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Timber in multi-residential, commercial and industrial building: Recognising opportunities and constraints

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**Timber in multi-residential, commercial and
industrial building:
Recognising opportunities and constraints**

Prepared for

Forest & Wood Products Australia

by

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**Forest & Wood
Products Australia**
Knowledge for a sustainable Australia

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Executive Summary

This report explores the potential for the timber and wood products industry to increase the use of its products in building construction, particularly in the *Class 2 to 9* multi-residential, commercial, and public building sector.

There are opportunities for industry in this sector. A small but growing section of the building design and building professions have developed an interest in timber construction for *Class 2 to 9* building. This is largely an underdeveloped market that has the potential to generate significantly additional sales if strategically developed. With targeted marketing, there is the potential to establish markets for products that are not accepted in *Class 1* construction, such as high-feature and lower grade timber. The sector is open to new prefabricated solutions.

It is in industry's interest to diversify its markets. Pressure is building for major structural change in house construction in Australia. The estimated current undersupply of 23,000 dwellings annually represents an unavoidable 10% market loss to industry. Further market loss will result from an increased shift from *Class 1* to *Class 2* apartment buildings.

The industry has strengths in the *Class 2 to 9* building sector. It is already an established market, consuming between 10% and 15% of material produced. Some sections of the industry specifically service the sector. Industry has sufficient technical solutions to economically and successfully include more timber in a wide range of *Class 2 to 9* projects. The current product suite is versatile and supported by an efficient and flexible fabrication sector. With strategic developments, this sector is capable to deliver more extensive solutions.

The industry has weaknesses in the *Class 2 to 9* building sector. These form the major constraints on increasing sales. The timber and wood products industry, and due to a lack of engagement, the building industry, do not have sufficient staff with the skill and expertise necessary to use timber in construction in the *Class 2 to 9* sector regularly and effectively. Engagement with building design professions is critically. The building products industry is highly competitive and unsupported systems can quickly be overshadowed. Unfortunately, the timber industry has generally resisted regular interaction with the building design professions.

Industry's technical capacity in building is not high. Major technical skill in building probably rests with the few specialist fabrication companies operating in Australia. Technical support outside of producer companies is limited and declining. Several regional timber support organisations have closed or withdrawn services. Educational opportunities are very limited.

This report recommends that to capture the significant opportunities for increased sales present in the *Class 2 to 9* construction section, industry act to build its own capacity in timber design and construction, and support increased capacity in these areas in the building design professions and the general building industry. This action should include:

- Incorporating the opportunities and constraints included in Section 7 of this report into the industry's market development plan.
- Review and increase funding for general technical and educational support.
- In cooperation with industry members, initiate two broad campaigns as vehicles for increasing confidence and skill. These campaigns are:
 1. Save money and carbon, use timber in structures.
 2. Timber in comfortable interiors.

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Introduction

This report explores the potential for the timber and wood products industry to increase the use of its products in building construction, particularly in *Class 2 to 9* multi-residential, commercial, and public buildings. Specifically, it explores the opportunities and constraints to increasing this use.

There is value in defining the key terms in this. *Timber and wood products* means the full range of sawn, moulded and glue laminated timber and engineered wood and fibre products used in building. The Building Code of Australia (BCA) classifies buildings by type in accordance with their use and the perceived risk to occupants. *Class 1* building is attached or detached housing. *Class 2 to 9 buildings* include most other building types. Given the importance of this classification system in the design and construction of buildings, BCA's building classes, set out in Table 1 of Section 2, are used as a key reference throughout this report. *Opportunities and constraint* are held to be regulatory, technical, organisational, market and other characteristics of the Australian building and the timber and wood products industry that can practically influence timber's use in these types of buildings. Events unlikely in the short term, such as the wholesale introduction of sophisticated wood fabrication technology into Australia, are not discussed.

The building construction sector is the major market for timber and wood products and a major segment of the Australian economy. In the June quarter 2009, building work was worth \$17.2 billion on trend estimates (ABS 2009) with residential (new and altered *Class 1* and 2 building) building worth about \$9.7 billion and non-residential building (*Class 3 to 9* building) about \$7.5 billion. Engineering construction, such as roads and bridges, was worth a further \$18.2 billion for the quarter. In late 2009, about 80% of residential buildings approved for construction were *Class 1* houses. The relative value of residential and non-residential building can fluctuate considerably. Over the last decade, the value of non-residential construction has been as low as 50% and as high as 79% of the value of residential construction. See Figure 1.

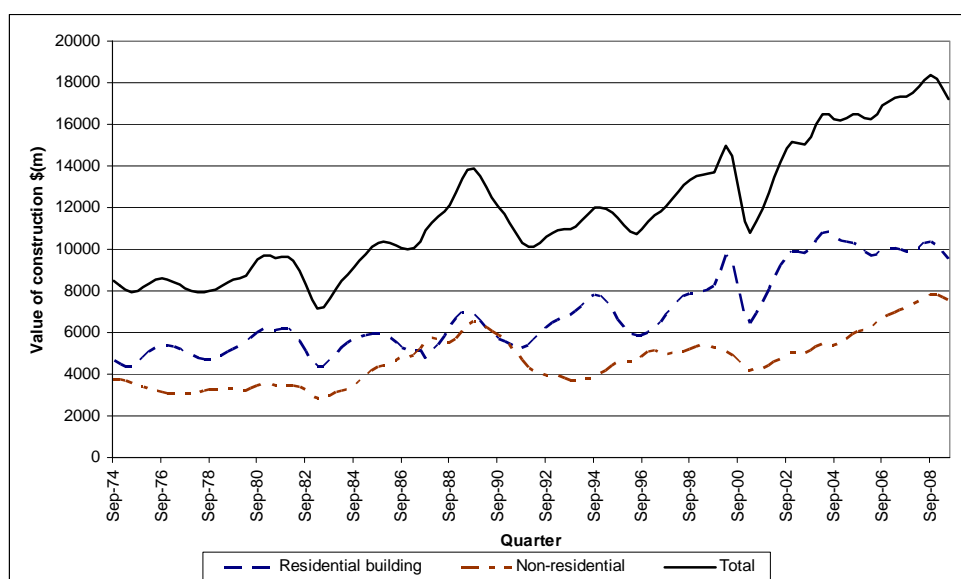


Figure 1: Value of building construction per quarter in trend terms (ABS 2009b)

For the timber and wood products industry, *Class 1* residential building (new houses and extensions to existing dwellings) is the dominant market section. In 2008, the construction of Australian residential building was estimated to account for approximately 70% of total

apparent sawn timber consumption (BIS Shrapnel 2008). Use of engineered wood and fibre products was probably similarly concentrated. By contrast, timber's penetration into the non-residential and engineering construction market is generally low, with probably between 10% and 15% of sales on average being used in non-residential building.

The timber and wood products industry concentrates strongly on servicing the *Class 1* building sector. Housing is the most valuable, least technically demanding and most democratic sector of the Australian building industry. People of all skill levels build and renovate housing all over Australia. This suits timber construction, as it is inherently easier and cheaper for either a house builder or do-it-yourself exponent to make or renovate residential scale buildings with wood than other major building materials. Timber construction is generally more economic, lighter, and more versatile than comparable building systems and uses simpler jointing methods and tools. Timber also comes in a broad product suite in a variety of species and configurations (sawn solids, plywoods, laminated veneer lumber {LVL}, glulam, and fibreboards) for both structural and appearance applications.

Historically, the timber and wood products industry has not serviced the *Class 2 to 9* building sector well. While there has been periods of notable activity in non-residential buildings (Nolan 1994), these have generally been local, minor and relatively short-lived. While the current product suite can bring the construction benefits obvious in *Class 1* building to many non-residential building projects, servicing the *Class 2 to 9* building sector is intrinsically more difficult than the *Class 1* market. As will be discussed in detail below, technical and service demands are higher; more varied, and have varying support levels. Building design professionals such as architects, engineers and quantity surveyors are involved in the process. Regulations are more complex and participants must maintain or have access to expertise in advanced structures and material effects, fire performance, acoustic separation and construction programming. While more difficult, *Class 2 to 9* buildings generally operate on higher cost basis than most *Class 1* building, and companies operating effectively in the *Class 2 to 9* market appear to do so profitably.

While the general wood industry has focused on *Class 1* construction, building designers have developed an interest in timber construction for *Class 2 to 9* building. Between 2003 and 2008, the value of all non-residential construction increased dramatically against a relative flat housing market. In 2008, key industry members noticed that three trends appeared to be encouraging developers and building professionals to consider economic alternatives to steel in the commercial and industrial building markets, presenting an opportunity for timber construction. These trends were:

- *Price.* In the three years to September 2008, the price of structural and reinforcing steel rose considerably and more price rises were flagged. This improved the relative economy of timber structures.
- *Carbon emissions.* Some building clients, especially governments, appeared to have recognized that building materials generate considerable carbon emissions. As part of an emissions-reduction strategy, they were open to considering timber as a preferred material in non-domestic construction.
- *Overseas and local design practice.* Timber was being portrayed as a fashionable and environmentally responsible building material in local and international magazines, journals and in other media. This established in designers' minds the potential for timber in construction.

These trends resulted in increased supply inquiries and sales and key timber and wood products manufacturers and suppliers recognised that their businesses were ill-equipped either individually or as an industry to capitalise on the available opportunities. They collaborated in framing a broad program to increase the use of timber in building by developing the industry's skill and capacity sufficiently to provide building procurers with a competitive range of well-supported, economic and practical solutions for non-residential building. This project is the first project in that program and was framed to:

- Identify the major building elements and types in non-domestic markets open to product substitution with timber.
- Determine the technical and other constraints on timber being used in these building elements and types.
- Match available timber industry and company guides and resources to these constraints and ascertain the gaps between the two.

To achieve these objectives, this report is structured to set out first the factors that appear to generate opportunities and constraints for timber in non-residential buildings, by examining:

- Buildings and their procurement.
- Timber and wood products and their supply.
- Timber use in construction.
- The dynamics of the building market.

It then brings these separate discussions together into discrete opportunities and constraints. In the building industry, opportunities and constraints for any product or service represent an aspect of use that results from specific sets of circumstances or preferences, generally when several often quite different factors act in combination. For example, product X may have an opportunity to increase sales because it has developed a perception of quality, is selectively available and has few ready competitors. Australian building case studies are included throughout the text to illustrate the type of buildings currently being constructed from timber, and highlight project issues.

The timber and wood products industry generally does not supply buildings. They make, fabricate or supply parts of buildings. It is useful to discuss these parts in three scales below the scale of a full building. In increasing detail, the scales used in this report are:

- *Component scale:* Components are the major sections of a building with common or similar performance requirements. In this report, components include:

<i>The superstructure:</i>	The primary load-bearing frame found in most buildings. There may be overlap between this and other components.
<i>The roof:</i>	The roof and roof structure.
<i>Upper floors:</i>	The upper floor surfaces and support structure.
<i>Ground floor:</i>	The base floor and ground support structure.
<i>External walls:</i>	The wall structure and associated cladding and external joinery such as doors and windows.
<i>Internal fabric:</i>	Internal non load-bearing walls, linings, architectural surfaces, and internal joinery.
<i>External elements:</i>	Verandas, decks and associated landscape structures.

- *Element scale*: Elements are the pieces assembled to make up a component, such as the trusses in a roof, the I-beams in a floor, or a window in an external wall.
- *Detail* – Details are the pieces assembled to make up an element, such as the nail-plate in a truss, or the sash of a window.

There is often overlap between particular products and items, especially at the *element* and *detail* scale. For example, a piece of sawn timber can be a joist in a floor (an *element* in a *component*) or a part of a nail plate truss (a *detail* in an *element*).

This report has limitations: everything cannot be included, there will always be exceptions to the points discussed, the commentary will largely reflect the view of those most directly involved, and there is a fine line between being realistic and unduly critical. The *Class 2 to 9* building construction sector is worth about \$30 billion annually and includes every type of new building from a block of apartments to the largest multi-storey office building. Similarly, there are many types of timber products. Even those that look the same can have subtle differences in the market. Clearly, documenting each connotation is impossible. Also, given the size, diversity and geographic spread of the timber and building industry, there will always be exceptions to any general result.

The building process is dynamic and every building process is generally unique in some way. This makes direct comparisons between projects and processes in different locations difficult. The approach taken for this project has been to identify and present the broad patterns of action and influences in the *Class 2 to 9* building sector in Australia, and, working closely with industry members involved in that sector, draw out the major opportunities and constraints from those patterns. So, only broad conclusion can be derived and exceptions to these conclusions will also be found. The benefit of this approach is that the results are likely to be strategically useful: representative of conditions in most cases. The problems with it are that the results may be less useful for a specific product and location.



Figure 2: Softwood members for a nail-plate element

Methodology

The methodology for this project used a mixture of qualitative and quantitative techniques including:

- *Literature review* on constraints and opportunities for timber in the multi-residential, commercial and industrial markets. Since 1997, several major studies have been done on the attitudes of building design professionals to using timber in building. Also, some reflective work on the use of timber in non-residential building was available. Industry's public technical guide and brochure set was also searched and tabulated.
- *Industry interviews*. These occurred in two sets: general preliminary interviews with project partners and interested external design professionals and detailed interviews with key timber production industry members.
- *A limited survey* of timber industry members and building design professionals.
- *Reporting and confirmation*. As it can be difficult to convert day-to-day experience into comment, notes and discussion papers were circulated to participants for confirmation.

The literature review is not reported separately. Its results are integrated into the general discussion. It was originally intended to match opportunities and constraints to industry's technical guides. However, as the study progressed, it became obvious that the major opportunities and constraints influencing timber use in *Class 2 to 9* building result from organisational or market factors. Unfortunately, technical guides do not address these issues.

Separate but similar survey questionnaires were sent to industry members and building design professionals. Designed to gauge use and opinion and to engage industry members in the topic, these questionnaires were emailed as a document to 40 industry members and 180 building design professionals. Response rates were low at 9 and 14 respectively. Consequently, these results cannot be viewed as representative of industry experience, especially of the building design industry. However, the results still have value as general indicators as the respondents were both interested in and experienced with timber in construction. Most of the design professional respondents were skilled timber users, actively incorporating timber in building of all classes. The timber supplier respondents were from various industry sectors and their companies represents a considerable proportion of the timber supply industry. Lastly, several major timber supplier admitted that they did not know where their company's timber was used in building. As this was the focus of the survey, they could not complete it. Unfortunately, no responses were received from the frame and truss sector. A comparison of responses is included in Part 5 where the results are referred to as the CSAW survey. The questionnaires and summary results are attached in Appendix 3.

The in-depth interviews were conducted after initial discussions and circulation of the first discussion paper. An interview schedule is included in Appendix 2. During these interviews, industry members were asked general questions about their company, its product and market strategy and their general experience in the *Class 2 to 9* building market. Interviewees were then asked specific questions about:

- where they felt stress would occur if timber use in the *Class 2 to 9* building market started to increase considerably. In answering this, they were asked to consider first stress caused by regulations, stress in their company, and stress from other factors.
- where they would invest \$100 outside of their company to improve the use of timber in *Class 2 to 9* building market.

By considering pending aspects of stress in their own operations, interviewees were able to describe the key themes that limit timber use in *Class 2 to 9* building for them and cite examples of both successes and problems. They could also quickly identify what they would need to resolve. These themes and priorities have been included in the discussion below.

Reporting on industry interviews has benefits and difficulties. While complex, the building industry still has several consistent characteristics and industry was able to identify regional differences. They were also able to quickly establish priorities. Industry members provided information freely, even though some was potentially commercially sensitive.



Figure 3: Timber structure, lining and joinery in a *Class 3* resort

1. Timber in building

Timber and wood products are used in building construction because they are selected for use during the building procurement process. To understand how this occurs currently and how the use of timber and wood products in building can be increased in *Class 2 to 9* buildings, it is important to understand the three major components of this statement: buildings, the building procurement process, and the place of timber and wood products in that process. Then, it is necessary to explore the connections between these three in a dynamic marketplace before drawing the opportunities and constraints in this process together.



Figure 4: Dry hardwood in a distributor's rack



Figure 5: Central circulation space in a *Class 9b* school

Image courtesy of Spowers Architects

2. Buildings

A building is a man-made enclosure that protects those inside it from the external environment. Buildings vary significantly in complexity, from simple sheds to complex facilities like hospitals. Regardless of the complexity, an individual building represents a long-term and significant investment for those wishing to acquire it. For society, buildings are fundamental to the safety and well being of the community. Given their importance on both an individual and community level, most aspects of buildings are highly controlled and regulated, especially during the design and construction phase.

In Australia, the design and arrangement of new building is regulated through the national Building Code of Australia (BCA). The BCA's goal is to '*enable the achievement of nationally consistent, minimum necessary standards of relevant health, safety (including structural safety and safety from fire), amenity and sustainability objectives efficiently (ABCB 2008)*'. As a performance-based code, the BCA's requirements vary with the importance and perceived risk to occupants of different types and sizes of buildings. As the basis for risk assessment, it separates buildings of different function into distinct *building classes*. These are listed in Table 1.

Table 1: The BCA's building classes

Building Class	Building function
1	Single dwelling unit, detached or attached, not one above another.
2	A residential building with 2 or more sole-occupancy units. Units are often one above another.
3	Hotels, motels, boarding houses, etc
4	Residential part included in a Class 5, 6, 7, 8, 9
5	Office building
6	Shops, including display rooms, restaurants, showrooms, etc
7	Car parks, store buildings or wholesalers
8	Factory or laboratory
9	Public buildings: 9a: a health-care building, 9b: an assembly building, such as a theatre or educational building and 9c: an aged-care building
10	An ancillary building, such as a shed, carport, or other outbuilding.



