INITIATIVES AND PROGRAMS USED TO TEACH AND PROMOTE TIMBER AT THE UNIVERSITY LEVEL A NORTH AMERICAN STUDY TOUR

ALASTAIR C WOODARD

1996 GOTTSTEIN FELLOWSHIP REPORT

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Bill Gottstein was an outstanding forest products research scientist working with the Division of Forest Products of the Commonwealth Scientific Industrial Research Organization (CSIRO) when tragically he was killed in 1971 photographing a tree-felling operation in New Guinea. He was held in such high esteem by the industry that he had assisted for many years that substantial financial support to establish an Educational Trust Fund to perpetuate his name was promptly forthcoming.

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2. Seminars - the information gained by Fellows is often best disseminated by seminars as well as through the written reports.

3. Wood Science Courses - at approximately two yearly intervals the Trust organises a week-long intensive course in wood science for executives and consultants in the Australian forest industries.

4. Study Tours - industry group study tours are arranged periodically and have been well supported.

Further information may be obtained by writing to,

The Secretary,
J.W. Gottstein Memorial Trust Fund,
Private Bag 10,
Rosebank M.D.C.,
Clayton, Victoria, 3169 Australia

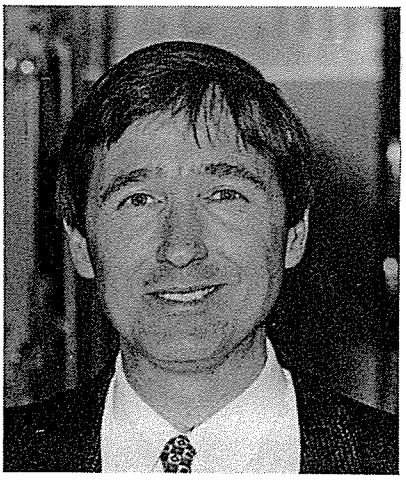
GOTTSTEIN REPORT

INITIATIVES AND PROGRAMS USED TO TEACH AND PROMOTE TIMBER AT THE UNIVERSITY LEVEL - *A NORTH AMERICAN STUDY TOUR*

& October 1996 &

Alastair C. Woodard
BE (Civil), PhD, MIE Aust, AIWSc, CPEng
Gottstein Fellow, 1996

March 1997



Dr Alastair Woodard is currently the Educational Consultant with the Timber Promotion Council in Melbourne, Australia.

With experience in both the consulting and academic fields, his background is well suited to this position. He joined the Timber Promotion Council in 1994 from Monash University where he had been undertaking a doctoral research project into Nailed Plywood Gusseted Moment Connections with the Monash Timber Engineering Centre.

Prior to this he was an Associate Director of Trevor Huggard & Associates, a Melbourne structural engineering consultancy, strongly involved in practical timber design especially in the areas of restoration and renovations of historic buildings.

The purpose of his Gottstein Fellowship was to visit Canada and the United States to investigate and document the initiatives and programs used in these countries to teach and promote timber at the university level. This study tour has been extremely timely and many of the findings have already been used in providing guidance for industry on its future directions regarding educational policy, program structure and funding mechanisms. The remaining recommendations given in this report will also be useful in enhancing the national Timber Education program in the future.

Executive Summary

Sections of the Australian Timber Industry have at last realised that the industry's future success is inextricably linked to the commitment it makes *now* to education, and in this regard, a number of specific educational policies and programs are currently being set in place. To assist in this process, this Gottstein Fellowship was sought to visit the United States and Canada to investigate and document the initiatives and programs used in these countries to teach and promote timber at the university level.

Briefly, the objectives of this Fellowship were:

- to investigate the timber related subjects taught at universities;
- to discuss with the relevant industry organisations their philosophy and approach to education;
- to document the types of teaching aids and resources available, both university and industry generated, analyse their effectiveness and assess the suitability for use in Australia; and
- to look at the impact and use of modern information technology transfer methods on course delivery, including CD-Rom and Internet applications, and their potential for use in a Distance Education mode.

Discussions were held with over thirty representatives from three groups: university academics, industry associations and industry manufacturers.

The study revealed many similarities between the situation in North America and that in Australia. Firstly, the amount of timber representation in university courses was found

to be low compared with competitive materials, such as steel and concrete, and in relative terms there were few academics active and confident in timber design and research. There were a number of reasons suggested for this, including decreased educational funding, insufficient space in course curriculum, environmental misconceptions, lack of suitably qualified academic candidates for lecturers positions and inadequate industry support.

