

Factors that influence design professionals when they use structural Timber in Australia.

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Summary

While Australian researchers produce considerable technical output on timber engineering, timber is not a dominant building material outside the domestic construction sector in Australia. While proven technical solutions are available, they are not the first choice for most practising building designers. This paper reports on research into the factors that influence Australia's building design professionals when they make decisions about using timber as a structural material in non domestic construction. Three professional groups were studied: architects, structural engineers and quantity surveyors and their opinions gauged by qualitative and quantitative means. In all, almost 250 practising professionals were interviewed.

The research confirms that the use of timber in complex or sophisticated building is restricted and that building professionals do not use timber as much as they could. The considerable variation in the use of structural timber between Australian states is documented as is the relative importance the various professions place on different criteria. Architects view timber differently to structural engineers. Nevertheless, both groups use it for similar reasons; its aesthetic character, its workability and its economy. However, a perceived lack of effective support from industry and a general lack of confidence in timber design and documentation skills are shown to be impediments to its increased use.

1 Introduction

Architects... use timber for residential work... as timber is traditional and trades-people know how to use it. Architects falsely believe that timber cannot be used or is inappropriate in commercial \ institutional buildings. (For them,) commercial & institutional building = steel & concrete.

Comment from architect experienced in timber design.

Timber is a fundamental building material which is generally preferred for domestic construction. It is evident, however, from everyday observation that for non domestic applications, timber is not the preferred construction material for many Australian building design professionals; architects, structural engineers and quantity surveyors. As a result, there is a huge percentage reduction in the use of structural timber when the function of the professionally designed building changes from a domestic to a non domestic one. Consequently, structural timber is relatively rarely used in the non domestic buildings that these professionals design.

Given this, the Tasmanian Timber Promotion Board (TTPB) commissioned the Timber Research Unit (TRU) at the University of Tasmania to conduct professional research to identify the factors that influenced these professionals in their specification of timber and timber products. While the TTPB and others had commissioned various market research studies in the past, these had tended to concentrate on the immediate response of a wide range of users to a specific process or product, such as flooring. Conducted by general market research companies, these were useful but limited in developing an understanding of how and why professionals use timber. The research commissioned from TRU differed as it was to provide fundamental understanding of the workings of a key user group; building design professionals. It concentrated on the problems in practice of these professionals and was conducted by those experienced in their processes. The research aimed to discover what proportion of professionals' work involved timber, what they felt about timber and timber products, how this influenced their pattern of usage and how the timber industry might encourage the increased specification of timber.

2 Methodology

The research was carried out as three separate studies. The first studied the factors that influenced architects in their use of timber products and included qualitative and quantitative stages. In the qualitative stage, twelve key architectural practitioners, all known to have used timber extensively in their practice, were asked to critique an issues paper exploring the benefits and problems of using timber in design. All responded, often with considerable written commentary. These were collated and analysed before being used to inform the design of a phone poll questionnaire. This poll was taken of a random sample of architects from one hundred architectural practices in NSW/ACT (30), Queensland (20), Tasmania (20) and Victoria (30). It sought to gain an understanding of the use of timber across the

range of applications that normally involve an architect, including internal finishing and the use of structural timber in both domestic and non domestic construction. The questions focused on timber as a generic material. They did not differentiate between hardwood, softwood or engineered timber products.

The comments on the issues paper and the results of the phone poll were analysed and an initial report prepared. In part, this report identified that two partner professions, structural engineers and quantity surveyors, also had significant influence on the design process and the decision to include or exclude timber in projects. Subsequently, studies were commissioned to investigate the factors that influenced these two professional groups in their design and use of timber in building. In these studies, structural engineers and quantity surveyors were interviewed about their practice and the results used to inform the design of phone poll questionnaires for each profession. These polls were taken of a random sample of 100 structural engineering practices (37 from NSW/ACT, 20 from Queensland, 15 from Tasmania and 31 from Victoria) and 35 quantity surveying practices (14 from NSW/ACT, 6 from Queensland, 4 from Tasmania and 11 from Victoria). Again, all questions focused on timber as a generic material.

The results of the two studies were reported individually and the three pieces of work were then synthesised into a short summary report. That summary report forms the basis of this paper.