Figure 6: The structural frame for a Class 3 hotel building

The BCA's major performance requirements for this type of building are structural adequacy, egress, and fire and sound separation across common wall, roof and floor elements.

Performance requirements

Buildings and their *components, elements and details* have requirements on their performance that they must satisfy to be regarded as fit-for-purpose. Performance requirements may be established by regulation and referenced standards, accepted standards of practice and market expectation.

Regulation and referenced standards

BCA provisions significantly affect the use of materials in building. It establishes mandatory *performance requirements* for buildings and their constituent parts and provides two means of demonstrating compliance:

- The *Deemed-to Satisfy (DTS)* provisions. These provide a recipe book approach to compliance. If a submitted building design fits within the parameters of the DTS provisions, it is held to meet the mandatory performance requirements. Given the compromises involved in framing the DTS provisions, solutions that comply by this method are generally conservative.
- *Alternative solutions*. A submitted design can depart from the DTS provisions if it is demonstrated that the building still complies with the mandatory performance requirements. Strict processes are imposed on demonstrating this compliance and these often involve professional assessment and modelling.

While the *DTS* provisions provide a relatively simple BCA compliance path, they are not always the most efficient or economic method. As industry experience with alternative solutions has grown, compliance by this means has becoming increasingly common, especially in multi-residential, commercial and public buildings.

As the BCA can not list every requirement for a building and remain a workable document, many of its requirements are established by referencing standards of practice, mainly Australian Standards. For example, the BCA ensures the structural adequacy of residential timber framing by requiring compliance with *AS 1684 Residential timber-framed construction*. As the BCA has legal force through legislation in each state, compliance with Standards referenced in the BCA is also mandatory.

The major BCA provisions affecting the selection of building materials deal with structural adequacy, protection from fire and in some building classes, sound separation. The BCA's Vol. 1 Section B Structural Provisions require that a building 'withstand the combination of loads and other actions to which it may be reasonably subjected. This section then calls up a series of standards, including *AS 1720.1 Timber structures - Design methods* for all classes of buildings and *AS 1684 Residential timber-framed construction* for *Class 1* residential buildings. Importantly, the loading conditions imposed on a structure under *AS 1170.1 Structural design actions - Permanent, imposed and other actions* are set significantly higher for a *Class 2 to 9* building than a *Class 1* building.



Figure 7: Commercial fit-out in multi-storey office building

The architects often set the performance requirements for floor and lining. To establish a quality benchmark, they often require a test panel be submitted for approval.

The complex and interlinked provisions covering protection from fire are mainly included in Vol. 1 Section C Fire Resistance and Section D Access and Egress. These provisions do not aim to protect the building against fire. They seek to ensure that people in the building can get out safely and limit the spread of fire to other buildings. In their application, these provisions link the class and height of the building to the resistance of the building's construction to fire and the provision of stairs and other forms of egress. Generally, performance requirements increase up to three storeys and then remain at a high but relatively constant level for taller buildings. The fire resistance requirements significantly affect the selection of materials used in building, particularly timber and unprotected steelwork in the *superstructure* and *upper floor* structures of buildings over three storeys, and timber and most other materials in the *internal fabric* in particular classes of buildings.

Vol. 1 Part F5 Sound Transition and Insulation establishes sound separation requirements between sole occupancy units in *Class 2 or 3* building or a *Class 9c* aged care building. Performance requirements are set for the transmission of both airborne and material borne impact sound. Compliance can be difficult for light-weight systems and generally requires multilayered and multi-product solutions.

Accepted standards of practice

As the BCA mainly concerns itself with structural adequacy and fire performance, many performance requirements for building components and elements are set as explicit or implied conditions of contract during the building procurement process. These conditions use accepted standards of practice such as Australian Standards as the performance benchmark. For timber products, the major performance requirements of this type tend to relate to their appearance and external durability. The example of having a strip hardwood floor installed in a new office illustrates this. The BCA only requires that a strip timber floor support occupants safely. It is not concerned with the appearance of the floor. The visual and milling quality of the hardwood used in the floor is often called up in the designer's specification or builder's order by using terms such as *select* or *standard*. These are defined terms in *AS 2796 Timber Hardwood - Sawn and milled products* and their use invoke that Standard, whether the designer or builder recognises this or not. However, there is no Australian Standard for laying a timber floor aside from the few structural provisions included in *AS 1684 Residential timber-framed construction*. So, installation practice is governed by any designer specification or by 'accepted practice' as demonstrated by industry installation guides or similar publications. The supply and installation of doors, windows and most other appearance products operate under a similar mechanism.

Market expectation

The BCA and most standards of practice generally establish minimum level of performance. The market continually sets higher performance expectations on the aesthetic, structural and acoustic performance of building components and elements. These depending on the building's size, construction type and intended function. For example, building users expect greater structural stability and acoustic separation in prestigious buildings than in other structures. In many cases, it is these feelings of stability and separation that establish the building as prestigious. While they are critical benchmarks of performance, market expectations are rarely documented.

Also, the market can have clear product or material recognition and resist change. In southern states, builders understand that structural hardwood is F17. Material that doesn't make this grade, while still useful, may not be sold or only sold at a discount.

3. Building procurement

Buildings are procured through a process that includes at least a client who needs a new or altered building, the design of the building or alteration, the approval of the design by the client (for function requirements and cost) and some approving authority (for regulatory requirements) and its tendering, construction of the building, and acceptance and occupation. The whole process is moderated by consideration of cost and controlled through contracts. This is shown diagrammatically in Figure 8.

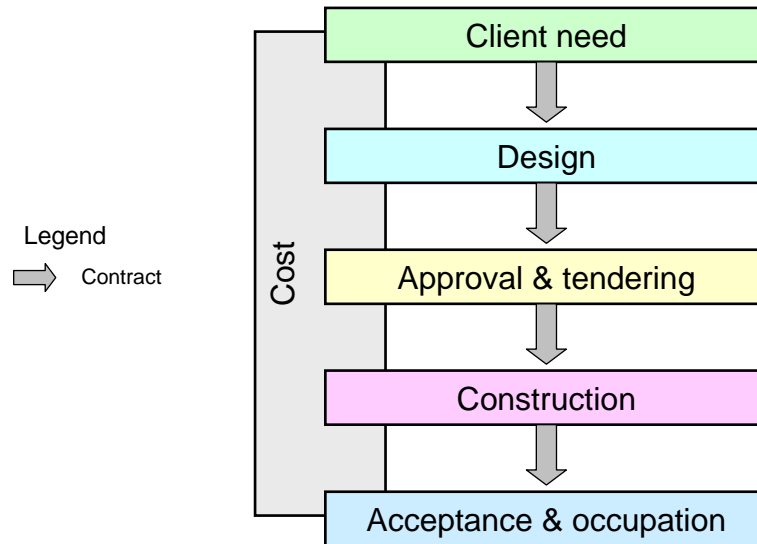


Figure 8: The building procurement process

The complexity of the procurement process and the number of participants involved at each step varies considerably from project to project and from simple to more complex building. For the simplest buildings or situations, one person can complete all of these steps except regulatory approval. However, most *Class 1* building projects usually include at least a client, a designer, an approving authority and a builder while larger and more complex *Class 2 to 9* building projects can include teams of people at each stage.

Client need

Clients want buildings that have particular functional and performance characteristics and are willing to pay for them to be designed and built. To do this, clients establish what they want and how much they want to pay and summarise their requirements into a building brief. This becomes the basic reference document during the design process.

Client requirements in the brief vary with building complexity and type, and the relationship of the client to the final occupier of the building. Clients for residential *Class 1* projects are often private individuals who intend to live in the completed building. Alternately, a developer speculates on building a design that is targeted at a particular client group and price point. Inclusions in the brief are governed by income and stage of life with selections often based on personal experience and general impressions of the building market. Residential construction is generally very competitive, with selection and inclusions strongly influenced by budget and economy.

Clients for other classes of building may be individuals but are more often developers or companies for *Class 2 to 6 and 8* buildings and public agencies for *Class 9a, b, and c* buildings. While the client may formally be an organisation, a small group or an individual usually acts as the client during the design process and that person may also be a building

design professional. The building briefs generated by commercial clients and government agencies are strongly influenced by cost and function followed by aspects of organisational policy and preferences, such as market appeal, occupational health and safety, maintenance, and environmental performance. Quantity surveyors (specialist building industry accountants) may also contribute during the brief development stage, providing cost plans for feasibility studies and shaping client expectation. Most multi-residential, commercial and public buildings tend to be constructed to higher and more individual cost structures than *Class 1* building, especially in projects with significant architectural input. There are several reasons for this. These buildings are generally bigger than houses, have more complex facilities and equipment, require additional circulation and service spaces, and are generally subject to higher performance requirements and expectations. All increase effective cost. However, *Class 7 and 8* (factory, store and warehouse) building is generally very competitive.

The relationship between the client and the final building occupier can strongly influence decisions about cost, materials and other inclusions. Developers who intend to dispose of the building after construction generally want to limit capital (or construction) cost as this directly influences risk, sale cost and potential profit. They are less concerned with operational cost unless it also affects sales cost. These developers tend to be conservative in their selection of building materials as this limits the risk that an ‘undesirable’ material choice will limit appeal and impede a sale or lease. Clients who intend to occupy the building can be less conservative in material choices and take a more balanced view between capital and operating costs.

Design

All buildings require: architectural design, setting the arrangement of the internal spaces, finishes and external envelope; engineering design, determining the size and connection of the structural components of the building; and documentation. Residential *Class 1* and *Class 10* buildings are regularly designed by domestic building or development companies or drafts persons (building designers), often after close interaction with the client. Professional involvement, outside of some aspects of structural design, may be limited. While it can be highly individual, design for residential *Class 1* building can also be repetitive, with many units built to a similar design. They are also generally low-rise buildings with relatively short-spans. *Class 1* buildings also tend to use relatively consistent and well-supported construction systems and the requirement for these are set out clearly in key references, such as the DTS sections of the BCA Volume 2, *AS 1684 Residential timber-framed construction* and similar documents. Regulatory requirements are also relatively simple.

The design of most *Class 2 to 9* building is very different, especially as the size and complexity of the project increases. These projects regularly have discrete multidisciplinary design teams of building design professionals, usually an architect, structural engineer and quantity (or cost) surveyor, supplemented by other professionals, such as fire engineers, building (or regulation) surveyors, and builders. *Class 7 & 8* building may be designed by engineers without architectural input. The project team leader may be a specialist project manager, the architect or another specialist. Interaction with the client is generally more constrained or controlled, with information passing from the team leader or architect to other professionals. Almost all *Class 2 to 9* buildings are constructed to unique designs. The design process is generally iterative, with selections for material and component systems evolving with the design. Cost and function remain as major drivers in selection. Generally, to be considered at all, materials or systems has to be recognised as desirable, fit-for-purpose, economic, available and supported. In short, a subcontractor has to be able to reliably supply them to the required standard at a competitive price. While individual buildings may be designed using a consistent construction approach, there may be a wide variety of

performance requirements and construction methods included in the one building and these characteristics certainly vary between buildings of different size, location and type. Given this diversity, there are few standard references for design in *Class 2 to 9* building outside of standard installation guides for specific elements and generic specification systems such as NatSpec.

In *Class 1* buildings, structural design loads are relatively consistent and design solutions readily available. As a result, a drafts person can size the timber components of a house for any site in a few hours using *AS 1684* or similar industry span tables. In *Class 2 to 9* building, loading conditions are more varied. As design loads are higher than those imposed on domestic building, domestic sizing guides or span tables cannot be used. For solutions outside established fabricator systems, an engineer must design each component and element individually using general or proprietary software. This can require considerable effort and skill. Regulatory requirement can also be complex and need the engagement of specialist building surveyors to ensure compliance. Also, in most *Class 2 to 9* projects, quantity surveyors are engaged to provide cost estimates of the developing design.

The diversity of construction approaches and the process of regular and iterative design development can place considerable demands on suppliers wishing to provide materials to *Class 2 to 9* projects. While professionals, the design teams still need specialist material information and often demand repetitive support responses.



Figure 9: Floor trusses in a three storey *Class 9b* educational building

The structural solution for this floor system changed regularly through the project in an effort to reduce cost. Regular fabricator support was critical.

Approval and tendering

Approval of the developing design on a functional and cost basis generally occurs progressively through the design process, as the client reviews the design and estimates of its likely construction cost and approves or seeks amendments to the scheme. The culmination of the design process is a set of contract documents, usually a drawing set, a specification, and possibly a bill of quantities, approved by the client and ready for regulatory approval and tendering. Regulatory approval for buildings is now generally conducted as a two stage process: assessment by an independent building surveyor who confirms and certifies compliance with the BCA and other relevant legislation, and formal regulatory approval of the project by an authority, usually a local council.

Buildings that have been designed by a building company or under a design and construct arrangement are costed after approval and a construction contract entered into between the client and the builder. However, most buildings are put to selected or public tender. Tendering is a process where builders assemble a price for the construction of the building and submit it to the client or their agent as the proposed contract sum. In building up the price, the tenders seek and receive subcontract prices from trades companies (such as carpenters and plumbers), component and element fabricators (such as truss and frame manufacturers and joiners) and material suppliers (such as hardware stores and timber merchants). Understandably, this can be a dynamic and potentially risky process as each organisation contributing to the price has to understand the sections of the contract documentation that apply to their components or elements and make allowances for any inclusion or requirement that will influence cost. This may not be difficult for a *Class 1* project but can be increasingly difficult as the complexity of the construction and documentation increases. Contract requirements that affect delivery and cash flow also have to be recognised.

In addition to providing a complying tender for the project, builders or subcontractors may submit a non-complying tender. Usually, this proposes to change aspects of the design to provide the same outcome at a lower price. For example, a builder may propose to replace steel-framed walling specified for a building with timber-framed walls.

Submitted tenders are assessed with the lowest tender for the project generally accepted. However, it can often occur that the lowest tender is still higher than the price that the client is willing to pay for the building. If this is the case, negotiations can occur, often between the architects and the lowest tenderer, to bring the overall cost of the project within the client's cost expectations. During this process, the design can be in flux, as the builder and often his subcontract team work with the architect and other professionals to reduce costs either by removing inclusions in the design or replacing expensive systems or components with cheaper alternatives. Once a suitable solution has been reached, the contract sum is agreed and contracts for construction are signed. Contracts for *Class 1* buildings can be relatively simple documents while contracts for large *Class 2 to 9* buildings can be complex and highly complicated documents. Industry standard contract exists for projects of different sizes but project specific standards can also be used.

Construction

Building companies generally specialise in constructing buildings of a particular size or complexity. With notable exceptions, residential building companies are relatively small. The principals often have carpentry or similar skills. Supply chain relationships are a key factor in the efficient operation of the business and often personal. House building companies usually operate with a team of regular subcontractors and loyalty between members of the team is important. Knowing your subcontractor team well limits misunderstandings and workload on-

site, administration off-site, and the potential for disputes. Specialist residential building companies are also often loyal to particular suppliers. Again, this can improve efficiency, minimise administration and provide flexibility in times of supply stress. As *Class 1* buildings are relatively small structures, small to medium-sized supply and trades companies can supply house lots and service a local builder market effectively. Residential builders generally require supply of elements only. As spans are relatively small, they can erect or install the structure themselves. Construction is programmed but timing of delivery has some flexibility.

As *Class 2 to 9* buildings are generally larger and more complex than *Class 1* buildings, they take longer to build and can require significantly greater administrative control. While commercial builders vary in size considerably, they are often larger and more sophisticated in their requirements and administrative processes than residential building companies. They also tend to do less of the construction work with their own staff, favouring supply and install subcontracts for much of the work. Also, as each *Class 2 to 9* building is unique and assembled from a wider range of materials and techniques, builder loyalty to particular suppliers is harder to maintain. As the sums of money involved are generally higher, there is more incentive to seek broader, competitive pricing. There is also a greater administrative capacity to do so. Cost control is also more critical as the longer construction period leaves the builder and subcontractors open to a greater range of unknowns, such as unforeseen price rises or material shortages. It is also more important to the client, who is often paying to maintain the finance for the construction process. As a result, the construction programming for *Class 2 to 9* buildings is often an integral part of the contract and failure to comply through lack of capacity or other causes can have significant financial consequences.



Figure 10: Structural glulam frame of a *Class 9b* educational building

The architect selected the building form and materials while the builder chose to prepare and erect this frame as a training exercise for his site staff.

Decision points

The procurement process has key decision points, where materials and equipment selections are made. These occur at the client, design and tendering stage. Decisions can also be made during the construction process.

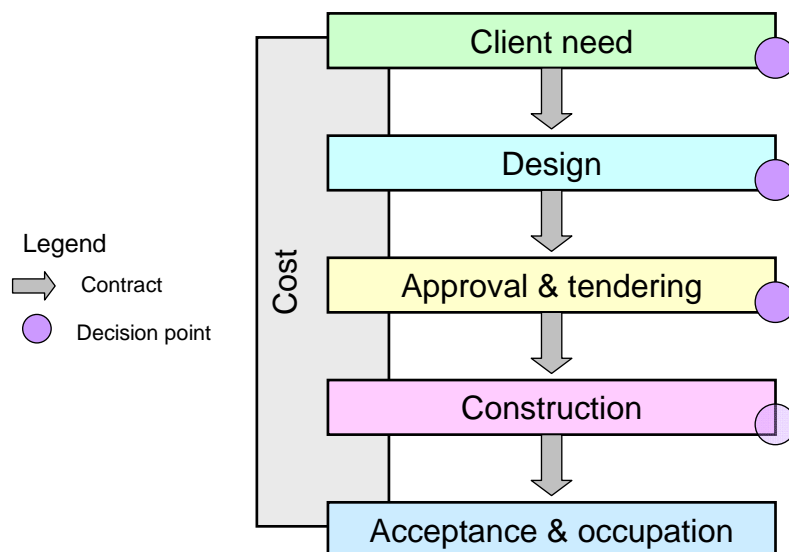


Figure 11: Decision points in the building procurement process

The first major decision point is formulation of the client brief. A client or client group can require, allow or exclude materials or other inclusions in the brief directly or indirectly. For example, under the Federal Government's 2009 schools construction program, many states issued construction guidelines for designs and these constrained the use of some material or construction options. In Tasmania, some briefs originally required a GreenStar rating for the design. As GreenStar only recognised Forest Stewardship Council (FSC) certified timber at the time and almost all Tasmanian forests are certified to the Australian Forestry Standard (AFS), this requirement effectively excluded the use of any Tasmanian produced timber in these projects. The client can also be advised in favour or against particular materials or construction systems due to their prominence, cost or other factors.

