TIMBER ENGINEERING EDUCATION IN AUSTRALIA

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Abstract
Education is arguably one of the most important factors in increasing the proliferation of timber engineering worldwide, yet in many countries timber subjects are being dropped from building related course curriculum. In Australia, the timber industry recognising the potential disastrous consequences of this trend, has recently implemented a number of pro-active initiatives to address this problem. In this paper the Australian scenario is presented. Description is made of the current state of timber education, the past involvement of industry associations, the new dedicated, pro-active industry based education programs and the future directions of timber engineering education in Australia.

Keywords: Timber, engineering, education, Internet

Introduction
Timber education in Australia is currently undergoing an exciting and reinvigorating renaissance as a result of a number of recently established industry based educational initiatives. The specific focus is the collaborative development of relevant curricula and educational resources to service the needs of university Engineering, Architectural and Building courses, traditional vocational trade courses such as carpentry and building construction and secondary school Trade Technical Orientation Programs. With the students of today destined to be the specifiers of tomorrow, the Australian Timber Industry is looking upon an investment now in education as a long term investment in its own future. From the industry's perspective, the universities have the potential to provide a broad range of new, future customers, as timber content in most university courses is currently quite low, whilst in the trade, or Technical and Further Education (TAFE), sector which has always had a tradition in timber, the industry is keen to retain its representation in the face of a push by its major competitor, the steel framed housing industry.

Use of Timber in Australia
Though timber is still the major material used in domestic framing in Australia, as a primary engineering material, it has had a somewhat cyclic popularity. Losing its pre-eminence around the turn of the century with the rise of more fashionable materials such as wrought iron and reinforced concrete, timber's re-immergence as a major engineering material has really only coincided with periods of steel shortage such as the two world wars, when many impressive long span timber structures were built (Nolan 1994). Today, timber's comparatively limited engineering use is to a great degree due to a combination of a lack of engineers confident in the design of timber, a perception by some architects that timber is not an environmentally responsible material and in some cases a real lack of fabrication capacity - all of which can be redressed by a better timber representation in professional building related courses.

Work place environment for timber engineers
This has changed markedly over the years. Structural design can no longer be undertaken in isolation, rather, the structural designer is an integral member of a team of professionals who fashion a completed structure rather than a set of drawings. Good design is intrinsically dependant on a collaborative effort between architect and structural engineer, often with substantial input from suppliers and fabricators. Timber engineering's renaissance is, therefore, very much dependant on a simultaneous change in the education of all the professions involved in the building industry. Lack of confidence in timber or its construction suitability by any of the design and construction team, may precipitate major changes in the design and see timber completely rejected as a primary structural alternative.

In the work place, the timber industry must also be prepared to accept a role as part of the design team. Modern large timber structures will require consultation between the industry and the designers at a

very early stage. This was the case for the construction of large timber auditoriums for the 1994 Winter Olympics in Norway (Aasheim 1994). Similarly, current preparations for the Sydney Olympic Games in the year 2000, are seeing the development of design consortiums involving architects, fabricators, structural engineers, timber suppliers and timber trade associations. Teamwork is an essential part of the current structural engineer's environment, and the need to rely on input from many other experts is likely to continue well into the future.

It is critical that professional engineering education provides a recognition of the importance of teamwork in design and instils a respect for the functions and talents of all the design team members. Clearly, there is a need for a collaborative relationship between academia and industry in the education of timber engineers, so that graduating students have confidence in the industry to supply and support its product.

Current Status of Timber Education in Australia

The education system in Australia can be divided into three main levels, primary, secondary and tertiary, (see Fig 1).

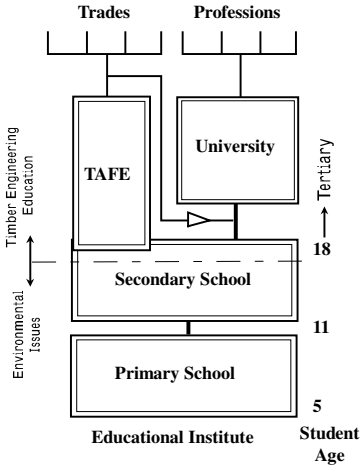


Fig 1. Simplified structure of the Australian education system.