2.1 Interpretation & quotes

In analysing the data and in the presentation below, phone poll respondents were generally sorted into three groups. Architects who identify themselves as using timber always or much of the time in non domestic structures or structural engineers who used timber in more than 30% of their building design work were grouped as **frequent users**. Architects who occasionally used structural timber and structural engineers who used timber in more than 11% but less than 30% of their building design work were grouped as **occasional users**. Those who never or rarely used structural timber in non domestic building were referred to as **non users**.

Quotes in the paper are taken from records of interview or written comments to the issues papers. As these were confidential, the quotes are not credited to individuals, only the type of professional involved.

3 Key findings

The key findings of the studies were:

1. Timber is an underutilised material in professionally designed non domestic buildings;
2. The design professions suffer from a major lack of timber building information;
3. The design professions are positive about timber as a material and industry strategies to help them design in timber are welcome;
4. There are significant numbers of non domestic timber buildings designed by professionals that are unacknowledged in industry or professional literature; and
5. Alternative product manufacturers recognise design professionals' requirements for design and technical support.

4 Timber is an underutilised material

This research shows that design professionals do not use timber as much as they could.

Architects routinely design domestic buildings using structural timber. While it might be assumed that much of this usage would transfer to the non domestic applications that form the bulk of their work, this does not happen. As shown in Chart 1, eighty-eight per cent of architects frequently use structural timber in housing but only twenty per cent use it frequently in non domestic construction.

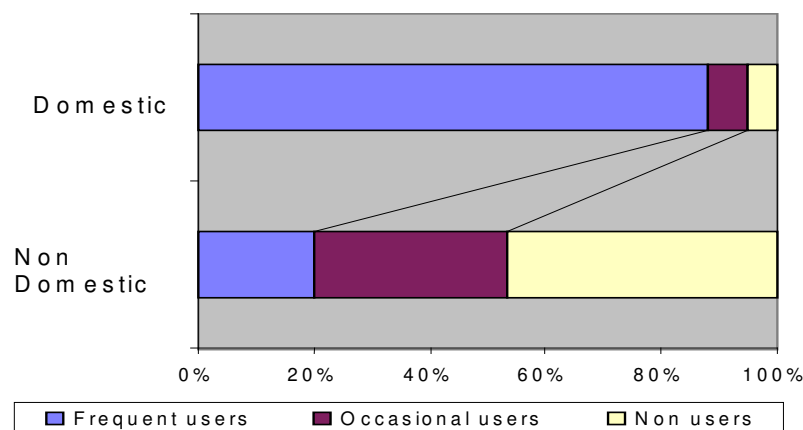


Chart 1: Architects - Percentage of frequent structural timber users.

This disparity of these results is even more glaring when examined by state. 76.7% of NSW architects were frequent timber users in domestic building but only 6.7% were frequent users for non domestic building. There is a similar fall in Tasmania from 95% to 10%. 63% of NSW architects said that they rarely or never used timber in non domestic projects. In Victoria, 100% of architects responded that they frequently used timber in housing but only 31% did so for non domestic projects.

% Respondents	Frequent users	Occasional users	Non users
NSW	6.7	26.7	63.3
Queensland	33.3	28.6	38.1
Tasmania	10.0	55.0	35.0
Victoria	31.0	27.6	41.4

Table 1: Architects: Structural Use in Non Domestic Building by State.

Much of this decline can be explained by the different requirements of building in the non domestic building sector. However, it is reasonable to assume that the profile of building projects for NSW and Victorian architects is similar and that their opportunity to use timber as a design solution would be the same. Yet, there were four times as many architects who were frequent timber users for non domestic projects in Victoria than in NSW.

30.1% per cent of structural engineers identified themselves as frequent users of structural timber in their design work. Again, the percentage use of structural timber varied between states. Victoria had the highest average use of timber with practitioners using it in about 34% of their building design work. NSW practitioners were again considerably lower with average use at 24%. Interestingly Queensland engineers returned the lowest average use of timber in the building work they designed at 18% while Queensland architects had the highest proportion of frequent timber users at 33.3%.