The expectations by academics of the level of industry support required varied, however, there was unanimous agreement that the North American Timber Industry should be doing far more in the support of timber education. A number of areas were identified which academics believed industry needed to address, including industry run 'educating the educator' courses for academics, an increase in industry/university research initiatives, development and distribution of coordinated, non-political specific teaching resources and encouraging further pro-active support by other key industry people.

The North American Timber Industry does currently involve itself to some degree in the education arena, mainly through the activities of the Canadian Wood Council and Forintek, in Canada, and the Wood Products Promotion Council in the US. These groups have carried out a range of excellent activities in the past including professorial workshops, university wood seminars, student competitions, development of Teaching Tool packages and text resources, and also in Canada, the production of a 'Designing with Wood' distance education course.

Whilst the North American timber industry is producing some excellent resources, and undertaking some worthwhile activities, it does however appear that nationally, particularly in the US, there is little overall coordination or planning in regards education and what is done is the result of the efforts of only a handful of dedicated industry members. Despite these political and logistical problems, however, we in Australia can certainly learn from their activities. In this regard, a number of recommendations are presented in Chapter 6 which can, and should, be integrated into any future Australian education programs. In brief, the recommendations (which are not listed in any order of priority) are as follows:

Administration

1. *Core education programs must be provided through a nationally planned program, coordinated by a single, generic organisation.*

2. *A national industry program should be established to facilitate and coordinate university timber research.*

3. *Industry must actively involve itself in postgraduate education if there is to be a pool of postgraduate qualified professionals from which future academics may be drawn.*

Implementation

4. *"Educate the Educator courses" should be carried out in each state to ensure the relevant academics have a consistent level of timber knowledge.*

5. *In select cases, where it is critical industry has a presence at a certain university, a practising building professional should be engaged to assist in delivery of the course in the first year.*

6. *A committee should be established to coordinate the inclusion of timber related papers at professional conferences and to encourage academics to become involved.*

Resources

7. *Any teaching packages developed by industry must be comprehensive and focused on the teachers and students specific needs.*

8. *A bibliography of national timber publications should be produced.*

9. *It is critical that environmental issues be adequately addressed under future educational programs.*

10. *Industry should establish and support a program of national student competitions to broaden the awareness of timber at educational institutes throughout Australia.*

11. The planning of current educational resources should include forethought of how they might be used to form the basis of a future timber design Distance Education Course.

12. Industry should investigate how it can utilise the advantages and flexibility of the Internet in the provision of educational information.

13. More key industry people must be encouraged to become involved in education.

This study tour has proven to be extremely timely, and the findings have already been used to provide guidance for the industry on its future directions regarding educational policy, program structure and suggested funding mechanisms. The recent rapid demise of the NAFI/NMDC system accelerated the need to determine an industry educational strategy and in this regard much work has been undertaken, between the study tour and the release of this report, in documenting this program. The study tour has been invaluable in both confirming the correctness of the program's direction to date and in identifying a range of other activities, which if adopted, will certainly enhance the value of the proposed program. To ensure the reader is fully briefed, a Postscript has been included at the end of this report which outlines the proposed objectives and activities of the future national Australian education program.

Changes to the economic climate now mean that industry has a vital role to play in education. As an investment in its own future the Timber Industry must 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, cooperation and commitment. A model has now been presented which has the potential to maximise the impact of timber education on the professions. 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 design will flourish, rather than wither and die.

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Abbreviations

ACSA	Association of Collegiate Schools of Architecture
AF&PA	American Forest & Paper Association
AITC	American Institute of Timber Construction
ASCE	American Society of Civil Engineers
CCA	Copper-Chrome-Arsenate (treatment)
CSA	Canadian Standards Association
CWC	Canadian Wood Council
FPL	United States Forest Products Laboratory, Madison, Wisconsin
FWPRDC	Forest and Wood Products Research and Development Corporation
LVL	Laminated Veneer Lumber
LRFD	Load & Resistance Factor Design
MSR	Machine Stress Rated
NAFI	National Association of Forest Industries
NTDP	National Timber Development Program
OSB	Oriented Strandboard
TAFE	Technical and Further Education
TPC	Timber Promotion Council
WPPC	Wood Products Promotion Council