The next major decision point is the iterative design process, as the design team develops the design first in concept, then in scheme, and finally in detail. The major bases for decision are again function and cost, moderated by the design concept (the intended look and feel of the building), regulation and constructional considerations. While most decisions should be made during the design process and finalised at the beginning of tendering, in practice, significant change to the design can occur during tendering (and be submitted as part of a non-conforming tender) or after tendering in an effort to reduce the contract sum or handle unforeseen developments. This process can extend into the construction period if unexpected price rises during construction have to be off-set with new savings.

Each of these decision points represents an opportunity for one material system or product to be substituted for another. However, to capture these opportunities (or resist others from capturing them), proponents of particular systems or products have to be active in the process. Unsupported options quickly lose prominence and sales fade. For smaller companies or organisations, maintaining a profile sufficient to influence the right decision point can be difficult. It can take years to develop and require regular action to maintain. The right staff needs to know (or be available to) the right decision maker and provide the correct service.

4. Timber and wood products, their supply and use

Timber and wood products and their supply

Timber and wood products are natural and renewable building materials drawn from the trunks of trees. They include sawn timber, glue laminated timber, engineered wood and fibre products, and elements assembled from these products in combination. They fall into two main products types based on their major applications and performance requirements:

- *Appearance products*: flooring, finishing and joinery timber, external joinery, internal joinery, architectural lining, and architectural structures.
- *Structural products*: framing and structural timber, LVL, I-beams and LVL products, plywood, glulam, wall frames, nail-plated products, and other prefabricated elements.

Types are not exclusive as elements may serve appearance and structural functions.



Figure 12: Large section glulam elements in a Class 7 storage building

The timber and wood products industry includes the participants in the supply chain from the forest, through sawmillers and board manufacturers to distributors, fabricators and installers into the building. The industry is not homogeneous and can be regarded as having three main groupings - those involved with:

- timber in the building project (those who regularly come in contact with project plans).
- timber production and distribution.
- with the tree and land management.

These groupings are not exclusive and companies may be active in all or any of them. However, each group tends to have a different perspective on the industry, be from different backgrounds and operate at different time scales with different regional approaches. Since they need to work together at least part of the time, these differences can generate stress within and between groups and their members. This report mainly deals with the first two groups: those in building and timber production.

Sawmillers, board and engineered wood products manufacturers

Sawmillers and board and engineered wood products manufacturers receive logs and convert them into a range of value added appearance and structural products. In 2009, they processed 9.5 million m³ of softwood and 3.0 million m³ of hardwood sawlogs and produced the full range of appearance and structural products listed above. Most was used in building construction, particularly *Class 1* housing.

Historically, some sawmillers integrated vertically and were heavily involved in timber production, various types of fabrication and even construction. However, with increasing production concentration, this has largely reversed in recent years. Most major timber producers are now commodity manufacturers and suppliers, making a range of appearance or structural products. This product range is usually sufficiently broad to use any material recovered from the log but product concentration can be high, with some companies producing only one type of product. In these larger producers, production of niche products, such as glulam, has tended to be channelled into commodity production or stopped. Commodity production requires national or international commodity markets, while building markets are generally local or regional and service intensive. So, with notable exception, the concentration on commodity production and distribution has generally been matched with a withdrawal (or severe limiting) of direct involvement with the building market except for providing general product information and a response to orders.



Figure 13: Timber flooring in a major exhibition space

It became evident during the interviews that this concentration on commodity production and subsequent removal from direct engagement in the building market has several important consequences for timber use in building, particularly in *Class 2 to 9* building.

As became apparent in the survey stages of this project, several major producers did not know how their products were used, except that due to the species or configuration, they are generally used in building. They certainly did not know the type of building in which their product are used. Feedback mechanisms on product use can be limited to product orders received, hits on an internet site, technical questions from distributors, and the occasional involvement in flagship projects. This is satisfactory if product orders continue to arrive. However, it is not satisfactory if product orders decline, especially if they decline significantly over time. Then, companies have only anecdotal evidence of the reasons for this. As these reasons can not be communicated with confidence to the production division, unneeded products may continue to be manufactured and potential losses build. Marketing is also constrained. As companies do not know the type of building in which their material is used, they have no way of assessing if marketing in a particular sector produces an improvement in use. With no ready mechanism for identifying opportunities or avoiding problems as they form in the marketplace, marketing often has to be reactive, seeking to fix a problem that has already occurred. Withdrawal from engagement with the building market also means that technical support becomes a discretionary activity. In some companies, technical support capacity has been constrained to a point where their ability to service a sophisticated market is limited. Lastly, withdrawal from engagement in the building market means that producers have very little capacity to ‘grow’ the market for timber products at the expense of substitutes. They have to compete over a fixed volume of sales largely on commodity price.

Distributors

Timber products are distributed by a wide range of specialist and generalist companies. Major timber producers may distribute to wholesalers, fabricators, major retail distributors such as hardware stores, and even directly to major builder customers. Some retain an interest or ownership in major distribution networks. Unlike some timber producers, major distributors are closely aligned to their market base and supply what that base needs. Distributors may stock a full range of structural products from different producers in Australia and overseas including softwood and hardwood scantling, I-beams, plywood, glulam and LVL or some specialist selection of these products. Others will stock appearance products from around the world. Distributors then sell directly to the builder, hardware store, or fabricator. The distributor can be a hardware store.

The level of technical or support services offered by distributors varies with their market focus and company sales strategy. Many distributors act purely as a supplier, assuming that their customers know how and where to use the product. Some distributors provide quantification, design and even a fabrication role.

Fabricators

Fabricators are the members of the timber industry closest and most responsive to the construction market. While they do not produce timber, they can be responsible for the bulk of sales of timber onto the building site. There are generally three major types of timber products fabricators: frame and truss manufacturers, specialist structural fabricators, and joiners.

Frame and truss manufacturers

Frame and truss makers prefabricate engineered nail-plate trusses and walls frames for buildings of all types. There are literally hundreds of frame and truss manufacturers around Australia. Nationally, nail-plate truss systems dominate supply of timber roof structures and they prefabricate and supply a significant proportion of the timber wall frames erected. They handle a significant proportion of the structural timber used in buildings each year. A medium-sized fabricator can annually convert 5,000 m³ of scantling timber into building elements ready for site installation (pers comm. Bosveld, 2 Dec 2009) while a major capital facility will consume over 15,000 m³ annually (pers comm. Ladson, 10 Dec 2009).

Successful frame and truss manufacturers are fully integrated into the network of suppliers and subcontractors who make up Australia's *Class 1* building construction industry. They are pivotal component providers. Most frame and truss manufacturers maintain an in-house estimation and design office and supply builders with considerable design support services. They receive plans of the building and, using proprietary software, provide comprehensive design solutions for the roof, floor and wall structural systems. This includes solution development, material quantities, engineering certificates and cost breakdowns for estimates or tenders. Some fabricators provide similar services to building design professionals and become instrumental in ensuring timber solutions are adopted in a project.

While frame and truss manufacturers provide design services, they do not regularly maintain independent design skill. Instead, they rely on using proprietary software and specialist connectors and equipment, developed and supplied by one of Australia's three nail-plate companies, to design and make the products that they sell. While versatile, these systems have constraints as they are framed around the use of proprietary components.

With their close relationship to builders, fabricators can often become involved in developing and providing more economic structural solutions for designs, particularly those being reviewed after an unsatisfactory tender process. In short, they often have the opportunity to replace a costly steel structure with a more economical timber one. Builders approach them to do it. However, their capacity in this can be limited by both experience and skill. Without formal structural design education, fabricators do not necessarily have a full understanding of the capabilities of the design programs they use. They are often unfamiliar with the requirements of key connections, bracing and assembly. In these cases, fabricators may refer designs back to the nail-plate supplier for detailed design.

Frame and truss manufacturers' market approach, production capacity and administrative systems are tuned to the *Class 1* building industry. Marketing often focuses on developing and maintaining their service reputation with builders. Fabricators use skilled solution design as a tool to promote builder loyalty and exclude competitors. If necessary, they also help train their customers in necessary construction practices. With *Class 2 to 9* building, the connection with design support and winning the project can be more tenuous than in *Class 1* building. Having invested time and resources to have a particular design accepted, a fabricator may still lose the job to a competitor, being undercut on price.



Figure 14: Assembling a prefabricated wall frame



Figure 15: Prefabricated floor trusses awaiting delivery

Prefabricated wall frames and trusses can be used as easily in a shopping centre as they can in a house. Proprietary software provides design and manufacturing capability.

Fabricators' production capacity is often optimised to produce small to medium project lots efficiently. *Class 2 to 9* buildings are on average much larger than houses, and supplying material to them regularly requires significant and fluctuating production capacity. This can make fabricators wary of large commercial projects that tie up production capacity for a relatively long period. If they cannot supply their smaller regular customers, these clients may

take their business to a competitor and be lost. Large projects also complicate administrative processes. *Class 1* builders have relatively simple drawing and contractual demands. Their projects can also be finished and invoiced relatively quickly. This regular throughput of projects can maintain even cash-flow and reduce exposure to default. By contract, large projects have relatively complex contracts, and structured progress payment system that may not suit the cash flow requirements of a small company.

As *Class 1* builders generally erect their own structural frames, frame and truss manufacturers generally do not offer erection services. Keeping off-site limits their exposure to the vagaries of site construction and allows them to concentrate on what they do best: prefabricate components in a controlled workshop. However, commercial builders tend to require ‘supply and erect’ services and this can exclude fabricators from tendering for projects unless they can form partnerships with carpenters or installers. In these cases, the carpenters may be the fabricator’s client, and be the one tendering for the project. This team can then provide a timber alternative to a steel solution. There is potential for timber and steel to work in combination (timber purlins on steel beams). This may be in the builder’s interest. However, it can be difficult to organise and administer as it involves teaming up fabricators with competing areas of interest and skill.



Figure 16: Prefabricated wall frames awaiting delivery

Specialist structural fabricators

Specialist structural fabricators assemble and supply timber elements that are more sophisticated or complex than nail-plate trusses solution and wall frames. In addition to nail-plated products, they make and assemble architectural glulam, full timber building frames and high performance timber components, such as composite floor systems, architectural trusses and frames and bridges. Almost all specialist structural fabricators maintain independent engineering design capacity and specialist timber processing equipment, such as computer driven routers and formers for prefabricating large elements.



Figure 17: The building procurement process

The structural frame for this outback Class 9b community centre was fabricated with specialist equipment in Melbourne and shipped to the site, ready to erect.

Specialist fabricators differ significantly from normal frame and truss manufacturers. There are not many of them, probably only a few in each state. They are generally active in architecturally designed *Class 2 to 9* buildings and provide skilled specialist services to the building design team. They invest a lot in developing and tracking projects. Their design and support staff tends to work on projects all the way from sketch design through to the sign-off of shop drawings. To supply into the market, they maintain specialist timber processing and prefabrication skills. Their administrative capacity and structures align more closely to those common in commercial building.

Given the general lack of skill in timber engineering in the consulting professions, specialist fabricators regularly take on the role of timber engineer, providing the solution that is then

accepted by other design consultants. They can also act as solution brokers, working to bring together the trades and suppliers necessary to service large and complex projects.

The limited numbers of specialist fabricators reflects the historical market share for timber in *Class 2 to 9* building construction. Increased demand in this areas from 2006 to 2008 highlighted points of weakness. Their production capacity is limited, both in the volume they can produce and the sizes they can make and handle, especially in particular regional markets. There is not a critical mass of producers. Companies have to operate largely self-sufficiently. If they need extra production capacity quickly, they need to collaborate with companies nationally. They cannot learn from others or work with other companies to establish confidence in timber construction with building design professions. Opportunities and product niches may be identified but not exploited; and support and education systems are limited. To broaden market opportunities, specialist fabricators often also service other sectors of the construction market, running frame and truss operations. They may also be discrete sections in timber processing or importing companies.



Figure 18: Exposed glulam roof beams supporting timber purlins

This project was originally designed with a steel roof. The suppliers worked closely with the client and architects to have timber considered before designing the structure for engineer approval. The solution was cost competitive. Additional projects for the same client have resulted.

Some timber producers act as specialist fabricators while not necessarily attempting to be solution providers. They make products such as glulam after an order from the builder and supply it to site. This can work well if the fabricator has sufficient understanding of building conditions. However, if the requirements of production are allowed to override the builder requirement, significant site delays can occur.



Figure 19: Hardwood glulam on site for a *Class 9b* project

The delivery of this material was framed around production considerations. The pieces the builder needed first were made and delivered last and the whole project schedule was delayed as a result.

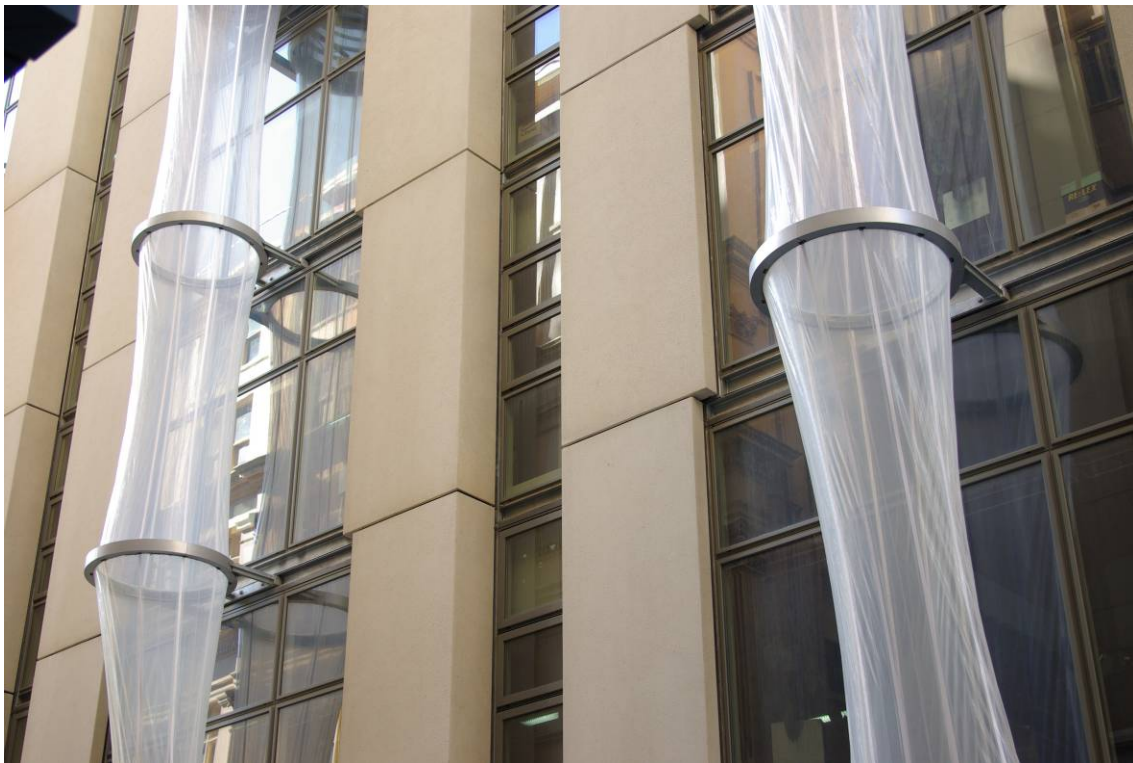


Figure 20: Timber windows in a multi-storey office building

The architects selected timber windows to minimise environmental impacts. After considerable negotiation, only a few joiners were willing to tender on such a large and complex project.

Joiners

Joiners prefabricate architectural components and elements for the building, including walls, windows, doors, benches, cupboard joinery, and lining. Like structural fabricators, there are a large number of joiners around Australia and they are responsible for supplying considerable amount of appearance timber and board products to sites as high-value building elements.

Most joineries are relatively small organisations providing services to a local or regional professional or builder market. They generally specialise in different product and market sectors (internal joinery; window and doors; heritage work; high-end domestic or commercial projects) and maintain the skill and equipment necessary to service those markets. Joiners can provide design services. For *Class 1* building, this generally involves providing showrooms where intending customers can see particular product options. For *Class 2 to 9* projects, design may include regular interaction with the building design team, mainly the architects, and the preparation of shop drawings and example panels for project approval. Like all suppliers, joiners tender for work in projects of all types.

Fabricators, the design process, and new systems solutions

All fabricators supply some level of design and technical support to their customer base. Generally, the demand for design and technical support increases with the complexity of the project. As house construction is relative consistent and supply is supported by standards and proprietary software, frame and truss manufacturers provide a regular and sufficient (but not necessarily technically advanced) level of support to builder customers. More adventurous manufacturers provide more sophisticated support and so ensure greater security and diversity of work. Once the technical demand of a project exceeds the coverage of proprietary design software or ‘everyday’ experience, design support demands increase significantly and possibly only a few firms in a region can provide it. Even with this specialist knowledge, they still may not secure the project. As described above, most building projects are tendered and, if the fabricator is not included in the tender documents as a nominated subcontractor, another subcontractor may win the project on price.