At the tertiary level, universities deliver the gamut of professional courses while through the Technical and Further Education (TAFE) system an extensive range of generally trade related vocations are available. Building related timber subjects are currently delivered at a number of scholastic levels in Australia.

Secondary Schools

At many secondary schools preparatory trade skill courses are becoming more readily available through Trade Technical Orientation Programs. These courses provide a bridge for more practical orientated students between their school life and a vocational trade course. In the building and construction industry these courses involve basic hand tool skills and an introduction to the different types of building materials commonly used. An 'Introduction to Timber Technology' is the focus at this level, a subject which broadly touches upon a number of topics including the growth and structure of wood, characteristics of timber and the issues of strength and durability.

TAFE

At the TAFE level, a number of courses exist which deal with timber, including: Pre-Apprenticeships, Apprenticeships, Certificate, Advanced Certificate and Associate Diploma Courses ranging through carpentry, building and construction, architectural drafting, building surveying, building inspection and engineering. In these courses the 'Introduction to Timber Technology' subject is expanded upon in detail and integrated with teaching of the practical and theoretical aspects of domestic and light commercial timber framing. The Timber Industry has in recent years become somewhat blasé in their support of the TAFE system, assuming that the current levels of representation would continue on ad infinitum. They now recognise, however, that they must in fact be far more vigilant of their competitors and far more pro-active in their educational support of the TAFE sector.

University

Architecture & Building

At the university level, the main building related degrees involve Architecture, Building and Civil Engineering. In terms of the future proliferation of timber products, and in particular engineered timber products, architecture is perhaps the most significant of these three, due to the influence practising architects have over the choice of the final building material used in a project. Most architectural courses currently include a Timber Technology component which covers, to differing degrees, the material property aspects of timber, a Domestic Timber Framed Structures component which in most universities is quite detailed and comprehensive and a Structures component which usually gives a rather cursory introduction to the design of timber elements and the use of timber in commercial structures. Though the overall time allocated to timber is in most universities quite good,

the main problem is that the information provided is often outdated and teaching aids are virtually non-existent. Building courses which are often delivered through the architectural departments offer a similar coverage.

Engineering

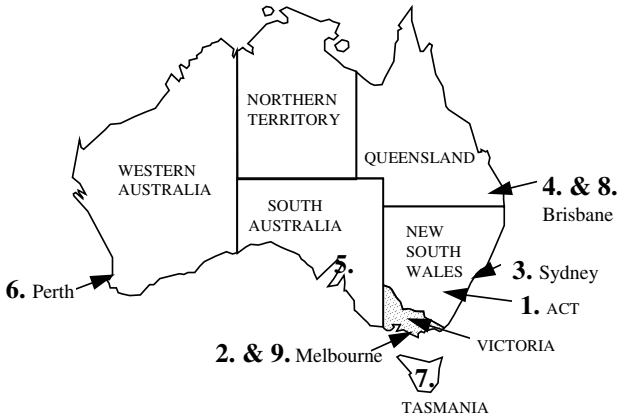
In Engineering courses the time given to timber is much more variable. In general, the situation is far from good as many lecturers still look upon timber as a secondary structural material and as a consequence timber engineering subjects are often relegated to the status of minor electives. Some universities, however, who are fortunate to have enthusiastic timber knowledgeable staff, provide courses with excellent timber representation. These courses include both thorough coverage of timber technology in Materials core subjects and dedicated Timber Engineering core subjects which include all aspects of timber design, from durability through stress grading, member design and connections to composite products. This disparity between universities in time allocated to timber is a result of the autonomy that individual university departments in Australia enjoy in determining course structure. Though the departments must conform to accreditation guidelines set down by the professional engineering regulatory body, the Institution of Engineers, Australia, these guidelines only define the overall course balance, they do not specify individual course content or regulate time allocated to each subject. Therefore, when engineering departments review the contents of their courses, and in Australia the trend is a reduction of student contact hours, then those subjects without strong academic support bear the brunt of the cut-backs. The importance of having sympathetic academics, at each university campus, comfortable in timber design and interested in timber research, who are prepared to lobby and argue for increased representation from within, cannot be over stated.