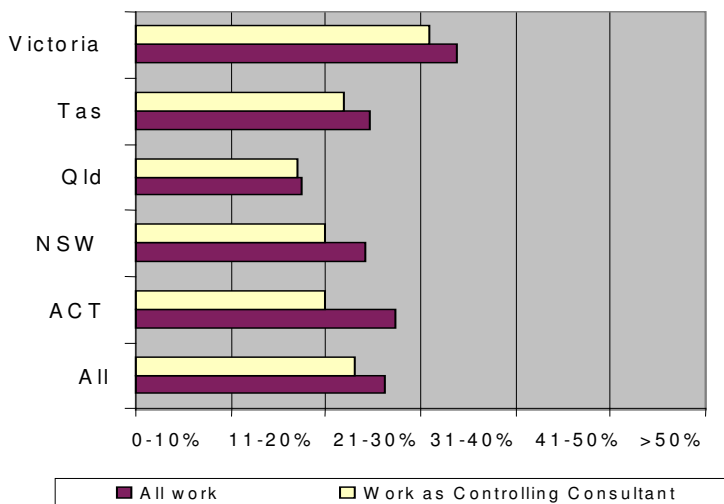


Chart 2: Structural Engineers - Percentage of building design work using structural timber.

In comments on the issues paper, architects reported that structural engineers generally avoided timber in building structures. This research does not support that assertion. Structural engineers were asked about their use of timber in all their building design work and in their work when they were the controlling consultant. For all respondents, the drop in timber usage between projects where structural engineers were controlling consultants and where they were secondary consultants was only 3%. This implies that if structural engineers use timber when they work with architects, they are also likely to use it when architects are not involved.

Quantity surveyors estimated structural timber in thirty-six per cent of the domestic buildings they quantified and in twenty per cent of the non domestic structures (on average). Again, there are significant regional differences in these figures as shown in Chart 3 with the results further supporting the position that Victorian professions have a higher usage of timber in non domestic buildings than professionals in other states.

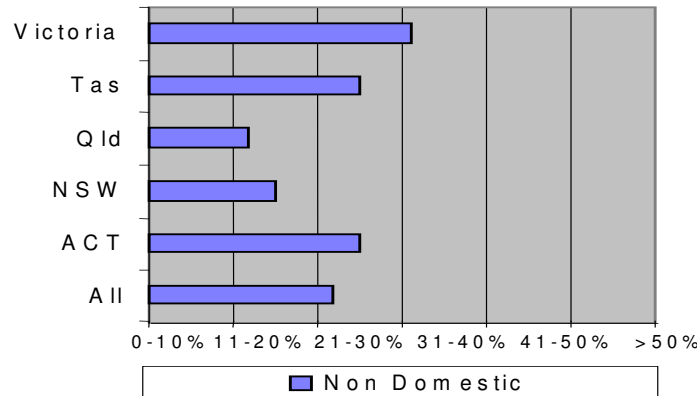


Chart 3: Quantity Surveyors - Percentage of projects with timber in non domestic construction.

These results demonstrate that professionals do not use structural timber as much as they could. If Victorian usage of timber in all three professions is taken as the maximum practicable use of timber in the range of professionally designed projects, then clearly design professionals in other states have the potential to increase timber and timber product usage in buildings. However, as set out below, it is probable that the use of structural timber could be improved in Victoria as well given increased industry support.

5 Design professions lack timber design skills and building information

Timber structures are tricky little suckers to design.

Comment from structural engineer experienced in timber design.

Our experience with architects working on new... buildings ...(is that) they design buildings for steel, substitute timber, and then complain that the section sizes are too big!

Comment by an architect experienced in timber design.

I enjoy using timber but it is often complicated - never drawn well enough for us to measure and quantify. Architects find timber difficult to draw and we often have to ring and ask a lot of questions. Architects need more training in drawing timber buildings and components

Comment by a quantity surveyor.

Although most design professionals covered timber building in their graduate education, it appears that many lack the skills necessary to design or quantify non domestic or non standard timber buildings efficiently. This manifests itself in practice through uncertainty in the design and documentation process, and over allowance in estimating costs.