Engagement with the current fabrication industry is fundamental to the introduction of any new products or systems solutions to the *Class 2 to 9* construction market. The sector represents both a constraint and an opportunity. Fabricators have an existing delivery network that features wide geographic reach, established access to the building design and construction sectors, effective sales and administrative systems and an incentive to try and capture additional markets. To succeed in the market, new building component or element systems needs such a delivery network. To exploit fabricators’ existing network, any new system must either work with other available systems (such as nail-plate trusses) and be supported by some franchising company, or limit itself to just a few fabricators who are willing to work with the new system. This may often be those with independent design and production capacity.

5. Timber's use in construction

Timber and wood products form a major materials group available to the Australian construction industry. They are mainly used in residential construction, predominantly new houses and extensions to existing dwelling. Industry sales are highly dependent on activity in this market (URS 2006) and as discussed above, industry's systems and products focus on servicing this market. By contrast, timber's penetration into the *Class 2 to 9* and engineering construction market is generally low. In the CSAW survey, respondents from the timber supply industry reported that the residential sector accounted for about 87% of sales while *Class 2 to 9* building accounted for only about 13% of sales on average. Of this, about two-thirds of the material supplied was structural products. By contrast, building design professionals reported using roughly equal amount of appearance and structural material in *Class 2 to 9* building.

Table 2: Timber supplier and professional use of timber types

% by value	Appearance applications	Structural products
Timber suppliers	32.5	67.5
Building design professional	47	53

Elsewhere in the survey, timber suppliers and building design professionals rated their sales and use of timber and wood products in various *Class 2 to 9* buildings and in various building components in these buildings on a one to five scale. Producers rated their current sales to the *Class 2 to 9* buildings as 2.2 on average, with only sales to *Class 9c*: aged-care building rating as high as 3 *occasional or some*. Building design professionals rated their current timber use in the non-residential building sector as only 2.4 on average. See Table 3 and Figure 22.

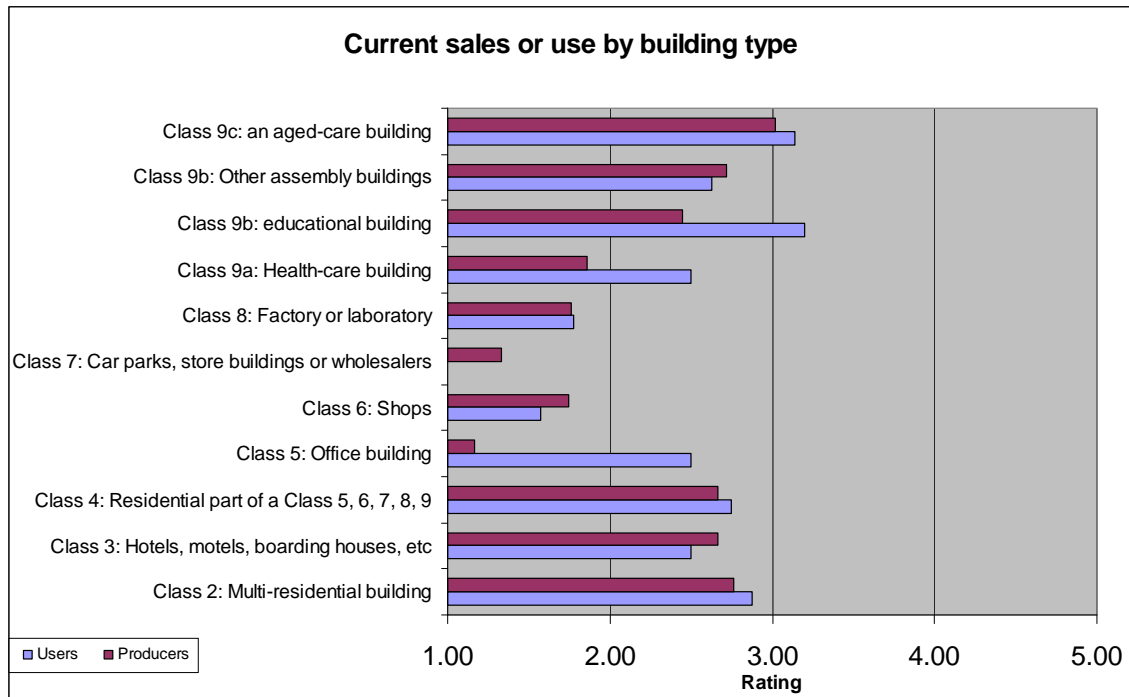


Figure 21: Prefabricated timber elements in a Class 3 hotel building.

This is a relatively uncommon construction method. A specialist fabricator operating locally inspired the approach and detailing.

Table 3: Timber supplier and professional rating of Class 2 to 9 sales or use by building class

Building type	Professional	Suppliers
Class 2: Multi-residential building	2.9	2.8
Class 3: Hotels, motels, boarding houses, etc	2.5	2.7
Class 4: Residential part of a Class 5, 6, 7, 8, 9	2.8	2.7
Class 5: Office building	2.5	1.2
Class 6: Shops	1.6	1.7
Class 7: Car parks, store buildings or wholesalers	0.8	1.3
Class 8: Factory or laboratory	1.8	1.8
Class 9a: Health-care building	2.5	1.9
Class 9b: educational building	3.2	2.4
Class 9b: Other assembly buildings	2.6	2.7
Class 9c: an aged-care building	3.1	3.0

**Figure 22: Timber supplier and professional rating of Class 2 to 9 sales or use by building class**

1 means *little or none*, 3 means *occasional or some*; and 5 means *regularly or most*.

Producers rated their current sales to different building components as 2.7 on average, with sales to only *the roof* and *superstructure* rating higher than 3 *occasional or some*. Building design professionals rated their current timber use in different building components as 2.8 on average, with only sales to *the roof*, *the internal fabric* and *external items* rating higher than 3 *occasional or some*. See Table 4 and Figure 23. While these averages and ratings give only an indication of current sales and use, it is clear that *Class 2 to 9* building is on average a minor market for the timber and wood products industry, and a minor part of building design practice.

Table 4: Timber supplier and professional rating of *Class 2 to 9* sales or use by building component

Component	Professional	Suppliers
Superstructure	2.2	3.4
The roof	3.2	3.4
Upper floors	2.6	2.5
Ground floor	1.8	2.4
External walls	2.6	1.9
Internal fabric	3.6	2.6
External items	3.6	

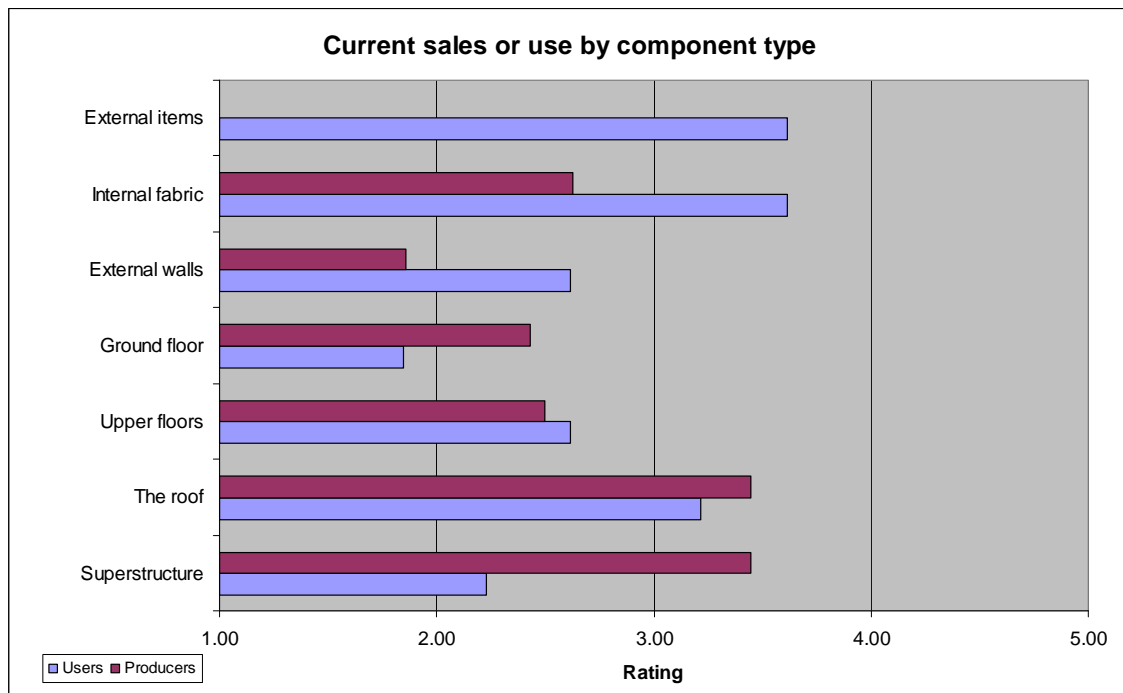


Figure 23: Timber supplier and professional rating of *Class 2 to 9* sales or use by building component

1 means *little or none*, 3 means *occasional or some*; and 5 means *regularly or most*.



Figure 24: Timber in the internal fabric of a *Class 9b* church

These results and the relative values of the Australia domestic and non-residential building sectors raise a key question: why are timber and wood products selected for use during the procurement process for *Class 1* buildings and not selected during procurement of *Class 2 to 9* buildings? As a guide to potential reasons, it must be remembered that to be considered at all during the building procurement process, the designer, builder or building design professionals involved must regard the material or system as desirable, fit-for-purpose, economic, available and supported.

Desirable

A material can be desirable in building because it is attractive, easy-to-use, and flexible or has some innate characteristics that set it aside from other building materials. Timber has natural design appeal. It is widely used in architectural surfaces and this is a major market for much of Australia's hardwood industry. In the CSAW survey, building design professionals estimated that 47% of their timber use was in appearance applications. Building design professionals can appreciate the aesthetical properties of visual grade glulam timber, appearance hardwoods and engineered wood products, the improved internal conditions (acoustics and warmth) found in wood rich environments, the high strength-to-weight structural properties of the material, its thermal performance and its resistance to corrosive environments. However, some can find timber old-fashioned (not up-to-date) or very "alternative". Flexibility and ease of use are significant factors for timber's appeal in *Class 1* construction and the same characteristics carry over to the design and construction of *Class 2 to 9* buildings. In the CSAW survey, timber suppliers listed *environmental and aesthetic appeal* as characteristics that helped sales in the non-residential building sector. Design professionals mentioned *aesthetics and appearance, ease of use, environmental factors, client preference* and *practical flexibility* as characteristics that encouraged the use of timber and wood products in this sector.



Figure 25: A local carpentry firm acted as builder for this project due the relative ease of timber building

Image courtesy of Spowers Architects



Figure 26: It is much easier to alter timber than steel on site

Fit-for-purpose

For a material or material system to be fit-for purpose, it has to satisfy the regulatory and other performance requirements applicable to the intended building. From their regular use, timber appearance and structural systems available in Australia are obviously fit-for-purpose for *Class 1* buildings of almost any size and generally for mid-range *Class 2 to 9* building up to 3 storeys. These products include nail plated products, engineered wood products, appearance hardwoods, and external joinery. There are no significant regulatory or technical constraints on using the existing product suite in many new buildings up to three storeys. This includes *Class 2, 3 and 9* buildings generally if they are sprinkled. While BCA compliance requires an alternative solution, these solutions are becoming increasingly common. Similarly, timber appearance products (flooring, lining, and joinery) are fit-for-purpose in multi-storey buildings of any size. They are used regularly and confidently.

However, some in industry expressed doubts that the current Australian suite of timber structural system is suitable for prestigious *Class 2 to 9* building. They suggested that existing systems do not provide the stability, acoustic and other performance expected in buildings of this type. To be satisfactory, they would have to perform more like concrete and masonry and this is not the current design approach.

To satisfy the performance requirements for fire and acoustic separation in several building types, timber products are often combined in a system with other materials, such as plasterboard. As the system may not belong to any single producer, cross-producer collaboration is required to test and establish these systems.

In the CSAW survey, timber suppliers identified *product performance* as a characteristic that helped sales in the non-residential building sector. Design professionals mentioned *durability and maintenance*, and *fire* as characteristics that discouraged use.



Figure 27: The current product suite used extensively in a two storey *Class 9b* school

Image courtesy of Spowers Architects

Economic

Economic construction supplies the desired level of performance at a complete system cost comparable to or less than alternatives. Builders generally want the most economic price for the project. It helps them win the job if it is in tender stage or stay in budget if they have won the project. They will include timber if they are confident that it is economical as a system and provides satisfactory performance. Standard timber structural systems are demonstrably economic for *Class 1* building and, anecdotally this carries over into mid-range *Class 2 to 9* building that exploit these same systems.

While this economy for structural products is recognised in some sectors of the *Class 2 to 9* construction industry, it appears to be disguised or only a potential in others. Some estimators place premiums on the cost estimates of timber solutions to cover uncertainty. The variety of timber systems, where a particular element can be made in six or seven different ways each with slightly different cost and performance level, reportedly encourages this uncertainty. Also, timber systems designed and erected by those inexperienced or unskilled in system optimisation are inevitably going to be more expensive than those provided by more established competitors such as steel fabricators. The focus group results that Baynes et al. (2006) report include a range of comments about the adverse cost implications of timber construction such as the time taken for shop drawing and timber's slow speed of erection. In some circumstances, this is true but industry experience shows that skilled timber design and fabrication teams (when they are available) can regularly provide cost competitive solution packages for many applications.

Timber appearance products may not be the economic option for many building types but they are used because they are more desirable than alternatives. Strip timber flooring in homes is mainly used in the premium and second-home market, where customers have higher disposable incomes and can afford a higher quality solution. Similarly, strip timber flooring and solid trims is targeted at the upper end of the retail and office market in *Class 2 to 9* building.

In the CSAW survey, timber suppliers identified *economy (competitive pricing)* as a characteristic that helped sales in the non-residential building sector. Design professionals mentioned *cost* as a characteristic that both encouraged and discouraged the use of timber and wood products in the non-residential building sector, indicating that different cost regimes apply in discrete market sectors.

Availability

Like economy, availability refers to full systems availability. As highlighted in the discussion on fabricators above, the availability of timber systems is closely tied to their use in *Class 1* building. The existing suite of structural systems, using off-the-shelf sawn and engineered wood products, board and nail-plated elements, is readily available for *Class 2 to 9* buildings from distributors and frame and truss manufacturers. However, more complex timber systems, especially those based on large glulam sections, are much less readily available and only provided by a few suppliers.

Installer availability follows a similar pattern. Many builders and subcontractors know how to handle and install the timber product suite widely used in *Class 1* building. However, very few are experienced in large scale timber fabrication, especially large section LVL and glue laminated material. This lack of fabrication skill alone can exclude timber use.

In the CSAW survey, design professionals mentioned *ready availability* as a characteristic that encouraged the use of timber and wood products in the *Class 2 to 9* building sector and *site labour requirements* and *limited availability of stock and sizes* as characteristics that discouraged use.

Supported

Every design decision reflects the building designer's confidence that the material or system selected satisfies the criteria established for the project. Confidence in building design takes time to develop and is generally the result of the designer, builder or other professional's training and experience over many years. This confidence has implicit boundaries or steps. A professional will have an intuitive understanding that a particular product will be satisfactory at one size or scale, but unsuitable at another. Confidence in a material system is closely related to the support that it receives over both the short and long term. This concept of support applies to direct project support, more general market and technical support, the maintenance of standards and reference material and interaction with the general infrastructure of building design.

Direct project support

The level of direct project support available for a timber construction system is highly dependent on the type of project and the company involved. In a *Class 1* building, direct project support is generally high and delivered through the network of frame and truss manufacturers, hardware stores and other distributors, and online through producer internet sites. As outlined above, this is sufficient but not necessarily technically advanced support.

For technically demanding projects of any class, support is highly dependant on the company involved. If a skilled specialist fabricator is involved, the level of support can be quite high. However, support from frame and truss manufacturers is variable, while distributor support is limited. For example, if a building designer or builder wants to use timber in a non-residential project and does not know one of the few specialist fabricators in their state, they may go to either their timber merchant or a fabricator. Merchants generally only have limited technical knowledge of timber construction outside of housing and joinery. If outside this narrow band, the query will be passed to the manufacturer or on to a fabricator. Manufacturers may have little technical support capacity or not be able to provide a holistic response and so the request expends itself. If approached, the fabricator will try to develop a solution around the products they know, avoiding aspects of the project where their products are not suitable. If the task is beyond their skill, they may pass the problem through to their systems supplier for a solution. If the project can be converted, a design may be prepared, and potentially fabricated and supplied. While workable on occasions, this remains a difficult and haphazard process. Project support for architectural projects follow a similar path.

Market and technical support

The level of general technical and market support that the industry provides the *Class 2 to 9* construction industry appears to be limited. There appears to be a disconnection between many timber producers and their eventual market as they are at opposite ends of the supply chain. As a result of this and industry consolidation, expertise levels in producer companies appear to be constrained or declining. The industry also has few opportunities to build expertise even if it wanted to do so. In Australia, there are no timber production or building educational courses on offer beyond mid-level production training.

Active market interaction with the building design profession is reportedly low. Timber companies are rarely present at major construction industry marketing events. Technical support outside of producer companies is also limited and declining. Several regional timber support organisations have closed or withdrawn services. Technical guides and tools are generally product specific, so important areas that combine product types such as fire and sound separation are poorly represented, especially when compared to competitor product groups. Understanding how timber solutions comply with the building regulations is an obvious area of unmet concern. In the CSAW survey, both the timber suppliers and building design professionals rated *building regulation requirements* as the factor that most hindered their sales or use of timber in *Class 2 to 9* building.