Environmental Concerns

There is also a strong case to show that distorted environmental perceptions are also providing somewhat of an impediment in the wider acceptance of timber at some educational institutes. Sensationalised media coverage of the theatrical antics of many radical conservation groups in Australia has led to widespread public confusion of the environmental debate. Many students, and academics alike, still believe that timber is the irresponsible environmental choice. Inevitably, when questioned further on what they believe is the best alternative, steel is most commonly the answer given, reflecting Australia's deep seated tradition in this material. The opportunity to explain why timber, from sustainably managed forests, is in fact really the only environmentally friendly material usually restores some balance, however, the fact remains that much work is still required in educating the public, as a whole, about timbers unique environmental credentials.

Research and Development

Research is clearly part of a University's charter. In many Australian universities, the principal criterion for promotion is research output. Good teaching is often associated with state-of-the-art knowledge, and research output is one indicator of this. As an educational tool, research has a role, in that higher degree students further their own education in the research process. Mechanisms are in place for industry to support research and development, but the number of people who directly benefit from this type of education are relatively small compared with the undergraduate and TAFE programs



Timber Promotional Associations

1.	NAFI	National Association of Forest Industries	ACT
2.	TPC Vic	Timber Promotion Council	Victoria
3.	TDA NSW	Timber Development Association	NSW
4.	TRADAC	Timber Research & Development Advisory Council	Qld
5.	TDA SA	Timber Development Association	SA
6.	TPC WA	Timber Promotion Council	WA
7.	TTPB	Tasmanian Timber Promotion Board	Tasmania
8.	PAA	Plywood Association of Australia	
9.		Pine Australia	

Fig 2 - Australian Timber Associations

Professional Development Programs

In a constantly changing environment, there is a continuing need for updating of knowledge and skills through continuing education. Both the Institution of Engineers, and the Royal Australian Institute of Architects require their members to maintain their skills through prescribed hours of continuing education. This is a great opportunity for the timber industry, and one that has been recently exploited in the seminars promoting Multi-Residential Timber Framed Construction coinciding with recent changes to the Australian Building Code. Further opportunities for professional development will be presented with the publishing of a new Timber Design Code in early 1997.

The Role of Industry Associations

There are nine major professional timber promotional associations distributed throughout Australia, see Fig 2.

All of these associations, to differing degrees, involve themselves in education. To date, however, this has usually involved an ad hoc approach with support and resources being provided to individual educational institutes only when it has been specifically requested. In most cases this support has been excellent, unfortunately though, there has been little inter-state coordination of these efforts. A nationally coordinated program, however, would enable the resources developed to be used a number of times for the same development effort thereby making them far more effective.

These associations have had great success though in the sponsoring and encouragement of student investigation projects. In civil engineering courses, most universities run a final year Investigation Project. These projects provide an excellent opportunity to rapidly lift the exposure of timber at a university, particularly when the projects involve experimental work and testing. Students feedback of timber projects has always been extremely positive, both because the workability of the material allows the students to do much of the project construction work themselves, and also because there are plenty of interesting timber research topics still to explore. Innovative undergraduate projects often go on to become successful postgraduate investigations, again reinforcing a departments interest in timber.

Like the associations, individual corporate industry members also provide excellent support when requested but again without coordination and an overall plan this support again has limited value.

Recognising the tangible benefits of a coordinated, pro-active role in education, a number of sectors of the Australian Timber Industry are now making a committed investment in the development of structured Timber Education programs:

- A national 'Timber Education' program, set up in January 1996, jointly funded by the National Association of Forest Industries (NAFI) and the Forest and Wood Products Research and Development Corporation (FWPRDC) targeted specifically at University Engineering, Architectural and Building courses.
- The Timber Promotion Council of Victoria's 'Timber Education Program', commenced in February 1995, which also addresses the needs of the TAFE sector in addition to the Victorian universities.

National Timber Education Program

This national program is intended to coordinate support and resources offered by the timber industries to University level courses across the country. It complements the work performed at the state levels and has the following objectives:

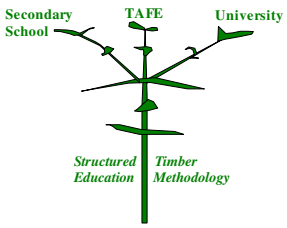
1. To develop a national education strategy, program and resources that address educational needs of professions that use or specify timber products eg. engineering, architecture and building.