CHAPTER 1

Introduction

1.1 The Importance and Status of Education in Australia

Education is arguably one of the most important factors in the success of any industry, as it is only through properly structured education programs that the future specifiers can be made aware and kept informed of an industry's products and the contribution that the industry may make to society. The Australian steel and concrete industries, recognising this fact over a decade ago, are now reaping the benefits of their aggressive pro-active approach to education with both an excellent representation at educational institutes, especially within university courses, and a workforce of practicing building professionals who are totally familiar with their products. The students of today are the specifiers of tomorrow and therefore any industry investment in education must be viewed as an investment in the future with the potential to yield excellent returns in the medium to long term.

A number of past Gottstein Fellows [Juniper (1986)[1], Syme (1987)[2] and Crews (1990)[3]], following their travels overseas, have commented on the importance of improving timber related educational courses here in Australia. In an attempt to address these concerns the National Association of Forest Industries (NAFI) commissioned Mick McDowall, in 1993, to produce a *Survey Report and Education Strategy* focusing on the *Educational Resource Needs of Teachers to Provide the Minimum Timber Study Component in Australian Trade and University Curricula.* In his report McDowall concluded:

> *"... survival in an ever competitive field of endeavour, i.e. in the area of providing* ***construction materials*** *and* ***expertise*** *to the public sector into the 2000's, will only be done through a complete commitment by the relevant industry to the* ***education*** *and* ***training*** *of its* ***workforce.*** *In the* ***long term*** *it is believed* ***timber,*** *as a construction material, has all of the* ***necessary attributes*** *to command survival. However,* ***medium term survival*** *of the forest products industry will be seriously jeopardised if it persists with the practice of providing* ***minimum input*** *into the education process".*
>
> ...McDowall [4]

The McDowall Report recommended the development of a number of industry based timber educational resources and the establishment of a network of state association staff to implement a national education strategy and establish and maintain contact with the relevant educational staff within their own states.

In general, education of building professionals in Australia is delivered at two levels, through the University and TAFE systems. The status of timber as a building material and its representation in building courses is, however, viewed far differently by each of these sectors. In Australian universities, the current situation is not good, particularly in Engineering where 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. In Architectural and Building departments, timber gets somewhat better representation, in most cases equal to that of concrete and steel. However, the time allocated is not being used effectively as information is often dated and teaching resources are scarce. There is a real challenge ahead to develop effective and relevant educational tools for Australian Universities.

In the TAFE sector, timber still enjoys a good representation however its future is by no means secure. The generation of teachers brought up on timber is rapidly declining while the next generation filling the void is far more open and accepting of modern materials. The steel industry is actively pursuing the TAFE sector and though they may

be currently meeting resistance this will not last. The Timber Industry must be extremely vigilant if it wishes to retain current levels of course representation in Australian TAFE's.

Recognising the tangible benefits of a pro-active role in education, the Victorian Timber Promotion Council were the first to respond to the challenges of the McDowall Report by appointing the author as a full-time educational consultant in February 1995. Education is one of the most generic functions of any industry, transcending all sectorial boundaries. Certainly this is the case with TPC's Educational Program where all materials, products and product uses are promoted and discussed. Targeting engineering, building and architectural courses at Universities, and building related courses at TAFE's, the TPC's Educational Program has proved to be extremely successful in its pro-active pursuit of a greater representation for timber. The main focus of the program has been the development of strong active working relationships with all the individual educational institutes and their relevant departmental staff. Activities have included presentations to the heads of department of all the Victorian TAFE Carpentry and Building Technology Departments, involvement in the course restructuring of three university departments, dissemination of industry information to those teachers involved in timber related subjects, over 250 in all, sponsorship of a wide range of student investigation projects and coordination of a number of industry/education initiatives. Feedback from educators revealed the need for a number of specific teaching aids and resources; some of these resources have since been completed while some are still under development.

In January 1996 a national "Tertiary Timber Education" program was established through a joint funding arrangement with NAFI and the Forest and Wood Products Research and Development Corporation (FWPRDC). This national program, which is managed by Geoff Boughton out of Curtin University in Perth Western Australia, is intended to coordinate support and resources offered by the timber industries to University level courses across the country. The program 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 e.g. 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, and
3. to initiate professional development and undergraduate programs where needed in cooperation with target group organisations, institutions and the Timber Industry networks.