In the CSAW survey, timber suppliers identified *the design support and interaction they provided* as a characteristic that helped their sales in the non-residential building sector. Design professionals mentioned *builder familiarity* as a characteristic that encouraged the use of timber and wood products in the non-residential building sector. However, suppliers listed *restricted marketing contact* and *restricted technical capacity* as factors that hindered sales in the non-residential building sector. Design professionals mentioned the *lack of technical and market support* as characteristics that discouraged use in that sector.



Figure 28: Glulam trusses in the architectural roof structure over the foyer of a major exhibition space



Figure 29: Trusses with purlins, roof and ceiling

Working with the local frame and truss manufacturer, engineers from a nail-plate manufacturer acted as consultants to the building design team, ensuring that the full timber component design was economic, efficient and effective.

Standards

Industry's participation with standard development and maintenance is mixed. Key timber engineering standards reportedly need further support, specifically *AS 1684 Residential timber-framed construction* and *AS 1720.1 Timber structures - Design methods*. Without this, they risk losing pace with comparable steel and concrete standards and relevance with the design professions. Most areas of appearance timber use are not covered by standards while there is an increasing disconnection between the current appearance grading standards and log supply. *AS 2796 Timber Hardwood - Sawn and milled products* establishes three appearance grades with similar milling tolerance: *select – low feature*, *standard – medium feature*, and *high feature*. In the market these are generally sold as *select*, *standard or better* and *high feature*. Problems arise as the term *select* implies that this grade is by acclaim the most desirable. Demand for *select* grade is high, especially in *Class 2 to 9* projects, but this undermines sales of equally useful material of other grades. It also substantially affects production profitability as hardwood log quality declines.

Infrastructure of building design

Building design professionals involved in *Class 2 to 9* buildings use an underlying infrastructure to maintain professional skill and comparable standards of practice. This includes oversight and accreditation of university education, participation in professional associations and maintenance of key practice tools, such as standard contracts and the national specification documents, *NatSpec*. While this is a large area, the timber industry's interaction with this infrastructure is generally low or non-existent. While there are panels for concrete and other materials in Engineers Australia, there is no timber panel. There is no obvious timber representation in the materials science and engineering group, Materials Australia while the industry has little or no input to the national building specification system, *NatSpec*. Professional development opportunities are limited.

Building design professionals

Materials or systems may meet the necessary conditions for inclusion in a *Class 2 to 9* building project and still not be used. Building design professionals naturally resist changing what they know works in favour of something that may (or may not) work. This caution generates considerable specification inertia. Within this general trend, the skill and preferences of individual design professionals significantly influence system selection in any project. For timber in building, the four key professionals are the architect, the structural engineer, the quantity surveyor and the commercial builder. Several key studies (Truskett et al, 1997a, 1997b, 1997c, 1997d, Baynes et al 2006) explore the differences between these professions and their perspectives and experience in using wood. Generally, their findings remain current and are not repeated here.

Industry reported that inspiring building design professionals to work with timber is difficult but there has been increasing interest within sections of the professions in recent years. Architects are relatively open to consider timber in *Class 2 to 9* building and will work with industry to explore potential solutions early in the process. However, the consensus in the structural timber supply industry skilled in *Class 2 to 9* building is that these classes of buildings are normally conceived as being built from steel and concrete construction systems and any timber option, if considered at all, is explored later in the design phase, often to secure cost saving. At this later stage of the project, many of the limits and boundaries of the project have been set. Timber beams require greater depth than steel or concrete to achieve a similar span. If the depth is fixed, the span has to be reduced and the beam supported more regularly. So, direct substitution of systems is not necessarily possible and some alterations often have to be made to the structural arrangement and possibly cladding and other elements.

If the brief and initial architectural design supports a timber solution, it appears likely that the structural engineer will encourage a structural solution in a material or arrangement with which they are comfortable. Again with notable exception, this generally means something besides wood. The quantity surveyor may support the engineer by adding a premium to any ‘novel’ timber system. As timber is only occasionally used in *Class 2 to 9* buildings, quantity surveyors do not have the experience to cost timber construction efficiently and it does not regularly appear in their reference publications. To keep timber structural components in the project, the architect or the builder have to either push the project engineer to do the work or allow potential timber suppliers to do much of the structural design work and provide price estimates as the project develops. Under this scenario, the project engineer signs off on the design supplied by the timber systems supplier. For their part, potential timber systems suppliers agree to do the structural design work, matching and optimizing the solution to their preferred product set for the best performance and price. They expect that the project will remain a timber project and that they will be able to secure the work. However, this is usually not guaranteed. Interestingly, some companies can bear the uncertainty and cost of this support work and still appear to make a suitable return.

Industry interviews and the CSAW survey support this view. Industry finds it very hard to get external engineering skill with wood. They tend to employ and train internally. In the survey, after *building regulation requirements*, building design professionals rated *working with structural engineers* as the second most negative factor of those listed for using timber in *Class 2 to 9* building. Interestingly, timber suppliers rated working with structural engineers as a positive. See Table 5 and Figure 30. However, industry works with their own structural engineers while building design professionals work with the general consulting profession. This trend was reversed with quantity surveyors. Building design professionals rated them as a neutral influence while industry rated them as a hindrance, and only marginally less of a hindrance than *building regulation requirements* and *complying with construction programming*.

Unfortunately, all three are hindrances found in most *Class 2 to 9* building projects.

Table 5: Timber supplier and professional rating of factors that helped or hindered sales or use in *Class 2 to 9* building

Item	Users	Producers
Building regulation requirements	2.4	2.1
Working with structural engineers	2.6	3.4
Working with quantity surveyors / cost estimators	2.9	2.4
Product economy / cost of supply	3.4	4.0
Complying with construction programming	3.6	2.1
Working with wholesalers	3.7	3.4
Working with other suppliers	3.8	3.1
Working with builders	3.9	3.9
Working with architects	3.9	3.7
Ease of construction / detailing	4.0	

1 means *hindered a lot*, 3 means *did not matter*; and 5 means *helped a lot*

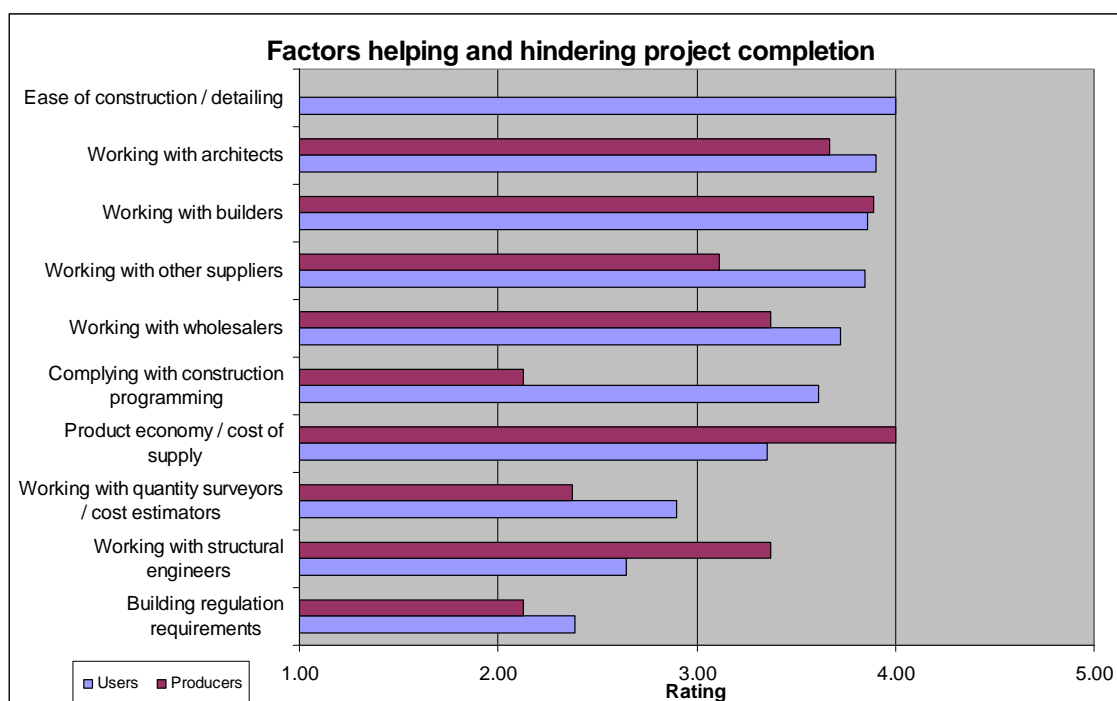


Figure 30: Timber supplier and professional rating of factors that helped or hindered sales or use in Class 2 to 9 building

1 means *hindered a lot*, 3 means *did not matter*; and 5 means *helped a lot*

Truskett et al (1997a, 1997b, 1997c, and 1997d) and Baynes et al (2006) both identified that engineers are not confident about timber in design or construction. Industry interviews reinforced this view and provide further background. Industry members explained that design with timber presents considerable challenges beyond that of steel and concrete. Timber is a natural and variable material. Its properties are not homogenous, varying in the three axes around the predominant grain direction of the piece. By contrast, steel and concrete are manufactured material with generally homogeneous properties. With steel, there is effectively one strength value for force applied in any direction. Standards for non-domestic timber design have been framed around the material's natural variability. There are fourteen different structural grades and four design values for each grade. Codes then apply adjustment factors to cope with the statistical distributions of a natural material forced into a rigid system. Individual joint design is also particularly challenging. Timber design is likened to an art that takes skill and experience.

Even standardised solution sets are complex. AS 1684 has 56 tables for each of its 14 grades and 6 wind classifications. Naturally, inexperienced practitioners are cautious of or confused by timber and the wide range products it offers to the market. One potential response to this complexity in design is to create software that provides structural solutions without needing practitioner understanding. In effect, this is what the nail-plate truss design packages do. However this sort of black-box approach 'dumbs down' design and limits versatility.

Industry felt that building the necessary expertise and confidence in timber construction in the design professions is a medium to long-term proposition. To secure projects for wood in the short term, timber solution providers are regularly taking over responsibility for structural design and detailing and provide running cost estimates. The same response may be needed for architectural components but the appearance material supply industry is not structured to supports this.

Increasing the use of timber products

The *Class 2 to 9* building sector is large and diverse. It clearly offers a range of significant and continuing opportunities for commodity and niche timber and wood products and services for companies capable of responding effectively. Timber construction in *Class 2 to 9* buildings largely represents an underdeveloped market for the industry.

Key classes of building, particularly *Class 2 to 4 residential buildings* and *Class 9b & 9c: assembly buildings* offer ready opportunities for the increased sale and use of industry's existing product suite. Opportunities also exist for particular building elements. There is notable but minor sales in these areas currently but these can potentially grow significantly. Demand in this sector can complement demand generated by the housing sectors as activity tends to be counter cyclical to the *Class 1* building market. With targeted marketing, there is also the potential to establish markets for products that are not accepted in *Class 1* construction, such as high-feature timber. Engagement with the building design professionals, generally involved in most *Class 2 to 9* projects is critically important. Building design professionals see timber being portrayed as a fashionable and environmentally responsible material in local and international magazines and journals and in television programs such as *Grand Design*. These spark interest.

To capture a greater share of the *Class 2 to 9* building market, industry members felt that building design professionals need to be provided with a *closed loop* of integrated services for both structural and appearance products. A *closed loop* is where a developer or specifier can regularly supply preliminary drawings or specifications for a project to a fabricator and confidently receive a BCA compliant solution, competitively costed for design, supply and installation. If accepted, supply or installation can then occur efficiently and in line with the building program. Some industry members have attempted to provide just this, establishing partnerships across industry so that complementary solution sets can be offered.

For timber to capture a greater share of the *Class 2 to 9* building market, other solutions have to be displaced. However, the building industry is conservative and has significant specification inertia. Traditional design solutions, such as steel and concrete in the structure, aluminium in window and doors, and laminates in joinery, are strongly entrenched. Perceptions and understanding support their use. They are widely supported by companies or industry associations experienced and skilled in defending market share. For timber to be used in *Class 2 to 9* building in preference to these solutions, its use as a 'package' must, on balance, be clearly superior to its competitors. Otherwise, there is no incentive to change.

Increased use by building type

In the CSAW survey, timber suppliers and building design professionals rated the potential to increase sales and use of timber and wood products in different *Class 2 to 9* buildings and in different building components in these buildings. Producers rated their potential to increase sales to the *Class 2 to 9* buildings as 2.89 (or neutral) on average over a one to five scale, up from 2.19 for current sales. Only potential sales to *Class 2: Multi-residential*, *Class 9b: education* and *Class 9c: aged-care building* rated as high as 3 *occasional or some*. See Figure 32. Building design professionals were much more positive, rating their potential use as 3.35 on average, up from 2.39 from current use. They were particularly positive on potential use in *Class 2 to 4 residential building*, averaging 4.1, and *Class 9b & c building*, averaging 4.19.

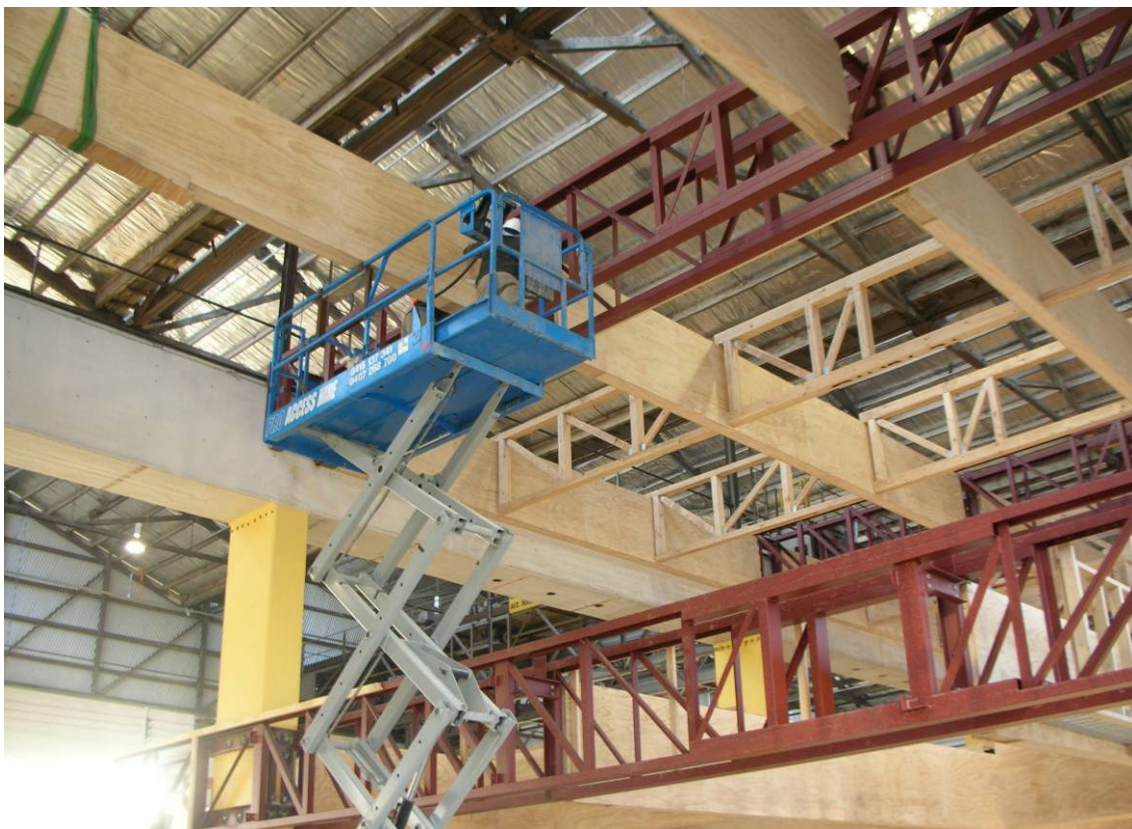


Figure 31: Combination steel and timber floor being installed in the renovation of existing factory building. It became a *Class 9b* educational building

The use of a light weight floor system eliminated the need to upgrade the existing structural frame. The plywood cladding of these elements and a sprinklers system provide the required fire resistance.