5.1 Complication in practice

Design professionals run businesses that succeed or fail on the cost effectiveness of the services they offer to clients. There is evidence that they favour systems of prefabrication or assembly precisely because design and documentation time is reduced and structural engineers favour well supported pre-engineered systems as they require less research. While many design professionals responding to this research found the timber framing manuals adequate for domestic construction, they described designing non standard timber construction as being on a tightrope without a net. Less than 50% of the surveyed architects who were occasional or non timber users found documenting non domestic timber building uncomplicated. A third of architects who were frequent users found documenting these building a complicated task. Only 47% of all structural engineers found documenting non domestic timber building uncomplicated while 41% agreed that other design professionals appeared to have little knowledge about building with timber. This figure rose to 50% for structural engineers who were non users. This lack of understanding means that design with timber is more risky and take longer to design than with other materials. As timber is only one of a number of material options, practitioners are aware of the cost of designing with a material that they do not understand well. As a consequence, in challenging or important projects, there is a tendency to avoid it.

The competitive fee bidding for Olympic works almost ruled out timber engineering. I know that much of the timber engineering that (Firm A) does is more for love than profit.

Comment by an architect experienced in timber design.

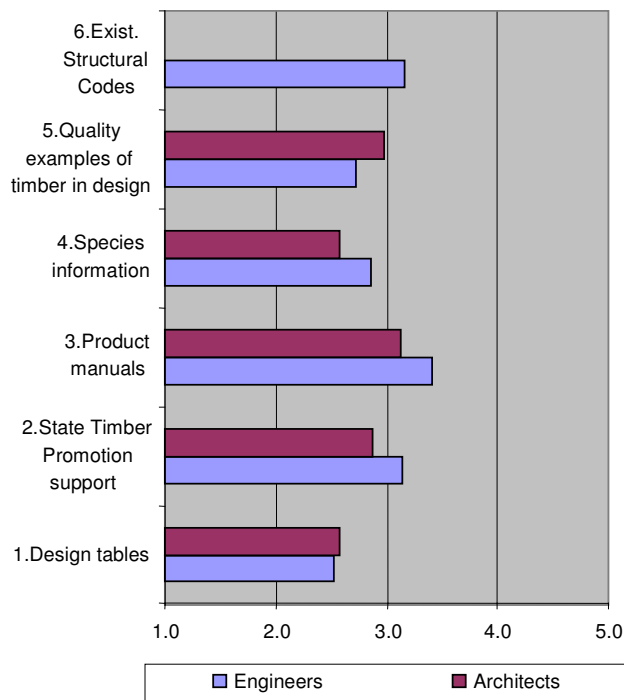
5.2 The perceived cost of timber structures

Cost is one of the most critical considerations in any building process. However, this research determined that there is confusion among design professionals about the relative economy of timber structures. Professionals who use timber regularly are convinced of its economy while those that are non users believe it is uneconomic. 84% of architects who were frequent users believed timber is an economic building alternative while only 55% of non users responded the same way. Frequent users rated the cost of timber construction as a positive 4.1 on a one to five scale, while non users rated it as a neutral 3.1. 90% of structural engineers who were frequent users believed timber is economical in building while only 51% of non users did.

Quantity surveyors interviewed found non domestic applications almost impossible to cost accurately. There is no doubt that there is often an uncertainty factor built into cost estimates for timber buildings. Experienced timber engineers described avoiding quantity surveyors altogether, working out their own prices for timber structures from the ground up.

5.3 Supply of building information.

Expertise in timber design can be developed or maintained in two ways, through practice and by professional development. However, all professions reported poor professional and practice support from the timber industry. Within their practices, design professionals place the timber industry in a context with other materials and describe a fragmented industry that competes within itself, often making unreliable claims for its products. Poll respondents were unimpressed by the current information resources made available by industry. Few categories of provided information were rated above a neutral 3 on a one to five scale. The results for a range of information are shown in Chart 4.



1 = poor quality 5 = excellent

Chart 4: Rating of current information resources.

The lowest overall rating of any category of information was costed case studies of non domestic buildings. While identified as an important source of comparative construction information, quantity surveyors rate the information on this topic that receive from the timber industry as a 1.5 on a one to five scale. Architects rate the supply of span tables at 2.6, species information at 2.8 and provisions of fit out details at 2.4 on a one to five scale. Engineers rated span and design tables at 2.5, example of quality design at 2.7 and species information at 2.9.