2. To establish and coordinate national networks of educators and state education officers to maximise the efficient use of resources earmarked for education.
3. To initiate professional development and undergraduate programs where needed in cooperation with target group organisations, institutions and the Timber Industry networks.

Simply stated, the National Timber Education Program aims to offer assistance to already over-worked academics as they prepare courses or units that bring students into contact with timber. It has few resources of its own, but through networking is able to ensure that the available timber resources are used to best advantage.

Victoria's Timber Education Program

The Timber Promotion Council of Victoria's 'Timber Education Program' follows a similar set of objectives to those stated above, however, the program addresses the needs of a broader client base. The aim of the program is " to increase the penetration of timber products in the commercial, industrial and domestic construction industry by increasing knowledge and awareness of timber as a building material in University and TAFE courses related to building construction." Involving education at secondary school, TAFE and university levels the program involves an integrated approach to education: *STEM - Structured Timber Educational Methodology.*



The aim of STEM is to ensure that the information delivered in each of the respective courses is consistent, structured and coordinated. Many timber subjects are common over a range of courses and it is really only the level to which they are delivered that varies. For instance, 'Timber Technology' is a common subject from secondary school level to university. At secondary school it may simply include topics such as photosynthesis, tree structure, the carbon cycle, etc, all topics which would also be included and investigated in more detail further up the academic chain. Using this structured methodology ensures that students across the academic board are given consistent, structured and relevant information. It is proposed that this structured methodology be used with all timber related study areas. Figure 3 illustrates this concept for a number of timber related subjects.

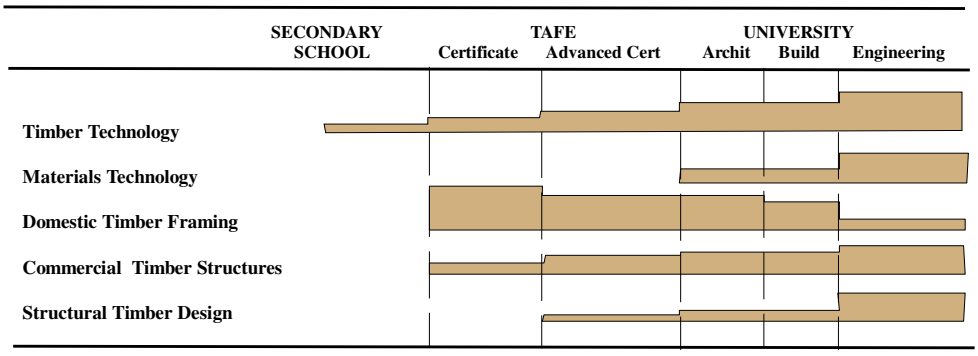


Fig 3 - STEM: Structured Timber Educational Methodology

Future Directions in Timber Engineering Education

There is no doubt that the education process will change substantially in the next decade. In Australia, the last ten years has seen a steady erosion of government funds earmarked for education at all levels, and indications are that this decline will continue in the near future at least. Reduction in funding means increased work loads for staff and greater pressure to reduce, rather than expand, the material covered in their curriculums. Pressure on teaching has already been reflected in the reduction in timber content in many Engineering courses. If this trend is to be reversed then the timber industry must assist academic staff to deliver up-to-date and relevant material in a way that is not demanding of their time.

Educational Resources

One major form of assistance is through the development of relevant coordinated educational resources. Again adopting a structured educational methodology, it is planned that those teaching aids developed be designed so as they can be utilised by as many academic levels as possible. This also includes post-tertiary practising professionals as often resources originating due to educational need also become excellent marketing and design tools assisting practicing professionals to use timber more effectively.

Discussions with educators have identified the need for a number of different types of educational resources.