The National Program, complements the work performed at the state levels and currently excellent linkages exist between this program and the Victorian Timber Promotion Council's program.

The basic infrastructure for a coordinated and integrated national/state timber education program has now been established and discussions with the education fraternity have identified a number of areas in which industry can and should assist, some of these projects are even currently well under way. However, before making a total commitment to the current strategy it was important to look abroad to the educational activities of other countries, to investigate the parallels between their educational system and ours and to determine the types of initiatives their timber associations are pursuing.

The purpose for which this Fellowship was sought, therefore, was to visit selected parts of the US and Canada to investigate and document the initiatives and programs used in these countries to teach and promote timber at the university level.

1.2 Objectives of Fellowship

The main objectives of this Fellowship were:

- to investigate the undergraduate and postgraduate timber related subjects taught at university, and document their structure and content,
- to discuss with the relevant industry organisations their philosophy and approach to education,
- to investigate the methods used by industry organisations to influence course structure and curriculum,

- to document the types of teaching aids and resources available, both university and industry generated, analyse their effectiveness and assess the suitability for use in Australia, and
- to look at the impact and use of modern information technology transfer methods on course delivery, including CD-Rom and Internet applications, and their potential for use in a Distance Education mode.

1.3 Canadian and US Meetings

As opportunities such as this happen very rarely, an extensive, and in the end somewhat adventurous itinerary was proposed (the actual itinerary and contact details of those visited are given in Appendix A). In general, the plan was to meet with a cross-section of representatives from three groups: university academics, industry associations and industry manufacturers, and as such, discussions were held with the following:

Academics

Professor Dave Barrett	University of British Columbia
Professor Ricardo Foschi	University of British Columbia
Professor Borg Madsen	University of British Columbia (Retired)
Dr Rod MacNeill	British Columbia Institute of Technology
Mr Rick Dohl	British Columbia Institute of Technology
Mr Thomas Abbuhl	British Columbia Institute of Technology
Mr Eric Worthy	British Columbia Institute of Technology
Dr Robert Tichy	Washington State University
Professor Tom McLain	Oregon State University
Assoc Prof Bob Lechti	Oregon State University
Assist Prof Rakesh Gupta	Oregon State University
Dr Dave Bohnhoff	University of Wisconsin
Professor Keith Faherty	Marquette University
Mr Robin Allardyce	Carleton University
Professor Don Westwood	Carleton University
Professor Juan Salinas	Carleton University
Professor Vijaya Gopu	Louisiana State University
Assoc Prof Mike Folse	University of New Orleans

Industry Association Representatives

Dr Jean Cook	Forintek Canada Corp
Dr Kevin Cheung	Western Wood Products Association
Dr Russ Moody	US Forest Products Laboratory
Dr Lawrence Soltis	US Forest Products Laboratory
Dr Jerrold Winandy	US Forest Products Laboratory
Ms Catherine Lalonde	Canadian Wood Council
Dr Alf Warnock	National Research Council of Canada
Ms Catherine Marx	Southern Forest Products Association

Industry Producer Representatives

Dr Robert Pike	MacMillan Bloedel Ltd
Mr Ken Lau	MacMillan Bloedel Ltd
Mr Rob Imbrogno	Trus Joist MacMillan
Mr John Kerns	Weyerhaeuser
Mr Dave Gromala	Weyerhauser

Meetings were also organised with Mr Ken McKeen of the Canadian Council of Forest Industries and Mr Tom Williamson of the APA - The Engineered Wood Association, however, these meetings unfortunately had to be cancelled because of last minute commitments by Mr McKeen and Mr Williamson.

In order to maximise the effectiveness of this Fellowship, the timing was also coordinated to coincide with the International Wood Engineering Conference '96 in New Orleans, 28-31st October 1996. This forum provided a unique opportunity to meet and network with many other international academics and association representatives with education expertise. Three papers were presented by the author at IWEC '96 one of which, "*Timber Engineering Education in Australia*", described the NAFI and TPC educational programs which are currently under way, this paper is reproduced in Appendix B.