As shown in Table 2, perceptions of support from State Timber Promotion organisation varies considerably between states.

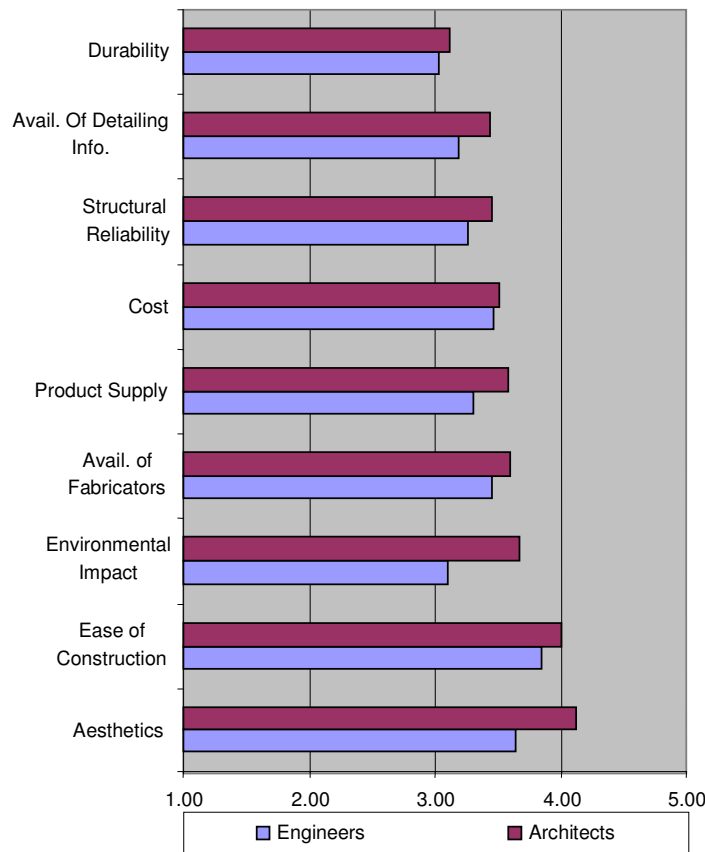
Average Response	Architects	Engineers
NSW	2.4	2.5
Queensland	3.4	3.7
Tasmania	2.5	2.8
Victoria	3.3	3.5

Table 2. Perception of support from State Timber Promotion organisation.

Generally, design professionals in Queensland and Victoria received consistently better professional support than professionals in NSW and Tasmania.

6 The design professions are positive about timber

Designers appreciate timber's beauty, buildability and economy (for frequent users). They would like to use structural timber more but lack the design knowledge. Architects are most impressed by timber's aesthetic qualities and exploit these in buildings for people to live, work and recreate in. Structural engineers are more pragmatic, using structural timber in a broader range of applications, some of which include industrial buildings. An experienced structural engineer explained that timber natural place is in structures where it's beauty and strength can be appreciated. Asked to rank factors that influenced their design decisions about using structural timber in non domestic construction on a one to five scale. Architects ranked timbers *aesthetic qualities* highly at 4.1, while engineers rated it at 3.6. Architects who were frequent users rated timber *aesthetic qualities* at 4.6. The second highest rating for architects and highest rating for engineers was *ease of construction*. This rated 3.8 for all engineers and 4.3 for engineers in Victoria. Architects *rated ease of construction* at 4.0 as an average while frequent and occasional users rated it on average at 4.2. While timber's environmental impact was an important factor for architects, with a rating of 3.7, engineers were neutral. Architects who were frequent users rated environmental impact at 4.2.