Well-indexed Technical Literature

An enormous volume of excellent information is already produced by industry members covering a broad range of timber related topics from forest management practices, environmental issues, tree physiology, species classification right through to highly technical architectural and engineering framing manuals, span tables and design data. To date, however, this plethora of information has been developed and distributed in a rather ad hoc fashion by individual industry members resulting in incomplete circulation and reducing the overall potential value of these resources. To redress this problem, a dedicated timber CD-Rom is currently under development on which it is hoped to include all Australia's timber industry product and technical publications. Properly coordinated and catalogued, this regularly updated CD-Rom will provide an invaluable resource for both educators and the specifiers of the industry's products alike.

Course Notes

Development of course notes or accompanying text books are also planned for those courses which are deficient in this area. This is particularly the case in Engineering where good educational or professional texts specifically for the local conditions are rare. To date, engineering departments have independently developed their own course notes which have often simply consisted of a compilation of photocopies of industry publications, and as such, there is currently a great variation in the quality of these documents. A more definitive text, however, is nearing completion (Boughton & Crews 1996). Written specifically for educating undergraduates and professional engineers, this text covers in detail the structural design process of common timber elements and connections making extensive reference to the Australian building regulations and standards.

A slightly different approach will be used for university architectural and building courses. As subjects within these courses can differ quite dramatically in the emphasis they place on specific topics and in the mode of presentation from one university to another, it is important that the format chosen for these resources provide as much flexibility as possible. This resource will involve an extensive series of individual, highly visual datafiles covering a broad range of timber related topics including:

- light timber framing,
- surface treatment of timber,
- life cycle costing of timber,
- durability of timber in structures,
- environmental aspects of timber use, and
- detailing of openings in timber buildings, amongst many others.

Topic specific slide sets, technical data and where relevant, videos and computer software will also accompany each of the lecturers master set of datafiles, to enhance the quality of the class presentations of these subjects. The dedicated timber industry CD-Rom will also be extensively referenced, ensuring the students are accessing the most up-to-date industry information.

The datafile system will provide the flexibility to suit virtually any course structure. Lecturers will be able to easily modify or specialise their subject to suit their course themes, simply by varying the datafiles they include in the student course note folders. In addition to architectural and building courses, these datafiles will also provide an excellent resource for supplementing other timber courses and for professional training programs for practising building consultants.

Computer Aids

A number of computer based teaching resources have also been developed or are in the development stage. Currently nearing completion is NAFItads a highly versatile and comprehensive timber

engineering framing design package developed for the Australian Timber Industry. When completed, the program will be available in a number of different forms, including:

- A limited input version, in which a user has a limit as to which loading and restraint parameters may be changed. This version can be used by industry to generate span tables for specific products for a normal use environment.
- An open version, in which the user can vary any parameter at all. This version will have very limited circulation, specifically restricted to researchers and engineers with extensive timber design experience.

In carpentry, building surveying, architectural drafting, architecture and some engineering courses domestic timber framing is taught in detail. Widely used in many states in Australia is the Victorian Timber Framing Manual, a comprehensive document for domestic timber framing which includes span tables and design and building practice regulations. For use in these subjects, a highly interactive Windows based version of this manual has been developed which through its extensive hypertext links and user friendly tools dramatically increases the useability of the written manual. The catalyst for this program was its need as an educational tool for carpentry students at the TAFE level, however, its development has seen it grow to a sophisticated package with great commercial as well as educational potential.

Multimedia - Integrated Learning Packages

Plans are also under way to develop a series of Multimedia based learning packages, structured to directly tie in with current courses. These interactive packages would also include, where relevant, the aforementioned software as well as training tutorials and self assessment and testing programs. The aim of these computer based packages is to try and bring some theatre and interest back into the process of learning, especially at TAFE level where students have little interest in reading and digesting technical documents. It will also provide a high quality learning resource that can free time for academics.

The first of these Multimedia packages is currently being developed with sponsorship from the Forest and Wood Products Research and Development Corporation. Designed specifically as an engineering tool, this highly visual interactive package will allow students to explore the Timber Design Code and its use in structures at their own pace. There is a huge future for the use of Multimedia in education due to its ability to reduce teacher/student contact time without compromising quality. However, any Multimedia development is very expensive, so it is important that the appropriate level of quality be built into the package from the start and coordinated distribution of the finished product is essential to make it pay!