Table 6: Supplier and professional rating of *potential Class 2 to 9* sales or use by building class

Building type	Professional	Suppliers
Class 2: Multi-residential building	4.5	3.4
Class 3: Hotels, motels, boarding houses, etc	3.6	3.2
Class 4: Residential part of a Class 5, 6, 7, 8, 9	4.2	2.7
Class 5: Office building	2.9	2.7
Class 6: Shops	2.7	2.6
Class 7: Car parks, store buildings or wholesalers	1.5	1.7
Class 8: Factory or laboratory	1.9	2.4
Class 9a: Health-care building	3.0	2.9
Class 9b: educational building	4.4	3.9
Class 9b: Other assembly buildings	4.0	3.0
Class 9c: an aged-care building	4.2	3.5

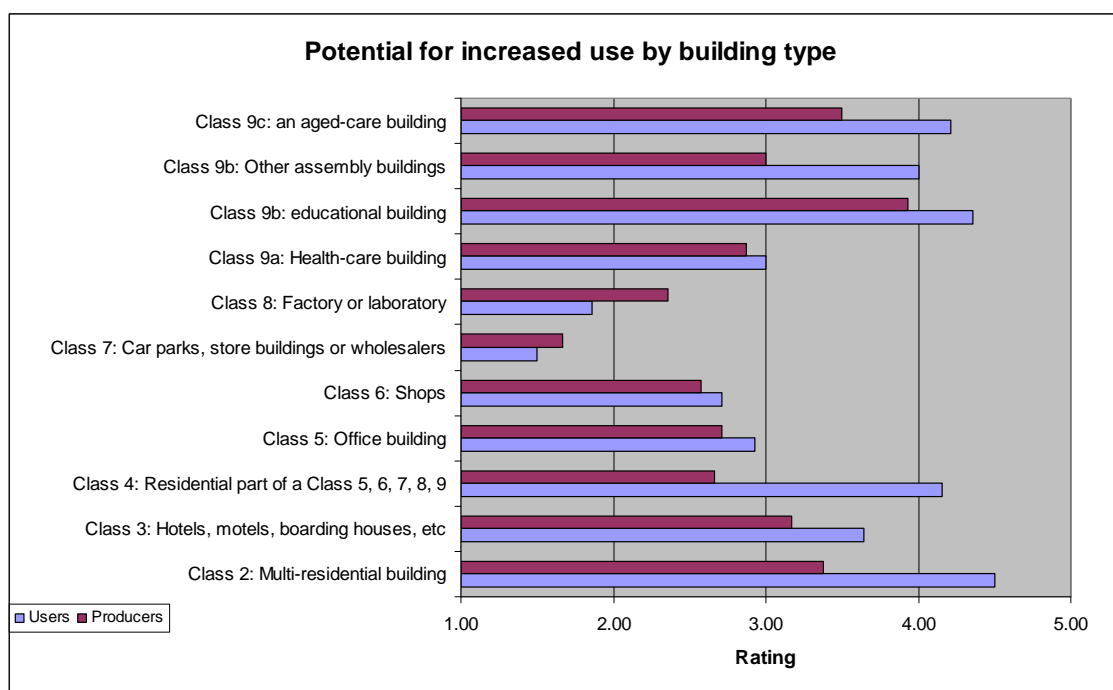


Figure 32: Timber supplier and professional rating of *potential* Class 2 to 9 sales or use by building class

1 means *little or none*, 3 means *occasional or some*; and 5 means *regularly or most*.

The net potential for increase (the rating for potential minus the rating for current use) indicate that the building design professional see the potential to use much more timber in *Class 2 to 4* residential building, and in *Class 9b* (except schools) and *Class 9c*. See Figure 33. Interesting, industry sees relatively little potential in these areas. Industry sees more in *Class 5* offices and *Class 9a* Healthcare while the professionals see relatively little potential increase in use in these areas.

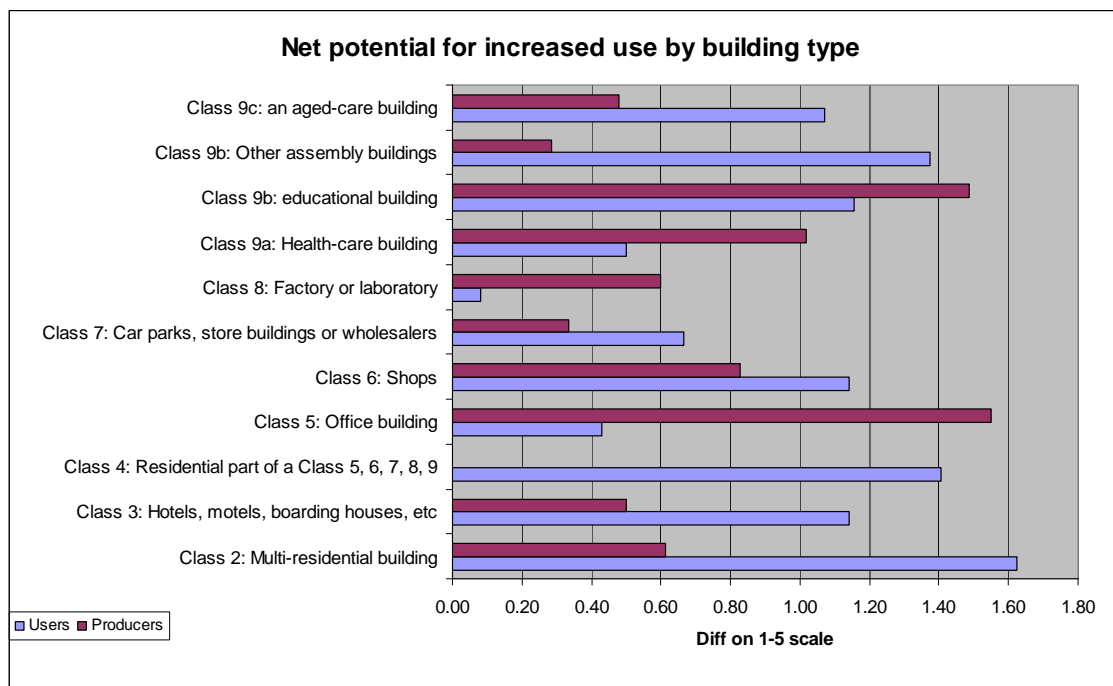


Figure 33: Timber supplier and professional rating of *net potential* (potential – current) Class 2 to 9 sales or use by building class

When interviewed, industry members saw potential to increase sales in some classes of residential building and in smaller scale public buildings, especially those with an architectural component such as age care facilities, multi-residential building to 4 storeys, general commercial buildings to 3 storeys, the upper floors and roof of commercial building buildings over 3 storeys; educational, sporting and similar assembly buildings to 3 storeys. While some championed potential in industrial buildings and workshops, others felt that these areas were less attractive as the steel industry was very competitive in these areas.



Figure 34: Class 7 store buildings look exciting but are unlikely to be an attractive market

Baynes (2006) identified churches and religious buildings (*Class 9b*), community centres (*Class 9b*), single story institutional buildings such as aged-care facilities (*Class 9c*), commercial offices including commercial services buildings (*Class 5*), schools (*Class 9b*) and swimming pools (*Class 9b*) as *worthy applications*, and warehouses (*Class 7b*), industrial (*Class 8*), commercial high-rise (*Class 5*), hotels (*Class 3*) and restaurants, and speculative building as *poor applications*.

Increased use by element type

When considering building elements in the CSAW survey, producers rated their potential to increase sales to different elements in *Class 2 to 9* buildings as 3.3 on average over a one to five scale, up from 2.72 for current sales. Potential sales to the *superstructure, roof, and upper and ground floors* rated higher than 3. See Figure 36. Building design professionals were again more positive, rating their potential use as 3.69 on average, up from 2.82 from current use. They were particularly positive on potential use in *the roof, the internal fabric and external items*. The net potential for increase in building elements indicated that the building design professionals see considerable addition potential to use timber in the *superstructure, roof, upper floors, external walls, internal fabric and external items*. See Figure 37. Industry agreed with *upper and external wall* but did not give the same prominence to *internal fabric*. A possible reason for this disparity is that components of the internal fabric, wall framing and architectural linings, are manufactured mainly by commodity producers who can not quantify the use of these products in *Class 2 to 9* buildings.

Table 7: Timber supplier and professional rating of *potential Class 2 to 9* sales or use by building element

Component	Professional	Suppliers
Superstructure	3.6	3.6
The roof	4.3	3.6
Upper floors	3.4	3.9
Ground floor	2.4	3.3
External walls	3.6	2.9
Internal fabric	4.3	2.7
External items	4.3	



Figure 35: Timber superstructure in a *Class 9b* pool building

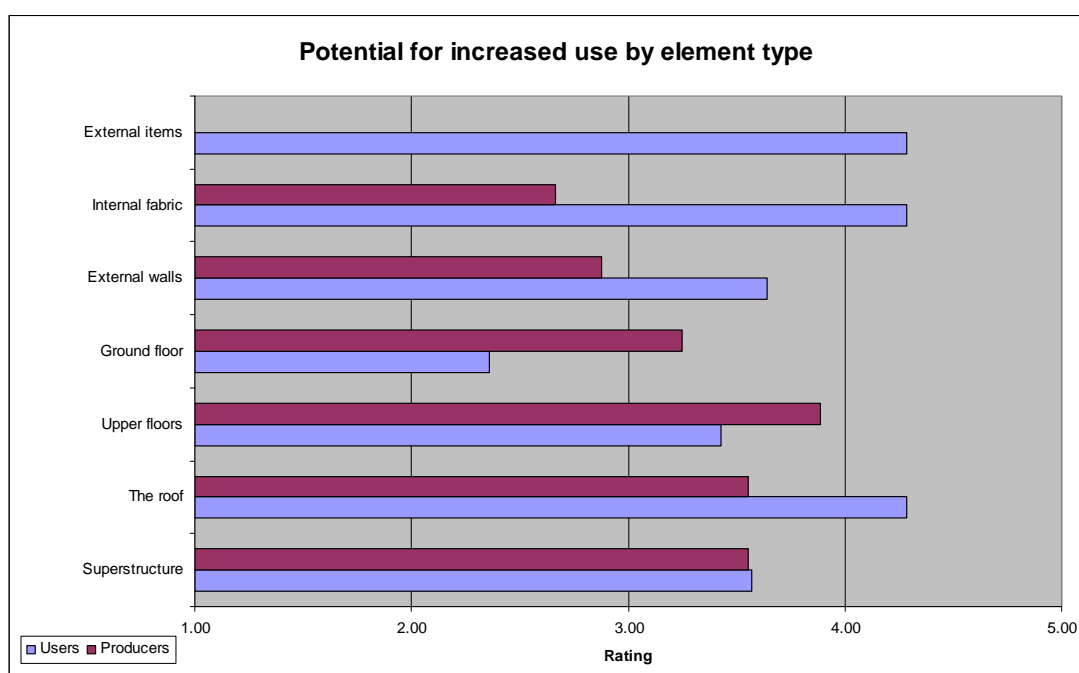


Figure 36: Timber supplier and professional rating of *potential Class 2 to 9* sales or use by building element

1 means *little or none*, 3 means *occasional or some*; and 5 means *regularly or most*.

In industry interview, the roof and upper floors, especially mezzanines, were seen as key development areas especially for columns, purlins and girts. Also, major opportunities existed for timber replacement of steel in the upper storey or storeys of buildings up to 5 storeys. These levels are usually designed as a steel frame structure. When the upper storeys are for apartments, then the levels above the last office level or last slab can be converted to timber relatively easily. A market may exist for stud framing, especially in architectural refurbishments, replacing heavier gauge metal studs. Light steel framing is tendered as part of the plastering subcontract, so its replacement is highly unlikely.

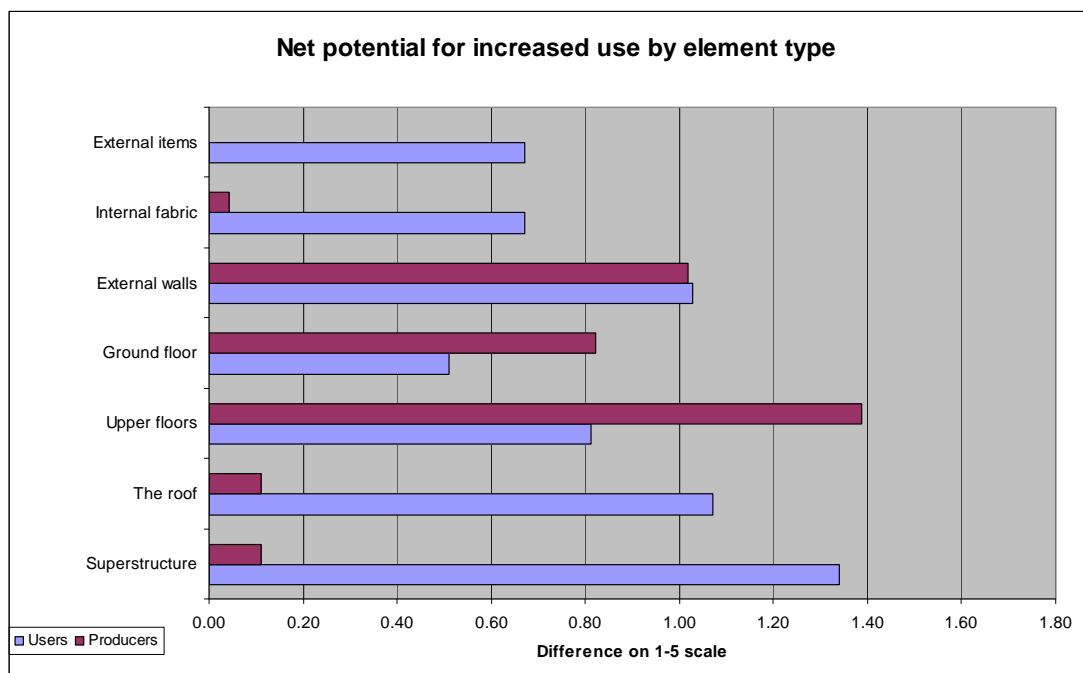


Figure 37: Timber supplier and professional rating of *net potential* (*potential – current*) Class 2 to 9 sales or use by building element

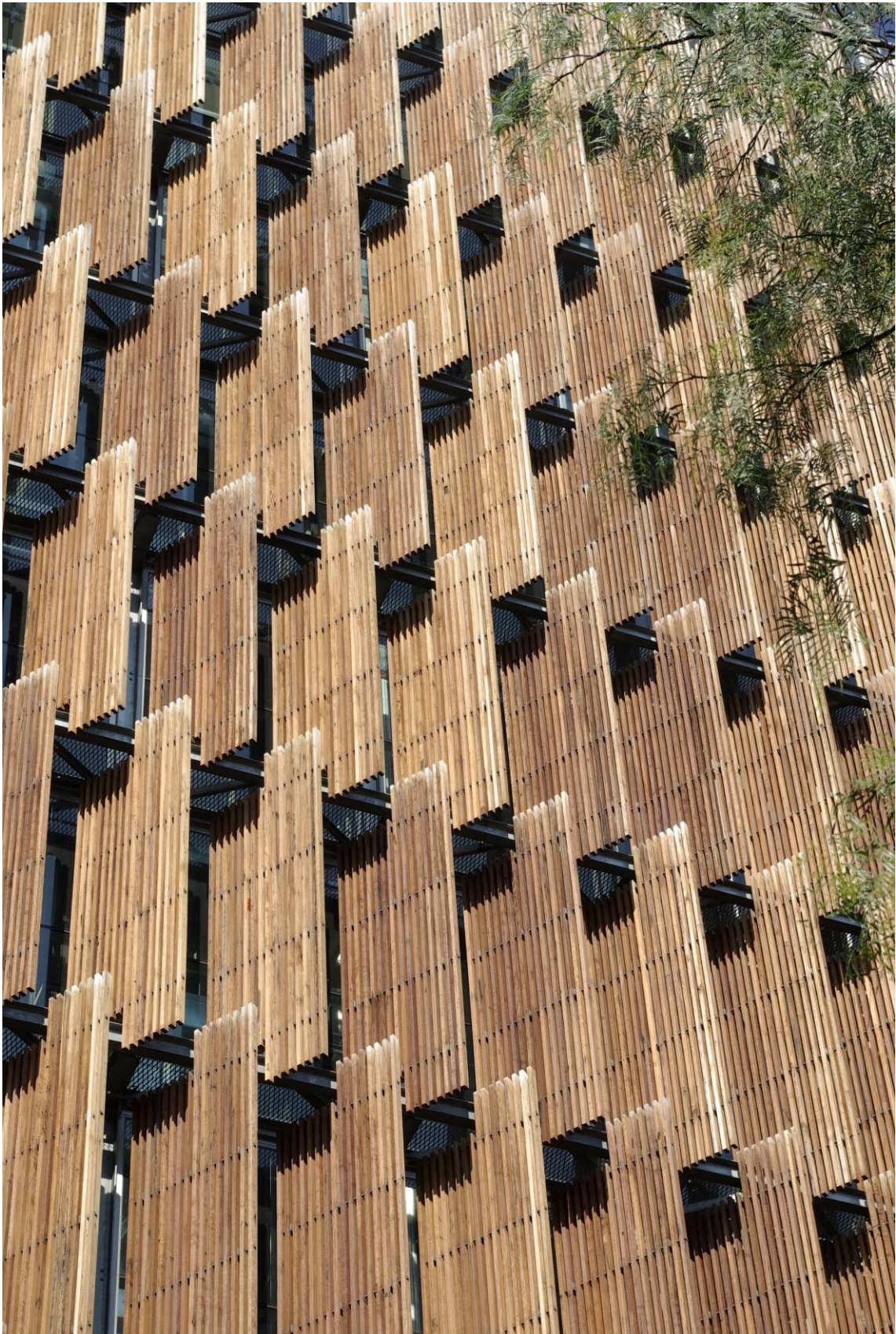


Figure 38: Sunshade on the west face of a multi-storey office building

Environmental considerations drove the design of this landmark office building. Selected on the basis of international life cycle assessment results, the windows are timber framed and the western sun shades are recycled high durability hardwoods. They are unfinished and will go grey over time. This mirrors established European practice.

6. Dynamic market

The Australian building and timber industries are part of a dynamic national and increasingly globalised economy. Change throughout the national economy and within industry has and will change the applications available for timber in building of all classes, the types of timber available to be used and the companies producing that timber. The major areas of change considered here are in Australia's building market, the timber industry and its products, alternative materials, and environmental, regulatory and policy factors.

Australia's building market

As outlined above, the timber industry's major market is residential construction, predominantly new houses and extensions to existing dwelling. However, the *Class 1* housing market is under considerable stress. Pressure is building for structural change in the patterns of house construction in Australia. In its 2008 report, the National Housing Supply Council (NHSC 2009) identified that there was a pent-up demand for housing in Australia in 2008 of a minimum of 85,000 dwelling and forecast *'a cumulative gap by 2028 of 431,000 dwellings. Annually, the shortfall is projected to be 23,000 dwellings in 2010, rising each year by a similar amount until 2016, when the size of the annual gap decreases, consistent with an ageing population.'* Reasons they cited for this short fall included:

- The varied release of broad-hectare lot construction in accordance with economic cycles, industry capacity and changing demand.
- Development of land on the urban fringe being impacted by energy use and environmental considerations.
- Planning, subdivision and development approval processes being very lengthy.
- The high and compounding taxes and charges, including contributions for hard and soft infrastructure that increase the price of housing and may delay or preclude development.