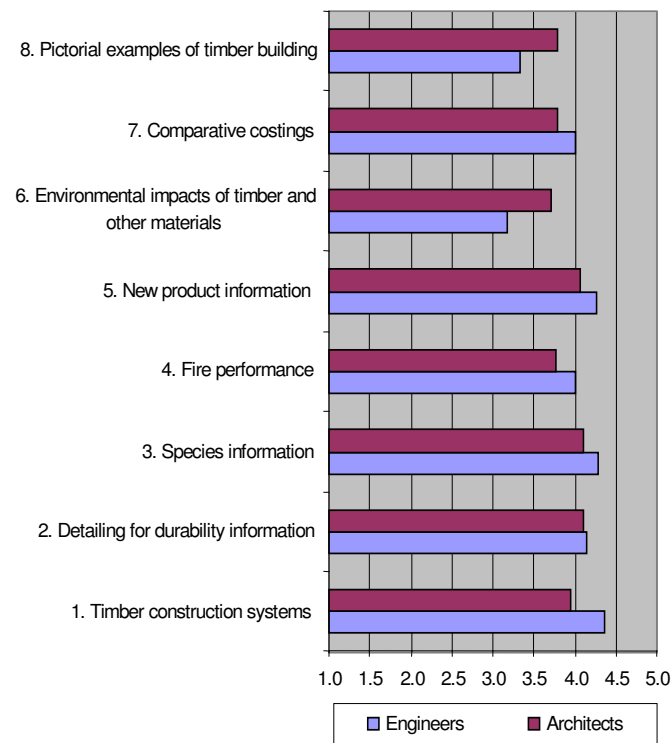


1 = strongly against 5 = strongly for

Chart 5: Factor influencing use of structural timber in non domestic construction.

While current information resources were rated as poor, the demand for resources was high across almost all information areas and all professions. Engineers, generally more conservative in their rating of factors influencing design, were more demanding in the information they need for their practice. They rated several categories over 4,

including *timber construction systems*, *detailing for durability* and *species information*. Most categories rated over 3.5 for both professions.



1 = unnecessary 5 = essential
Chart 6: Required information.

This research asked professionals whether they had any underlying conceptual difficulty with timber’s natural variability. Their response was not that timber itself was unreliable, in fact they praise its beauty, workability and for frequent users, it’s economy. 86% of engineers regarded timber as a reliable material and over 90% of architects agreed.

7 Timber buildings designed by professionals are unacknowledged

Some architects are using well designed combinations, but neither magazines nor the timber industry tend to be interested in publishing these. Timber industry often uses boring project homes in their advertising promotions.

Comment by an architect experienced in timber design.

Civil Engineering Journal only had 1 or 2 write ups on timber in the last 10 years.

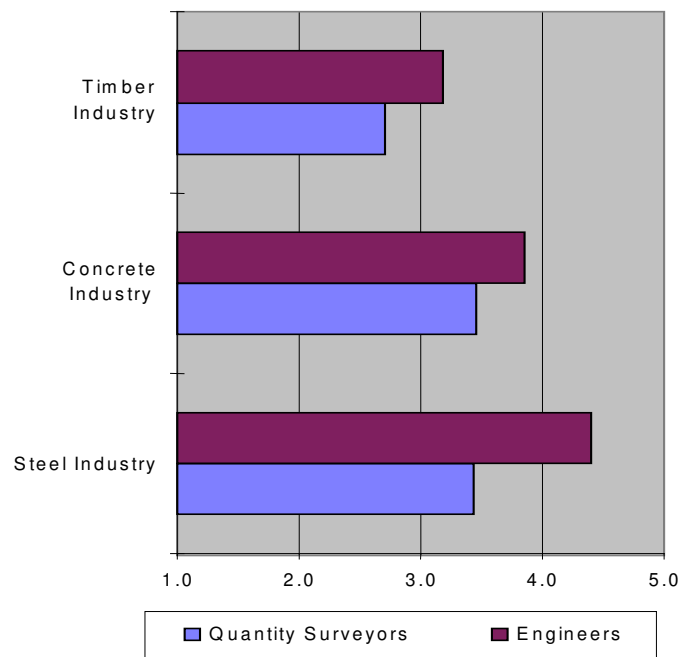
Comment from a structural engineer.

