this are:

- Current utility requirements are already considered too lenient. In practice, many timber producers supplying the F&T sector apply stricter in-house grading rules beyond the minimum requirements of AS/NZS 1748.1 [1]. These enhanced criteria developed in consultation with F&T manufacturers typically focus on improved straightness, stability consistency as well as reduced knots and other defects.
- Automation and robotisation demand higher timber quality in terms of straightness and defects.
- Straightness and distortion limits are critical to produce frames accepted by the builders and defects such as wane, splits, knots can cause manufacturing and safety problems (Figure 15).
- Customer expectations: builders and consumers demand visually appealing timber frames and trusses.
- Increases in competition from steel and usage of LVL, both straighter, more uniform and with minimal defects. Some F&T manufacturers reported concerns about losing market share to steel if they started using lower sawn timber quality with higher distortion.
- Lower qualities increase wastage, reduce efficiency and productivity (Figure 15).

The remaining 19% of F&T manufacturers interviewed indicated they would consider limited relaxation for specific grade characteristics namely wane and splits but only under two conditions:

1. The timber price was sufficiently favourable, and
2. Builders also agreed to the change.

One industry expert and a software/equipment/connector provider also suggested that it may be feasible to relax limits on characteristics such as wane, want and resin pockets, provided such changes were acceptable to builders. However, they were clear that relaxing distortion limits would not be acceptable.

It was further noted by one timber supplier and one software/equipment/connector provider that less-automated F&T plants may be better able to accommodate lower-grade timber within their manufacturing processes. In addition, five interviewees - one F&T company and four timber suppliers - suggested that lower-grade timber is generally more compatible with onsite stick-built framing than with off-site prefabrication. Their view was that onsite construction practices tend to be more tolerant of lower timber quality than prefabricated manufacturing environments.



Figure 15: Timber grade characteristics that can cause problems during F&T manufacturing. Knots and resin pockets (Top Left). Spring (Top Middle). Resin pocket (Top Right). Wane (Bottom Left and Bottom Middle). Wasted offcuts (Bottom Right).

INTRODUCTION OF NEW STRUCTURAL GRADES

Despite the reluctance to relax utility quality requirements in the majority of F&T manufacturers interviewed, there was stronger interest (from 85% of F&T manufacturers interviewed) in developing alternative, fit-for-purpose grades or solutions that could increase utilisation of Australian softwood sawn timber in the F&T sector.

Conditions for acceptance of new grades that were noted by the interviewees included:

- Must comply with relevant standards and be approved by engineers, detailers and software providers.
- Must be accepted by builders and consumers; consistent quality and reliable, continuous supply.
- Price must be competitive and strategically positioned against imports and existing MGP grades.
- Must be suitable for automated manufacturing; straightness remains critical.
- Must work across the entire supply chain including for timber producers (sawmills) and timber distributors.
- Must be clearly different to those grades already available, e.g. from F4 to MGP15

Concerns about introducing new structural grades that were noted by the interviewees included:

- Added complexity and production inefficiencies, limited floor space.
- Risk of confusion and mistakes during manufacturing with too many grades.
- Concerns about the stability and straightness of 'core-wood', which constitutes a large portion of out-of-grade/lower-grade timber targeted as part of this project.

Potential opportunities for new grades that were noted by the interviewees included:

- Use for internal non-load bearing walls, short studs, truss webs, all requiring lower mechanical properties.

- The possibility to create lower MGP grades (e.g. MGP6 and MGP8) as alternatives to F grades. This would provide a better market perception if straightness and distortion tolerances are acceptable.
- Adoption would be facilitated in less automated plants or on-site framing building contexts.

Additionally, promotion and supply chain alignment were viewed as essential for successful introduction of new grades.

However, one industry expert, one timber supplier, one software/equipment/connector provider and two F&T manufacturers noted that some previous attempts to introduce new structural grades into the Australian F&T sector have not succeeded. They attributed these failures to several factors, including confusion and added complexity created by additional grades, concerns within the sawmilling sector about how new grades would be priced and the potential erosion of prices for existing structural grades, and a perception that new grades could increase competitive pressure from imported timber.