In short, for a variety of policy and financial reasons, *Class 1* residential construction has been, is and will probably be constrained below the level of underlying demand, mainly due to affordability of the current model of housing provisions. It is becoming simply too expensive to provide and service new *Class 1* housing over more and more of the landscape on the fringes of Australia's cities. In addition to the increased infrastructure charges listed above, the NHSC also cited pressure on costs in *Class 1 to 4* building in general from:

- A very tight market for skilled labour in the construction industry.
- Increased interest costs for projects due to delays in construction schedules caused by financiers' higher pre-sale requirements and skill shortages.
- Until recently rising costs of materials, particularly in steel, used extensively in multistorey construction.
- Higher costs of mid- to-high rise multi-unit developments vis-à-vis low-rise housing due to the cost of common areas, lifts and fire escapes, regulatory requirements including occupational health and safety requirements, varying trade union jurisdictions and specialist labour costs, and more complex structural designs and requirements.
- Increased environmental requirements (such as five-star energy and resource-use requirements), which impose additional costs at the construction stage.
- The imposition of GST.

This undersupply of housing has a significant structural impact on the market for timber and wood products. It represents an unavoidable loss of about 320,000 m³ of timber sales or about

6% of national sawn wood production in 2008-09 (ABARE 2009). Housing starts are unlikely to rebound from recession as they have in the past. Also, each house now uses less timber to build. Reportedly, timber use has decreased from 24 m³ per house in 1945 to 14 m³ per house in 2008, even though the average area of houses has increased considerably (Ximenes et al, 2008).



Figure 39: Large prefabricated roof modules for a major exhibition building

Several factors: pent-up demand; changing demographics; and resistance to urban sprawl, are likely to increase the proportion of housing built as *Class 2* apartment buildings. Industry reported that there already appears to be distinct changes occurring in the philosophies of government-supported residential development in cities such as Sydney and Melbourne. To minimise unsustainable expansion of infrastructure systems, governments are encouraging multi-residential developments up to six storeys in zones near existing transport and service hubs. Given the high marginal cost of providing infrastructure on the city fringe, this trend is likely to continue. In developing scenarios for selected timber markets, de Fegley et al (2006) used three cases where the share of multi-residential (*Class 2*) dwellings increased from 32% in 2005 to either 43.5% or 47.4% in 2020 against a background of declining new houses starts and reduced house sizes. After exploring these scenario and detail, de Fegley noted areas for potential timber industry strategy and policy development including:

- The shift towards medium and high density living.
- Prefabrication and modularisation of residential building to keep costs down.
- Advances in steel and concrete technology.
- The prospect of skill shortages in the building industry and related services.

Skill shortages on site appear to be increasing (NHSC 2008, de Fegley et al 2006). In response to this and other constraints on site activity, industry reported that builders appear to be starting to move as much work off-site as possible. This presents opportunities for prefabrication systems that offer speed of construction, ease of handling, and savings in other areas of the structure and the foundations. Timber systems also offer a safer construction

method, without the hardness, weight and danger of mass materials. They are cleaner and create less site noise and waste. They also provide builders with an alternative to the premiums that steel workers and tiers receive on site. In combination, these demographic, infrastructure and skills pressures create opportunities for timber construction if it can offer cost effective options, especially for *Class 2* buildings. Industry members reported receiving approaches from building design professionals, especially major builders, interested in overcoming these pressures in *Class 2 to 4* building with prefabricated timber construction.

The timber industry and its products

The Australian timber industry has, is and will continue to change and this will have considerable impacts on timber use in all forms of construction. The general concentration of production capacity discussed above is one aspect. The varying resource and species use in the market are others.

Both the hardwood and softwood industry have difficulty finding profitable markets for some portion of the timber they recover. As described in Nolan et al (2004), consumption of hardwoods in Australia has steadily declined since the 1960s to about 1.1 million m³ in 2003 while softwood consumption increased to about 3.5 million m³. Softwood products now dominate the structural timber market, especially in *Class 1* building. Since the 1990's, the proportion of hardwood being dried and used in appearance applications has increased progressively. As softwood drove hardwood from the structural market, stocks of structural grade hardwood in millers' yards rose. In the mid-1990s in Tasmania, this was known as the 'F17 problem'. While the production strategy for many in the hardwood industry now focuses on supplying primarily a high quality and high value appearance hardwood market, there is always a proportion of material unsuitable for appearance products, especially for high value *select* grade product. Producer stocks of structural and high feature grade hardwood remained high during the last cycle of housing demand and reportedly remain high. Softwood production is under similar stress. A significant minority of recovered structural softwood boards do not achieve the machine graded pine (MGP) rating necessary for market acceptance in *Class 1* framing. Consequently, producers stockpile this material or on-sell at a discount.

Engineered wood products, particularly LVL, have developed as a competitor for both structural hardwood and softwood. The suite of available LVL products competes directly with large section sawn structural material and nail-plated elements of trusses. Recently, increased LVL production overseas and from specific high-strength pine resources in Australia has sparked a further round of competition. Overseas produced LVL can reportedly be supplied at prices competitive to local softwood framing products while being as strong, straighter and more stable. All of these are desirable characteristics in building as they increase productivity and reduce construction cost. The high strength Australian LVL is being marketed as a direct competitor to niche F17 structural hardwood. Again, it is straighter, more stable and more structurally consistent. Lastly, a significant hardwood plantation estate is in the ground and sawlog supply from this resource is projected to increase sharply over the next decade. Much of this material is likely to be suitable for sawn appearance and structural timber and as a feedstock for LVL production.

While the construction industry's natural inertia cushions its impact, all these changes affect which products the builder or their fabricator select to use in a project. While some products sales increase, it is likely that a significant excess of structural and feature grade appearance hardwood and lower grade structural pine products will struggle in the competitive *Class 1* markets. Major companies need to increase the value recovered for this product. Increasing

timber sales into the *Class 2 to 9* construction market may provide a potential outlet for this material in its current form or converted into prefabricated building *elements* or *components*.



Figure 40: Steel and concrete are the 'natural' selection for most *Class 2 to 9* building

Competition from alternative materials

As discussed above, to capture a greater share of the *Class 2 to 9* building market, alternative solutions have to be displaced. The building products industry is highly competitive and materials are continually being marketed to key participants involved in the building procurement process. Among other means, marketing generally includes a manufacturer's direct marketing of a product and the joint marketing action of groups of manufacturers usually through associations such as Cement Concrete and Aggregates Australia. Associations generally market by strengthening building design professionals' confidence in their members' products, particularly through long-term market and technical support, and maintenance of standards and reference material.

For the timber industry to increase its sales in the *Class 2 to 9* construction market, it must supply and support, on balance, a superior service package than its competitors.

Unfortunately, the steel and concrete industries act with clearer market purpose. They engage with professionals in a systematic manner and are regularly seeking to develop new products and systems. They are also international industries and can introduce advances developed from around the world into Australia. Timber's direct competitor as a structural product is steel and to a lesser extent, concrete. Steel has traditionally been the structural materials of choice for non-fire rated commercial and industrial building in Australia. Key market success factors for steel construction include:

- A small pool of suppliers with strong technical control of the product.
- A relatively consistent product suite, enabling regular costing and detailing.

- An efficient and competitive fabrication and installation sector, skill in detailing, shop drawing and costing solutions.
- Competitive and consistent material supply arrangements.
- Solid support and skill development for building design professionals during their training and careers, particularly for structural engineers.
- Thorough integration of material and product properties with the infrastructure of design, such as design software & guides.

Similar success factors apply for appearance products, particularly joinery element such as aluminium windows and floor finishes. Unfortunately, the timber industry currently servicing the *Class 2 to 9* construction market does not have many of these characteristics.

Environmental and regulatory factors

Environmental impacts and sustainability are key areas of discussion in society and in the building design professions. Buildings consume great quantities of materials, energy and other resources and generate significant greenhouse gas emissions and other environmental impacts during their life-cycle. A key tenet of ecologically sustainable development (ESD) is for society to move away from reliance on non-renewable resources and the use of fossil fuels towards an increased use of renewable materials and energy sources. Timber and wood products form a major group of renewable building materials and this should improve their appeal in ESD inspired building solutions or in regulations aimed to encourage ESD.

Timber's environmental characteristics (natural, renewable, sustainable, third-party certified) are undoubtedly a positive in marketing and it is apparent that some building clients, especially governments, are open to considering timber as a preferred low-carbon material in construction. This is likely to be the basis of a long term trend. However, environmental impacts still generally rate well behind cost, functionality and availability as an influence in building procurement. Also, 'green wash' about many building materials abounds.

Regulation of environmental performance in building is difficult, as decisions about building components have significant economic impacts. Environmental-based regulation generally must be supported by evidence and have clear and achievable compliance paths. The BCA's only sustainability regulations deal with the thermal performance of buildings and aim to reduce greenhouse gas emission by using energy efficiently. While considerable debate remains over the impacts and benefits of these regulations, they could be implemented only because an evidence base existed and compliance could be demonstrated using workable computer models.

Regulatory and policy changes can appear unrelated to timber construction but still strongly influence its use. An example is the policy adopted in some states that requires sprinkler systems be installed in all new educational building. While adopted as a safety and risk aversion measure, the required inclusion of a sprinkler system in a design immediately opens the path for an alternative solution under the BCA's compliance procedures as their inclusion can reduce the required fire-resistance of the construction, especially the floors, considerably. As a result, timber structures can be used in these buildings more regularly. There are similar trends in the *Class 2* apartment sectors, where sprinklers are being increasingly seen as an essential marketing requirement.



Figure 41: High quality timber finishing and joinery in a *Class 9b* church

7. Opportunities and Constraints

As discussed above, the opportunities and constraints for any building product or service represent an aspect of use that results from specific sets of circumstances or preferences. Rarely resulting from a single requirement or characteristic, they generally occur from several often quite different factors acting in combination.

It is possible to group the discrete opportunities and constraints for timber construction in *Class 2 to 9* building identified in this study and discuss each separately, sorting them from opportunities (or strengths) to constraints (weaknesses or threats). These groups are:

- The types of building and element.
- The perception of timber in the marketplace.
- Timber with design professionals.
- Timber products and systems.
- Fabrication and supply capacity.

A. Building types and element

A1. There are significant opportunities in the Class 2 to 9 building sector.

The *Class 2 to 9* building sector is large and diverse. It offers a range of significant opportunities for commodity and niche timber and wood products and services for companies capable of responding effectively.

A2. Demand in this sector can complement demand in Class 1 building

Construction in *Class 2 to 9* buildings largely represents an extended market for timber products. Activity cycles in this market tend to complement *Class 1* building. There is the potential to establish markets for products that are not accepted in *Class 1* construction, such as high-feature timber.

A3. There are significant opportunities for the existing product suite

Due to their scale and function, key classes of building, particularly *Class 2 to 4 residential buildings* and *Class 9b & 9c: assembly buildings* offer ready opportunities for the increased sale and use of the industry's existing suite of products. Opportunities also exist for particular building elements, especially the *surfaces and structure of upper floors* and the *internal walls and associated cladding and joinery* in many classes of buildings.

A4. The internal fabric is a key market opportunity

There is considerable potential to increase timber sales and use in internal partitions and architectural surfaces with commodity products, such as scantling and strip flooring, and fabricated items, such as joinery, window and doors. This market is not complicated by structural consideration but demands attention to acoustic performance, some fire requirements, and key material characteristics, such as hardness.

A5. For structural applications, 'replace steel' is a clear approach

The performance and fire requirements for timber and unprotected steel are very similar. With the rising costs of steel, there is already a solid trend to save money by replacing steel elements with timber one in the upper floors and roofs of *Class 2 to 9* building. Timber's superior architectural appeal is also supporting steel replacement in assembly buildings, such as halls and swimming pools.

A6. Prefabrication will become increasingly important in construction

Trends such as increasing occupational health and safety requirements, constraints on site access, noise and waste, and escalating skill shortages favour increased prefabrication. Light

weight timber-based *components* and *elements* could replace traditional stick built systems and compete strongly with steel and concrete systems on cost, safety and speed of construction. Timber also provides builders with an alternative to the dominance of steel and concrete trades in larger projects.

A7. There are opportunities building for new high-performance products

It is probably impractical to extend *Class 1* building systems such as nail-plate trusses into a range of high-performance applications like high-grade apartment and hotels. They are unlikely to satisfy the performance characteristics that this market expects. However, opportunities exist in these markets for clean, light weight, prefabricated high performance components such as solid wood panels that provide an alternative to tilt slab.

A8. The housing market is undergoing structural change.

Long-term factors are constraining the timber industry's major market: standard *Class 1* residential building. A substantial supply gap has developed even in periods of substantial economic growth. This gap is projected to continue to grow, limiting the size of industry's market. At the same time, less wood is being used to make each *Class 1* building. Diversifying markets into other building classes is timely.

B. Timber in the marketplace

B1. Timber has natural design appeal

Timber construction has real appeal to a small but probably growing proportion of building clients and design professionals. They appreciate the aesthetical properties of visual grade glulam timber, appearance hardwoods and engineered wood products, the improved internal conditions (acoustics and warmth) found in wood rich environments, the high strength to weight structural properties of the material, and its resistance to corrosive environments.

B2. Timber's carbon emissions and environmental aspects are marketing positives

Some building clients, especially governments, now recognise that building materials generate considerable carbon emissions and are open to considering timber as a preferred low-carbon material in *Class 2 to 9* construction. Some professionals are taking a similar position by choice. Timber's other environmental credentials (natural, renewable, sustainable, certified) reinforce this preference. Forest certification is becoming an essential requirement to market timber and timber products to this user group.

B3. Many timber construction systems are competitively priced

Timber construction can be significantly more economic than other construction forms for buildings up to three storeys. Large price rises in recent years for structural and reinforcing steel improved timber's relative economy and forced developers and designers to consider it as a viable alternative to steel and concrete. Recent decreases in steel prices have slowed this trend but developers and builders recognise that this may just be a respite. An underlying interest in timber construction appears to remain.

B4. Large scale timber construction is novel

Building design professionals can still regard large-scale *Class 2 to 9* timber building as novel construction. Performance and specification requirements can be uncertain. Perception and understanding do not automatically support its use. Timber can be regarded as old-fashioned or too low technology.

B5. Environmental aspects are discretionary considerations

While the topic of considerable discussion, environmental impacts still rate well behind cost, functionality and availability as an influence in building procurement. Competitive products are marketing themselves strongly as the "green" product for the new millennium.

B6. Established systems remain dominant

The building industry is conservative and has significant specification inertia. Traditional design solutions, such as steel and concrete in the structure, aluminium in window and doors, and laminates in joinery, are strongly entrenched and widely supported. They are not novel. Costs and performance are known. Perceptions and understanding support their use.

C. Timber with design professionals

C1. Overseas and local design and construction practice provides inspiration

Building design professionals see timber being portrayed as a fashionable and environmentally responsible material in local and international magazines and journals and in television programs such as *Grand Design*. These spark interest. Production technology and construction techniques for high-performance *Class 2 to 9* timber-rich buildings are well established overseas, especially in Europe, and can be transferred to Australia.

C2. There is a shortage of competent design professionals

Professional design expertise with wood is limited and localised. Building design professionals, particularly consulting engineers, have little experience or confidence with timber design and performance. Many are ignorant of timber's structural potential and possibilities. Quantity surveyors do not have the experience to cost timber construction efficiently and it does not regularly appear in their reference publications.

C3. Overcoming these shortages needs short and medium term responses

Building the necessary expertise in the design professions is a medium to long-term proposition. To secure projects for wood in the short term, timber solution providers are regularly taking over responsibility for structural design and detailing and provide running cost estimates. The same response may be needed for architectural components but the appearance material supply industry is not structured in a way that supports this.

C4. Lack of confidence with many builders and developers

Builders operating in the *Class 2 to 9* construction market are often unfamiliar with engineered wood products or their opportunity in construction. Owners and developers can be risk-averse. As potentially a novel construction technology, timber building can be thought to affect performance, market acceptance, and resale value.



Figure 42: Fit out detail in a *Class 9b* public building

D. Timber products and systems

D1. A broad range of proven systems and techniques is available

The timber industry supplies the *Class 1* building industry with a range of highly efficient, economic and proven construction systems and techniques. Many of these are directly transferable to the *Class 2 to 9* construction sector in their current form or with minimal variation. These products include nail plated products, engineered wood products, appearance hardwoods, and external joinery.

D2. There is significant scope to increase prefabrication

Current prefabrication techniques focus on providing construction elements, such as basic wall frames and trusses. There is considerable scope to move more of the construction process into prefabricated timber panel systems.

D3. For the existing product suite, technical solutions are largely available

There are no significant regulatory or technical constraints on using the existing product suite in many new buildings up to three storeys. This includes *Class 2, 3 and 9* buildings, if they are sprinkled. Many are now required to be. While BCA compliance requires an alternative solution, these solutions are becoming increasingly common.

D4. Timber construction options are highly variable

The timber industry offers, supports and competes across a wide range of products and solution systems in addition to competing against non-timber alternatives. When alternative material suppliers are offering a clear message about a single solution set, timber's diversity of options can confuse designers and clients.

D5. Materials in combination are often needed to satisfy key performance requirements

Key performance requirements for *Class 2 to 9* buildings include the acoustic performance of separating floors, fire-performance in multi-level construction, the durability of external components, and resistance to insects like termites. The systems that satisfy these performance requirements often combine several types of wood products and other materials. As the system may not belong to any single producer and requires cross-producer collaboration, they may not be developed, or if developed, not promoted and only indifferently supported.