Fashion is a powerful determinant of the invented forms that design practitioners’ craft. These three highly literate professions are reliant on published sources that include their professional journals as well as some generic building magazines. In such publications, structural timber is largely absent. Yet, architects and structural engineers incorporate timber and timber products into a broad range of buildings. They exploit timber’s beauty in recreational and sacred buildings, its strength and acoustic qualities in performance spaces and its economic workability in multistorey construction. For this research, two hundred architects and engineers, chosen at random, were able to list literally hundreds of non domestic timber buildings where they had used timber as a structural material in the last three years. While such structures could provide a repertoire of successful solution for other practitioners, these timber solutions are absent from the published sources building professionals use for design inspiration.

8 Alternative material industries recognise design professionals’ requirements

The steel and concrete industries are well aware of the importance of design professionals in specifying their products. As a consequence they spend a great deal on marketing to designers and educating them in material usage. Their information is praised as continually updated, technically rigorous and highly professional in its design. Asked to rate the level of support that they receive from the steel, concrete and timber industries, both structural engineers and quantity surveyors rated the support for their practice from the timber industry as the lowest of the three. Engineers

rated the support they receive from the steel industry very highly at 4.4, with the concrete industry at 3.9 on a one to five scale. The results are shown in Chart 7.



1 = poor 5 = excellent

Chart 7: Comparison of industry support.

Both professions rated the level of support from the timber industry as the lowest of the three industries in every state. While the support rating from engineers for the steel and concrete industries across Australian states was relatively consistent, the rating of support from the timber industry varied widely. In Victoria and Queensland, engineers rated support at 3.5 or above while in Tasmania, it was rated at 2.9 and in NSW, 2.6. Interestingly, NSW engineers rated the support from the steel industry the highest of any state at 4.6. Generally, the best rating the timber industry received in any state was lower than the worst rating the other industries received in any state.

The effectiveness of design support was also gauged by asking professionals what they read. Steel industry publications are the biggest part of many structural engineers' libraries. Quantity surveyors are also well serviced by the steel industry, which designs costed drawings and other resource material specifically for their use. The concrete industry also produces a large part of the free literature professionals receive. Architects favour less technical sources than the other professions and receive glossy, industry based publications.

This high level of general support from the steel and concrete industries flavours other professional publications. Despite a current international move back to timber structures Australian designers and publishers have generally stuck to the *hard* materials. There is presently little evidence of stylistic pluralism in Architecture Australia and the Institute of Engineers Journal. There is no editorial policy that determines breadth of coverage of materials in institute journals. Most editors focus on design excellence, professional discourse and practice problem solving in their publications, while reflecting the interests of both their memberships and their advertisers. Such publications drive fashion, as well as reflect it. If there are thought to be insufficient timber buildings to meet design excellence criteria then timber solutions are seen to be out of fashion. At the moment fine non domestic timber buildings are invisible in most professional publications.

Conclusions

This paper is just a short summary of research that sought to understand professionals' attitude to timber and the factors that influenced their use of it in design. From the information set out above, it is possible to conclude that:

- Timber is not the generally preferred structural solution for building design professionals in Australia for non domestic projects.
- There is a considerable disparity between the amount of structural timber used in domestic projects and the amount used in non domestic projects. Even allowing for the different requirements of each type of building, it is evident that building design professional do not use as much structural timber in non domestic projects as they could. They are choosing not to use timber for a variety of reasons.
- The use of structural timber by design professionals in non domestic projects varies considerably across states. The extent of use appears to be in proportion with the apparent level of design support that design professionals receive in each state.

- Design professionals rate the support they receive from the timber industry as low. They rate it below the support they receive from the steel and concrete industries in every Australian state.
- Professionals require a greater level of support from industry for their use of timber in building.
- Lack of design and documentation skill and experience strongly influence the decision to use timber in non domestic buildings.
- Professionals recognise that timber is a aesthetically attractive structural material that is reliable and easy to build with. There is no significant evidence that they avoid timber due to any inherent unreliability in the material.
- There is considerable confusion over the economy of timber construction with frequent users citing timber economy as a positive factor in their decision, and non users being neutral or negative
- It is probable that increased practice and professional support from the timber industry will result in a greater use of structural timber in non domestic building.

Finally, none of the professionals interviewed or polled suggested that their use of structural timber in building was restricted for the want of timber technology. They find simpler concerns, such as obtaining reliable species recommendations and information, are far more significant.