One alternative suggestion recorded by one of the timber suppliers interviewed was that instead of introducing generic new structural grades (e.g. MGP 6 or MGP 8), a better strategy would be to introduce grades for specific fit-for-purpose products or components. This would include for instance load-bearing or non-load-bearing wall studs for specific wind regions and floor-to-floor heights, and truss webs. These products would be sold as fit-for-purpose for the specific above mentioned applications. This would most likely result in increased productivity and reduced wastage at F&T plants, as the products would be sold to the plants in the correct size and can be directly used. It is noted that one Australian company is already implementing this by supplying cut-to-size, fit-for-purpose, finished F&T components recovered from out-of-grade timber. On the contrary, it was also noted that some F&T manufacturers may prefer the flexibility of longer length generic grades which gives them options for cutting different sized F&T components as needed depending on the fluctuating demands of their customers and where intended final installed applications are not known from the outset. Longer length timbers allow the F&T manufacturers to have more docking-to-length options. Additionally, some F&T manufacturers are already using F5 for internal non-load bearing walls, different stud types and truss webs. Recent work by Gattas et al.[12] highlighted that internal non-load-bearing wall frames are a strong candidate for down-grade substitution. Their analysis shows that this component accounts for 27–29% of timber consumption in single- and double-storey dwellings.

Wespine in Western Australia has successfully commercialised three new grades for specific residential construction applications that utilise fibre previously classified as out-of-grade. These include “STUDMATE” for wall studs [13], “WESBATTEN” for roof battens [14], and the “MASONRY TOP PLATE (MTP)” [15].

STUDMATE is used in Western Australia’s growing timber wall-framing market, where timber framing combined with brick veneer is rapidly gaining market share. It is a fit-for-purpose wall stud produced through a specialised grading and selection process that targets fibre unsuitable for MGP10 but still providing mechanical properties and utility requirements suitable for framing.

The WESBATTEN grade is used as a roof batten for sheet-metal roofing and is suitable for both timber-truss and stick-built roof systems where sheet metal is the roof cover. WESBATTEN offers higher bending strength than MGP10, although with lower stiffness.

The MTP grade is designed for the brick-wall housing market, with sales closely tied to brick-walled housing activity where brick construction is paired with a timber roof structure.

Both WESBATTEN and STUDMATE have been incorporated into some commonly used truss and frame design software for several years.

OTHER OPTIONS TO UTILISE OF OUT-OF-GRADE TIMBER IN THE F&T SECTOR

Figure 16 shows suggestions by interviewees on other potential options to increase timber recovery and utilisation of out-of-grade timber in the Australian F&T sector:

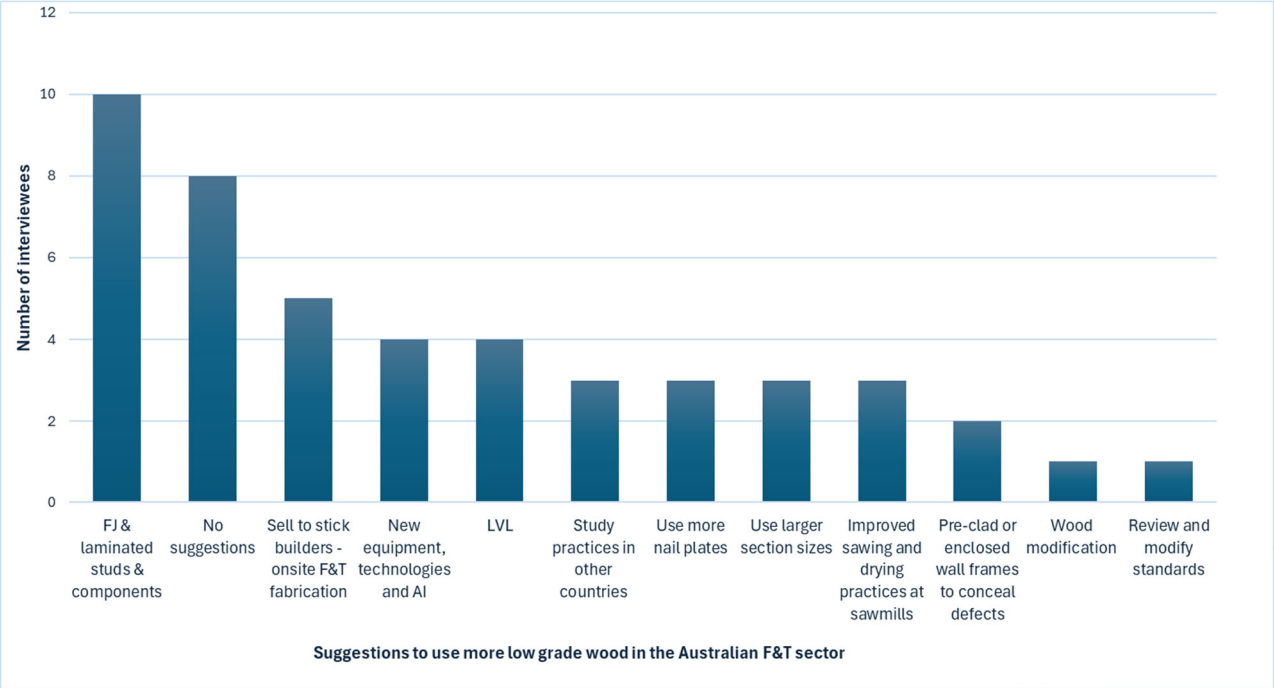

Figure 16: Suggestions by interviewees about how to increase use of low-grade timber in the F&T sector

These suggestions included:

- Finger-jointed (FJ) and/or laminated studs (Figure 17) and other F&T components from small sections of out-of-grade timber:
  - This was the most common suggestion, with 10 interviewees (7 F&T manufacturers, 1 software/equipment/connector provider and 2 timber suppliers) recommending this option, as indicated in Figure 16.
  - Such products are used internationally, and they are also currently being imported into Australia by StoraEnso [16] (Figure 17). They would provide straighter products, solving one of the main perceived issues with out-of-grade timber.

- It was reported by 1 timber supplier that a past trial commercial application in Australia reportedly failed due to the import of glue laminated studs made with non-structural adhesives that didn't perform – this created a negative perception in the market.
- Lamination could be through adhesives or nails (or other types of metal fasteners).

Figure 17: Glue-laminated studs (source StoraEnzo - https://www.bigrivergroup.com.au/wp-content/uploads/2016/05/SE_Glue-Laminated-Structural-Timber_A4_low.pdf)

- Using lower-grade timber in onsite stick-built framing (suggested by five interviewees: one F&T manufacturer and four timber suppliers), based on the view that onsite construction is generally more tolerant of lower timber quality than prefabrication.
- Adopting advanced technologies in F&T plants, including AI-enabled systems, scanners, sensors, specialised optimisation software and robotics, to improve detection, sorting and utilisation of lower-grade material (suggested by four interviewees: two F&T manufacturers, one connector/software/equipment provider and one industry expert).
- Increasing production of LVL rather than sawn timber, which four interviewees (two F&T companies and two timber suppliers) believed would improve overall resource recovery and enable greater use of lower-quality wood.
- Examining overseas F&T practices to better understand the timber qualities, manufacturing methods and design approaches used internationally that could support greater utilisation of low-grade timber in Australia (suggested by three interviewees: two F&T manufacturers and one software/equipment/connector provider).
- Increasing use of steel connectors such as nail plates to join short lengths of timber and reinforce lower qualities (suggested by three interviewees: one F&T manufacturer, one software/equipment/connector provider and one industry expert).
    - This approach has been used previously in Australia during timber shortages.
    - It could increase recovery rates, provided it remains economically viable.
- Using larger cross-sectional sizes to expand the suitability of lower-grade timber for structural applications (suggested by three interviewees: one F&T company, one timber supplier and one industry expert).
- Improving sawing and drying processes at sawmills to produce straighter and more stable timber (recommended by three interviewees, all timber suppliers).

- Using pre-clad, sheeted or otherwise enclosed wall frames supplied as prefabricated panels may help mask natural timber characteristics and visual defects, thereby reducing aesthetic concerns associated with lower-grade timber (recommended by two F&T manufacturers).
- Modifying timber to enhance straightness, stability, mechanical properties and appearance (suggested by one F&T manufacturer), including:
    - Chemical modification
    - Thermo-mechanical modification
- Exploring opportunities within standards and building codes to facilitate greater use of lower-grade timber (suggested by one software/equipment/connector provider).

Interviewees also consistently emphasised the need for broader education across the F&T supply chain including manufacturers, builders, building inspectors and homeowners about timber's natural characteristics and its fitness for purpose, even when visual imperfections are present. This was seen as essential for supporting the acceptance of products made from out-of-grade timber.

CONCLUSION & RECOMMENDATIONS

Consultations across the Australian F&T sector revealed strong consensus on the need to identify viable pathways for increasing the utilisation of Australian-grown timber in F&T manufacturing. However, most stakeholders were clear that, under current market conditions and economic pressures, relaxing existing F&T timber MGP utility quality requirements (AS 1748.1 [1] is not an acceptable option. Growing competition from LVL and steel, combined with customer expectations and material-pricing dynamics, reinforces the importance of maintaining current quality thresholds for characteristics such as distortion, wane, want, splits, knots and resin pockets.