The Future Mode of Presentation - Internet Information Systems

Continued cost cutting at academic institutions combined with the advances in information technology will see the mode of information presentation change dramatically in the future, a change which provides in fact enormous opportunity for industry to collaboratively participate in the education process.

With most universities currently ‘on-line’ and more and more TAFE’s and secondary schools linking in everyday, an exciting direction for education, especially for Distance Learning, is the use of Internet information delivery systems. The Internet, or Cyberspace, is the term used to describe the vast global network of linked computers which allow individuals throughout the world to communicate through the use of computer based applications such as electronic mail (E-Mail), file transfer protocols (FTP), information based World Wide Web servers (WWW), Bulletin Boards and interactive Discussion Groups (Foliente, Boughton & Woodard 1996). Together, these applications can provide enormous flexibility in how and where education is delivered in the future.

For universities specialising in Distance Education, the Internet has the potential to revolutionise student/university interaction. Administration requirements for instance will be undertaken by the student accessing the University’s WWW home page. Course notes and resources will be accessible to the student through FTP sites linked directly from departmental WWW home pages. Interactive discussions will be carried out with lecturers and classmates using real time discussion groups or video-conferencing and tutorials, and assignments will be submitted and returned via E-Mail. This concept should not be dismissed as far-fetched, as some universities are already converting their courses to a

distance education mode catering for students not just within different states, within a country, but also to a client base which may live half way around the world.

For the Timber Industries worldwide, this shift by Universities to Internet based information delivery systems provides enormous opportunities.

- Applications such as E-Mail, Bulletin Boards and Discussion Groups allows interactive networks to be established between industry members and university academics establishing or strengthening fraternal bonds and providing the opportunity of regular discourse or discussion regardless of distance.
- With the trend at universities being a reduction in lecturer/student contact hours, the focus for any industry trying to increase its course representation should be on providing self-contained educational packages. If developed in conjunction with academics and professional groups, these packages stand a good chance of being broadly adopted, especially by departments with over stretched resource development budgets. Applications such as FTP would allow educational institutes to rapidly and efficiently access these industry generated resources, whenever they are needed.
- The WWW would be used to seamlessly tie all of these applications together through a network of linked industry and university home pages. This infrastructure is already in place through *TINDER: Timber Information Network, Development Education & Research,* a home page set up specifically to cater for and link practitioners throughout the world whose interest is timber engineering and construction.
  (TINDER's URL is:
  http://www.ozemail.com.au/~woodard/)

The transition to an Internet focused approach to timber education will be gradual - evolution rather than revolution. Already though, many education institutions have reduced the timber content of their courses, and this has forced the timber industry to be pro-active in providing the support that will enable the continuance of timber education with reduced input from the educational institutions themselves. Networks of experts will have to be used to augment teaching by academics who increasingly have less familiarity with timber. This leads to the concept of cooperative education, where academics may deliver educational materials in a number of institutions. This will be facilitated by the sharing and coordination of educational resources, discussed above.

Conclusions

Teamwork in the practice of engineering is increasingly being reflected by teamwork within education delivery. The timber industry has a vital role in the education team and must be available to provide assistance to education institutions in the preparation and delivery of learning to students. Inevitably, if this is to be done efficiently, it requires coordination. The paper has presented a model in which the timber industry can foster a network of experts and coordinate their activities to maximise the impact of timber education on the professions.

Such a model involves:

- Facilitation of network development between teachers, industry and practising building professionals, forging fraternal bonds and encouraging cooperation rather than competition.
- Coordinated, collaborative development of educational resources to minimise duplication of effort.
- Distribution of those resources as widely as possible.
- Development of well-indexed and maintained data bases, so that state-of-the-art timber information is readily accessible to the educational community.
- Ultimately, the development of Multimedia and Internet based packages that facilitate self learning and distance education.

The timber industry has no choice but to become seriously involved in education. Without a steady stream of professionals with confidence and competence in the use of timber, the market of the future will slowly dwindle. Industry must rise to the challenge, as a pro-active participant in the educational process, part of a focussed team whose ultimate aim is to fashion and nurture an environment in which creative timber engineering will flourish rather than wither and die.

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