CHAPTER 2

The Current Status of Timber Education in North America

2.1 Introduction

Timber has always been the predominant material used in domestic framing in both the US and Canada, and today still around 80 - 90% of these country's sawn timber is used in this type of application. The non-residential building market, however, is an area which is still relatively untapped, despite the fact that the US and Canadian timber industries have been mulling over its potential for over a decade and a half. It was suggested in a 1993 study[5] that the total suitable North American non-residential market potential was an additional US$5.6 billion, including pull-through of non-structural wood products. One major hurdle, however, to capitalising on this non-residential market potential has been the lack of architects and engineers confident and knowledgable in the design of timber structures. To a great degree this problem stems from the fact that there are few formal wood design courses offered at North American universities.

In attempting to raise the level of awareness of future building professionals in regards non-residential timber structures, the North American timber industry has chosen to focus its attention on engineering courses. This is due to the fact that currently few engineering departments give timber design any substantial representation at all, particularly compared to the time given to competing materials, such as concrete and steel.

2.2 Timber Design Content in Civil Engineering Courses in North America

A number of surveys have been carried out in Canada and the US to determine the range of subjects being taught in engineering courses and to evaluate the amount of timber design involved.

A comprehensive survey was carried out by Keith Faherty in 1985 funded by the Weyerhauser Company Foundation[6]. The focus of the survey was US and Canadian civil, agricultural and architectural engineering schools. The results of the percentage of schools providing timber design as a core or an elective subject and the estimated number of students in 1985 receiving some instruction in timber design are shown below in Fig 2.1.

School	*Civil Engineering*		*Agricultural Engineering*		*Architectural Engineering*	
	US	*Canada*	*US*	*Canada*	*US*	*Canada*
Number of Accredited Programs	*194*	*24*	*44*	*6*	*10*	*0*
Response Rate	*83%*	*54%*	*86%*	*83%*	*80%*	*na*
Percentage Requiring a Timber Course (core subject)	10%		58%		37%	
Percentage with an Elective Timber Course	47%		28%		38%	
Number of Students Receiving Timber Design at Schools Who Responded	2,400		280		200	

Fig 2.1 Results of Faherty's 1985 survey on timber design courses taught in US and Canadian engineering schools[6].

From the table, it can be seen that of the Civil Engineering schools that responded only 10% provided a required course[Φ] in timber design, whilst 47% of the schools offered the course as an elective - the result, approximately 2,400 civil engineering students who actually received timber design in North America in 1985. Whilst this figure in itself may seem large, based on head of population and the fact that most students received their instruction as an elective, this really translates to an extremely small percentage of civil engineering graduates with a good knowledge of timber design.

[Φ] A 'required course' is a subject all students must take. Similar to a core subject in Australia.

With the agricultural and architectural schools, the percentage of required courses were far higher than the civil schools, at 58% and 37% respectively while the percentage of elective courses were slightly lower at 28% and 38% respectively. At a combined total of only 480, the number of students receiving timber design through these courses though is extremely low.

Faherty's survey also identified the following numbers of faculty and schools involved in timber research: 81 faculty members at 49 civil engineering schools, 18 faculty members at 13 agricultural engineering schools and one architectural faculty member. In regards to postgraduate students working on wood research projects the numbers were 127 civil, 32 agricultural and no architectural.

Insufficient space in the curriculum and lack of resources were two of the main reasons the respondents gave as to why timber design was not offered at their schools. It was also evident from the survey that there was a need for additional training for university staff and a strong interest in having educational materials such as slides, videos and samples made available.

The American Society of Civil Engineers (ASCE) has also surveyed Civil Engineering schools every five years since 1978. These surveys, however, have generally been far broader looking at overall course content rather than timber specifically. A summary of selected responses from the surveys carried out in '78, '84, '89 and the most recent in 1994, where 151 schools of engineering were sampled, are given in Fig 2.2.

Year	*1978*	*1984*	*1989*	*1994*
% Response	*100%*	*100%*	*100%*	*73%*
Required course Timber Design	14%	13%	14%	9%
Concrete Design	79%	82%	78%	77%
Steel Design	79%	77%	93%	73%
Structural Analysis	95%	98%	43%	89%
Concrete / Bituminous Materials	64%	63%	75%	71%

Fig 2.2 Percentage of Civil Engineering students taking required subjects[7].

From the figures it can be seen that only 9% of the civil engineering schools in the US require a course in timber design. In contrast, concrete and steel design are required by 77% and 73% respectively of these same programs. The 1994 figures show a reduced trend for all the design subjects, however, to what extent the reduced response rate of the 1994 survey (73%) effects the results is hard to determine. The 3% difference between the 1984 figure of 13% and Faherty's 1985 result of 10% is most likely a result of the different response rates rather than any annual variation. As a general comment though it is obvious that timber design gets far less representation in Civil Engineering courses compared to competitive materials.