There was genuine interest in exploring alternative structural grades provided they are demonstrably fit for purpose and meet, at minimum, existing MGP utility quality requirements (AS1748.1 [1]), particularly in relation to straightness. Potential pathways discussed included the creation of lower MGP grades (e.g., MGP 6 and MGP 8) and purpose-designed products tailored to specific F&T applications, such as internal non-load-bearing studs or truss webs.

Introducing any new grade would require addressing several significant challenges. New products must perform reliably and be compatible across the entire supply chain, from sawmills to F&T manufacturers, builders and homeowners. They must also be competitively priced, consistently available, and shown not to compromise economic viability or productivity at any stage.

Stakeholders identified a range of opportunities, beyond the relaxation of quality requirements or the creation of new structural grades that could support greater utilisation of lower-grade timber in the F&T sector:

- Expand the use of EWPs such as LVL, finger-jointed members and laminated studs to improve recovery rates and increase the efficient use of Australia's forest resources.

- Explore the use of larger cross-sectional sizes to broaden the suitability of lower-grade timber for structural applications.
- Adopt advanced technologies in F&T plants, including AI-enabled systems, scanners, sensors, specialised optimisation software and robotics, to improve detection, sorting and utilisation of lower-quality material.
- Increase the use of nail plates and other steel connectors to compensate for lower timber qualities and enable the use of shorter or lower-grade lengths.
- Improve sawing and drying processes at sawmills to enhance straightness, stability and overall consistency of lower-grade outputs.
- Investigate wood-modification technologies, including chemical and thermo-mechanical processes, to improve straightness, stability, mechanical properties and appearance.
- Review international F&T practices to identify approaches that could be adapted to the Australian context to support greater use of low-grade timber.
- Update relevant Australian standards and building codes to better accommodate the use of lower-grade timber products where appropriate.

Finally, interviewees consistently emphasised the need for improved education across the F&T supply chain, including manufacturers, builders, building inspectors and homeowners, to strengthen understanding of timber's natural characteristics and its fitness for purpose, even when visual imperfections are present. Enhanced education and communication will be essential for supporting market acceptance of products manufactured from out-of-grade timber.

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APPENDIX A: INTERVIEW QUESTIONS

Attendees:

Date:

Background (including information obtained through the tour of the manufacturing facility)

Experience (F&T manufacturers only):

1. How long have you worked as a frame and truss manufacturer?
2. How would you describe your work background/ role: carpenter, builder, building trade, engineer, project manager, design systems officer, business owner?
3. What is your current role in the company?

Business type/ market:

4. Can you briefly describe the type/scale of work you do with timber wall frames, roof and floor trusses?
5. How many people are a part of the business and for each area eg factory floor, sales, design etc? How would you describe your market/ area? Prompt: do you supply to the very high-volume building companies or smaller to mid-size companies?
6. What level of automation and prefabrication (e.g. from pre-cut members to semi to fully panelised) is used for wall frames, roofs and floor trusses?
7. What are the main timber species used?
8. Size, grade and specification of the timber, what sorts of material they are using?
9. What proportion is sawn timber versus engineered wood products (e.g. LVL, glulam)?
10. What proportion of the timber used is imported?
11. What proportion is not timber (e.g. steel)?

Challenges

12. Would you accept higher levels of imperfections (e.g. wane, want, bow, spring, twist, cupping, splits, resin etc) (but keeping same structural grades and not effecting structural performance) than those in the timber that you are currently buying, particularly in a timber supply shortage market situation? If yes, which type of imperfections and to which levels? If no, what are the reasons? Prompt- What problems do lower grade timber cause? e.g. in manufacturing, installation, aesthetics, productivity, equipment requirements, more staff etc
13. Which particular frame and truss components/parts do you think offer the best opportunities for use of an alternative, fit-for-purpose structural grade wood, but which may have lower structural properties than what you are currently using?
14. Would you be ok replacing only one particular component of a wall or truss (for example only replacing the jack studs or junction studs) or would you prefer replacing all the components of the wall or truss with a new fit-for-purpose, lower structural grade wood?

15. Do you see potential/opportunities for the development of fit-for-purpose custom grades to suit currently out-of-grade timber use in frames and trusses? For particular applications? (This question would apply only if not already answered well enough through the previous questions)
16. Additional, to what may have been covered above, do you have any suggestions on how greater quantities of out-of-grade/ lower grade timber could be used for frames and trusses? What would need to happen to achieve this objective?