D6. Appearance grade classifications are limiting

There are significant market constraints on the acceptance of some species and grades for appearance applications. With poor specifier understanding of the consequences of grade selection, the default position appears to be 'select'. This generates demand for this product but results in stockpiles and loss of value in equally useful material of other grades.

E. Fabrication and supply capacity

E1. Some companies are committed to exploiting opportunities in Class 2 to 9 building

Key fabrication and timber supply companies have established themselves as timber solution providers, committed to work in the *Class 2 to 9* building markets. They have invested strongly in developing the design support, administrative and fabrication capacity necessary to secure and service these projects.

E2. There is an established Class 1 fabrication and supply industry

A strong timber supply network and fabrication industry exists for *Class 1* building. A range of manufacturers supply a suite of economic and high-quality engineered wood products. Fabricators supply structural elements: wall frame and nail-plate truss, and appearance elements: windows, doors and joinery. Merchants and fabricators effectively service and have

established relationships with the broad builder community in their area. They are generally versatile and willing to explore new options and can respond quickly to changing market conditions and opportunities. Some successfully engage with building design professions. Others are capable of doing so.

E3. For the broad timber industry, the domestic market is dominant

Timber companies are structured to aggressively compete in the dominant domestic construction market. Producers and suppliers compete on price. Those directly connected to the building project compete on price and service. Servicing the domestic market is simpler than servicing the *Class 2 to 9* markets. Technical and service demands are fewer, lower, more consistent, better supported, and easier to understand.

E4. Potential for collaboration across the sector is high

Fabrication and supply companies operating in the *Class 2 to 9* building market frequently collaborate with other producers and installers to provide integrated solutions for projects and satisfy common tender conditions. Some have specialised in brokering solutions.

E5. Servicing the Class 2 to 9 market can be profitable

Companies operating effectively in the *Class 2 to 9* market can make good profits. However, they incur greater risks as they provide increased design support and production capacity.

E6. Servicing the Class 2 to 9 construction sector can be difficult

It is more difficult than servicing the *Class 1* sector. Technical, service and administrative demands are higher; more varied, and have varying support levels. Companies must maintain or have access to expertise in areas such as advanced structures and material effects, fire performance, acoustic separation and construction programming. Unpredictable project timelines can complicate support requirements and lead to considerable production and fabrication stress. There can also be complex contractual requirements. Considerable investment is required over time to build up the necessary technical support and production capacity, and establish a reputation within the architectural, engineering and builder sectors.

E7. It is hard to influence the point of initial decision

Many timber supply and fabrications companies are relatively small and do not have the capacity to research projects planned for construction, establish an industry profile or influence decisions at the planning stage. Just raising the option of timber in non-residential construction can be a challenge.

E8. Industry's administrative and contractual capacity is generally limited

Used to dealing with *Class 1* builders, the general timber supply industry is not structured to handle the administrative and contractual demands common in *Class 2 to 9* projects, especially large flagship projects. Tender documents can be complex, and the consequences of failure to supply considerable.

E9. There is no critical mass of participants

While some industry members are investing in these markets, others may have little interest or understanding of its potential. Consequently, there is not a critical mass of participants working in the sector. This has significant ramifications: companies operate largely in isolation and cannot learn from others; product niches may be identified but not exploited; and support and education systems are limited.

E10. Frame and truss manufacturers have limited expertise outside Class 1 building

Frame and truss manufacturers represent the bulk of Australia's fabrication capacity for structural timber products. They have often optimised their businesses to produce house lots efficiently. As commercial projects can tie up production capacity for relatively long periods,

service to their smaller regular customers may be broken. Also, the structured progress payment systems of commercial projects may not suit the cash flow requirements of a small company.

E11. The fabrication sector does not install and may be excluded from tendering on projects

Class 2 to 9 construction often requires supply & installation packages. As *Class 1* construction does not normally require this service, fabricators generally do not provide it. This can exclude them from consideration in many projects. To provide a complying tender, frame and truss manufacturers may have to partner with specialist installers.

E12. Production capacity of structural elements can be limited

Production capacity of key timber materials or elements can be limited and supplying large projects difficult. This particularly applies to products with only a marginal use in *Class 1* construction, such as glulam. Projects with significant architectural input often require specially manufactured and often large material. The capacity to make and manufacture large sizes and potentially complex timber jointing systems in Australia is very limited.

E13. The availability of premium appearance products is limited

With Australian hardwoods, there is naturally a delay between any movement in sales and movements in production and product supply. Also, log supply has fixed upper limits with significant supply constraints on certain species. Most market demand is for select timber and recovery of this material is dependent on log quality and maturity. As log quality and size decreases, select recovery will diminish and supply of other grades will increase. Plantation hardwoods will have different performance to accepted native forest material and this will complicate the position further.

E14. Any new system solution needs to complement existing methods and supply systems

The barriers to new systems solutions are high unless they complement existing fabrication and supply networks. If they seek to establish new solutions outside these networks, a full market support system will need to be established.

E15. Supplier replacement

It is highly probable that the *Class 1* builder will buy from the fabricator or supplier who supports them. However, given the competitiveness of *Class 2 to 9* projects, there is no guarantee that the company who supports the specification of timber in a project during the design stage will win the sale during construction. Others may undercut them on price or quality and win the tender. This can compromise support and confidence.

F. Timber industry structure

F1. Broad wood marketing is now centralized

A single, national timber marketing and research organization exists in Forest & Wood Products Australia. This has the potential to remove some of the industry's traditional fragmentation. While fabricator and joiners control the delivery to site of a significant proportion of wood products to the markets, they do not pay FWPA levies and are not directly included in decision making.

F2. Major producers are withdrawing from close interaction with the market

Commodity production requires national or international sales while the construction market is generally local or regional and service intensive. While withdrawal from the construction market simplifies business models, it can obscure opportunities, problems and the impacts of competitor action. Much of the industry now sells products but not solutions for projects. This

undermines a sales and innovation mentality, particularly the co-ordination of marketing with sales support. Technical capacity is also reduced. All limit long term sales potential.

F3. The broad industry does not consistently engage with the design professions well

Fragmented and concentrating on commodity production or supply to the *Class 1* building sector, the timber industry has generally resisted regular interaction with the building design professions. Participation in major marketing events and representation in professional organisations is limited. Unfortunately, the building products industry is highly competitive and unsupported products can quickly be overshadowed by competitors or fall from favour.

F4. Broad technical support is limited and of varying quality

Outside of the limited *Class 2 to 9* fabrication sector, skilled technical support for timber users is limited and appears to be diminishing. Regional timber support organisations have closed or withdrawn services. Key standards such as AS1720 and AS1684 have been poorly supported and are becoming disjointed, making them less relevant to those in practice and in education than the processes of competitor materials. There are insufficient general technical guides and tools to assist with project design work, especially when compared to competitor product groups. Market expertise levels in companies are constrained or declining.

F5. Production and support staff may have little understanding of construction processes

This limits the industry's potential to make quality products and deliver them to a schedule appropriate to building. Without appreciating the demands of site, the demands of production can dominate, often to the builder's cost. The production industry has few educational opportunities.

F6. Timber major competitors do not suffer the same organisational weaknesses

The steel and concrete industry act with clearer market purpose and engage with professionals in a systematic manner. They actively encourage education and training, particular in technical areas.



Figure 43: Timber roof and wall structure in a two storey religious centre.

The curved beams are plywood box beams made on site.



Figure 44: Apparent market 1: Framing, lining and joinery in the internal fabric

Conclusions

This report explores the potential for the timber and wood products industry to increase the use of its products in building construction, particularly in the *Class 2 to 9* multi-residential, commercial, and public building sector.

There are opportunities for industry in this sector. A small but growing section of the building design and building profession have developed an interest in timber construction for *Class 2 to 9* building, due to the rising cost of steel, timber's general economy, increasing site constraints, and concerns over carbon emission. The *Class 2 to 9* market is largely an underdeveloped market that has the potential to generate significantly additional sales if strategically developed. It is large and diverse. It offers a range of significant and continuing opportunities for commodity and niche timber and wood products and services to companies capable of responding effectively. With targeted marketing, there is the potential to establish markets for products that are not accepted in *Class 1* construction, such as high-feature timber and lower grade pine. The sector is also open to new prefabricated timber solutions.

There are at least three immediately apparent markets for timber construction in *Class 2 to 9* building. These are:

- Architectural framing, lining and joinery in the internal fabric of all building types
- The structural frame of low rise *Class 2 to 9* building; and
- Economic replacement of other materials in multi-storey Class 2 and 3 building.

It is in industry's interest to diversify from dependence on *Class 1* construction. Pressure is building for major structural change in the patterns of house construction in Australia. The undersupply of an estimated 23,000 dwellings annually from 2010 represents an unavoidable loss of about 320,000 m³ of timber sales in industry's major market. Further market loss will result from a shift in housing provision from *Class 1* to *Class 2* apartment buildings. This move is already apparent in the major capital cities and likely to increase in future years. While *Class 1* buildings are predominantly timber construction, *Class 2* buildings are generally other construction forms.

The industry has strengths in the *Class 2 to 9* building sector. This sector is already an established market for the Australian timber and wood products industry. It currently consumes between 10% and 15% of all material produced and probably a higher proportion of appearance material. Some sections of the industry specifically service the *Class 2 to 9* building market. The majority accept participation in this market while the remaining focused on servicing the dominant *Class 1* sector. Industry has sufficient technical solutions to economically supply and successfully include the current wood products suite in timber construction in a wide range of new *Class 2 to 9* projects. This includes buildings up to three storeys if alternative solutions are used for BCA compliance. The current product suite is versatile and supported by an efficient and flexible fabrication sector. With strategic developments, this sector is capable to deliver more extensive solutions.

The industry has weaknesses in the *Class 2 to 9* building sector and these form the major constraints on increasing sales. The timber and wood products industry, and due to a lack of regular engagement, the building and building design industry, do not have sufficient staff with the skill and expertise necessary to use timber in construction in the *Class 2 to 9* sector regularly and effectively. Technically sophisticated projects are currently only possible on an exceptional basis when one of Australia's few specialist timber fabrication companies is involved or the project is driven by strong architectural demand.

Engagement with building design professions is critically important to further sales in this sector. The building products industry is highly competitive and unsupported products and systems can quickly be overshadowed. Unfortunately, the timber industry has generally resisted regular interaction with the building design professions. Participation in major marketing events and representation in professional organisations is limited.



Figure 45: Apparent market 2: Low rise Class 2 to 9 building. This is Class 9b sports club

The benefits of timber construction seen in Class 1 building construction transfers directly to small Class 2 to 9 projects such as this clubhouse.



Figure 46: Apparent market 3: Economic options in multi-storey Class 2 and 3 building

Infill walls, the upper storey structure and even the whole façade system are ready markets for timber solutions based on the existing product suite

Industry's withdrawal from direct engagement in the building market has several important consequences. Building design professionals and building owners appear to lack confidence in the material as a design solution except in *Class 1* housing. Producers have very little capacity to 'grow' the market for timber products at the expense of substitutes. Probably most importantly, technical support becomes a discretionary activity for industry. This has the potential to further undermine industry's technical capacity, particularly in the regular and effective design and inclusion of timber solutions in buildings.

Industry's technical capacity in building is not high. Major technical skill in building probably rests with the few specialist fabrication companies operating in Australia. Technical support outside of producer companies is also limited and declining. Several regional timber support organisations have closed or withdrawn services. Educational opportunities are very limited.

This lack of skill has several important consequences. An industry with reduced technical capacity will find it difficult to capture and hold an increased share of *Class 2 to 9* construction, particularly *Class 2* construction. It will not be able to provide, on balance, a superior service package than its competitors. An industry with low technical skill can not encourage technical skill in others. In assessing the opportunities and constraints, industry members ranked *the shortage of competent building design professionals* as the most important item. Also, there comes a point where the industry's general technical expertise drops below a viable level and industry's capacity to maintain even the technical support infrastructure for *Class 1* building comes into question.

Action is needed to capture the opportunities of the *Class 2 to 9* construction market and overcome industry's weaknesses that constrain increased sales in this sector. This action should focus on both long and short term objectives that build:

- Technical capacity in industry by supporting those already active in the *Class 2 to 9* sector, encouraging fabricators and joiners to enter that sector, and persuading major producers to increase their general engagement with the building industry.
- Design capacity in the building professions by working with those professionals already involved in timber design and supporting those who wish to be involved with timber design. Part of this is broadening general engagement with the general professions.
- Confidence and resilience in Australian timber design.

There is a core of technical and design capacity within industry to support this action but currently it lacks encouragement and focus.

There are threats for industry. Timber's major competitors in *Class 2 to 9* construction, the steel and concrete industries, act with clearer market purpose. However, there are considerable opportunities for timber construction. It is prudent and likely to be more profitable for industry to maintain and build its technical capacity and become actively involved in the *Class 2 to 9* construction sector.



Figure 47: Hardwood cladding and timber framed doors and windows

*This is a market of interest but designers' concern over durability needs consideration.
Image courtesy of Spowers Architects*

Recommendations

This report recommends that industry act to build its own capacity in timber design and construction, and support increased capacity in these areas in the building design professions and the general building industry.

This action should include:

- Incorporating the opportunities and constraints included in Section 7. Opportunities and Constraints into the industry's market development plan.
- Review and increase funding for general technical and educational support for timber in *Class 2 to 9* building, particularly:
 - Direct technical support for projects, either through designated support officers or a co-ordinated industry support network; and
 - Maintenance of major technical standards
- In cooperation with industry members, initiate two broad campaigns as vehicles for action and means to increase confidence and skill. These recommended campaigns are:

1. **Save money and carbon, use timber in structures.**

This would build on action already occurring in the market to replace relatively expensive options such as steel in the upper storey structural components of a *Class 2 to 9* structure with timber construction. In addition to selling more timber, the aim of the campaign would be to:

- Recognise and support those already involved in this activity.
- Provide a focus for joint marketing and further collaboration between the specialist fabrication sectors and the nail-plate products industry.
- Encourage greater capacity in the frame and truss manufacturing and timber supply sectors.
- Foster links between fabricators, producers and builders.
- Provide a vehicle to communicate key marketing messages:
 1. Timber construction is economic.
 2. Timber does the same job in non-residential building as other materials.
 3. Timber has intrinsically lower environmental impact.

Educational activities and the preparation of additional technical guides and tools will necessarily form part of this campaign.

2. **Timber in comfortable interiors.**

This would build on the existing use of appearance grade products, particularly hardwood, and complementary structural products in internal applications. The aim of the campaign would be to:

- Provide a focus for joint marketing and further collaboration between appearance timber suppliers, joiners and internal finishing trades;
- Encourage the use of timber framing, linings and trims as internal wall systems and timber external joinery in conventionally concrete framed buildings.
- Provide a vehicle to communicate the value of natural grades of timber, especially native forest and plantation feature grades.

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- Boral Ltd
- Carter Holt Harvey
- Engineered Wood Products Association of Australia
- Frame and Truss Manufactures Association
- Gunns Ltd
- Hudson Building Supplies Pty Ltd
- Hyne Timber
- MiTek Australia Ltd
- Multi-Nail Pty
- Nelson Pine Industries Ltd
- Pryda Solutions
- Tasmanian Timber Engineering
- Tasmanian Timber Promotion Board
- Tilling Timber Pty Ltd
- Wespine
- Wines Trusses

Appendix 1. Technical support survey

The survey of technical support brochures was conducted by searching and downloading information from the Internet sites of major companies and organisations. The site searched included: the Australian Timber Flooring Association, Bradford Insulation, Carter Holt Harvey, the Engineered Wood Products Association of Australia (EWPA), Hynes Timber, ITC Ltd, MiTek, Tasmanian Timber, Timber.net, Timber.org, the Western Australia Timber Framing Resources (watimberframing.net) and Wesbeam.

160 brochures were recovered and their apparent focus assessed against product, component and building type. Brochures could have more than one apparent focus. The initial results of this assessment are included in the tables below.

Table 8: Brochures for appearance products by type

Appearance products	Brochures	%
Flooring	34	49.3%
Finishing and joinery timber	8	11.6%
External joinery	13	11.6%
Internal joinery	9	13.0%
Architectural lining	0	0.0%
Architectural structures	5	7.2%
Total	69	

Table 9: Brochures for structural products by type

Structural products	Brochures	%
Framing and structural timber	37	38.1%
LVL, I-beams and LVL products	25	25.8%
Plywood	15	25.8%
Glulam	1	1.0%
Wall frames	8	8.2%
Nail-plated products	6	6.2%
Other prefabricated components	5	5.2%
Total	97	

Table 10: Brochures for building components by type

Component	Brochures	%
Superstructure	33	20.5%
The roof	23	14.3%
Upper floors	33	14.3%
Ground floor	42	26.1%
External walls	19	11.8%
Internal fabric	11	6.8%
Total	161	

Appendix 2: Interview Schedule

The following members of the timber and construction industry were interviewed or made comment on documents for this report.

Fred Bosveld	Beck's Span Truss Systems
Leon Travis, David Angus	Boral Ltd
Ronald Green	Carter Holt Harvey
Peter Dingemanse.	cb&m design pty ltd
Simon Dorries	Engineered Wood Products Association of Australia
Nick Livanes	Frame and Truss Manufactures Association
Christine Briggs, Geoff Eberhardt	Gunns Ltd
John Simon	Hudson Building Supplies Pty Ltd
Fiona Luckey, Robert Mansell	Hyne Timber
Tim Rossiter	MiTek Australia Ltd
Phil Ladson	Multi-Nail Pty
Dominic Iannelli	Pryda Solutions
Chris Ward	Tasmanian Timber Engineering
Peter Wines	Wines Trusses

Appendix 3: Industry questionnaires