Another trend also observed during this study, that neither of the aforementioned surveys recorded, is the number of Forestry or Forest Products / Wood Science departments which now deliver timber design to engineering undergraduate students and offer postgraduate opportunities to graduate engineering students. It was suggested that this trend is due to the fact that many engineers in the 70's chose to do their postgraduate work in Wood Science, because there were 1-2 dozen good wood science academics carrying out structural timber research at that time. These postgraduates then went on to become lecturers within Forest Products / Wood Science departments themselves, either by choice or possibly because many civil engineering departments only hire staff with pure engineering postgraduate degrees. The high calibre of the current professors within these departments and the quality of their research also means that many postgraduate 'engineers' are again seeking to undertake their studies within Forest Products / Wood Science departments, a trend which could very well pose a problem to the future pool of potential civil engineering academics.

2.3 Reasons for Timber's Lack of Representation in Civil Engineering Courses

There are many possible reasons for timber's lack of representation in civil engineering courses. Faherty cited insufficient space in course curriculum as the major factor identified from his survey; a fair comment when it is realised that there are many other materials or products such as aluminium, masonry or asphalt which also receive little or no coverage in undergraduate civil engineering courses. This pressure on course

curriculum appears to be a worldwide trend which in most cases has resulted from decreased educational funding and a reduction in student/lecturer contact hours. Many engineering departments have also chosen to broaden their courses often including subjects such as those dealing with the environment or management, at the expense of more traditional engineering subjects.

Environmental misconceptions were also a factor put forward by a number of academics as to why timber design was being dropped as an elective subject at many universities. They suggested, that students had not been enrolling in many wood based courses because they believed using timber was environmentally bad. If an elective subject was not being supported and enrolments fell below a certain level then usually the subject would be dropped. It was also suggested that at some universities these environmental misconceptions were being internally encouraged by ill-informed lecturers whose own views had been obtained only from what they gleaned from the sensationalised media coverage. It was believed that addressing these environmental issues should be a major focus of any university education program.

Another major factor in timber's poor representation at universities is believed to be the lack of suitably qualified academic candidates for lecturer positions. It appears that currently there is a shortage of postgraduate qualified (Masters or PhD) civil engineers with an interest in timber design and research wanting to pursue an academic career. Rectifying this shortage will be critical if industry is to ensure a future pool of academics. It was suggested that one approach to this problem may be to introduce a national industry program to structure and co-ordinate university timber research. It was believed that a program such as this would provide a focus for research candidates and assist in a more equitable distribution of funding. It was even suggested that if the industry wanted a presence at a particular university it should directly hire academics to take on Masters and PhD students.

A further problem is maintaining the continuity and interest at individual universities. The time allocated to specific subjects is at most universities directly related to the support, enthusiasm, drive and influence of the lecturers. Therefore when the support is high, courses are usually maintained or advanced, however, when support stops such as

when the lecturer leaves, retires or changes interest then often the course hours can be cut or slashed completely. There are certainly clear examples of this. At Oregon State University, John Petersen, the professor who has looked after the teaching of timber design within the Civil Engineering department for many years has recently retired. Though the course is very popular, the Civil Engineering department at this stage has decided not to employ a suitably qualified academic to replace him. Another option would be for OSU's Forest Products department to supply a lecturer, there are certainly a number of eminently qualified staff available, however, the civil engineering department again is not prepared to pursue this line. There is therefore a real concern that the quality of civil engineering timber instruction at OSU may fall dramatically unless this problem is overcome.

2.4 Engineering Courses: Undergraduate and Postgraduate

The Undergraduate Level

The undergraduate timber design courses delivered at US and Canadian university civil engineering departments were found in most cases to be more extensive than that delivered in Australia. In regards to content, many topics were similar including

- wood properties,
- design of structural elements: beams, columns, combined members,
- fastener design (nails, screws, bolts, split rings, shear plates) and
- design of composite and glued laminated beams.

However unlike Australia, most courses also included detailed coverage of topics such as:

- panel products: plywood and OSB,
- diaphragms and shear walls and
- formwork design.

Course times varied from two hours per week, around 30 hours all up (typical of a well represented course in Australia), to three hours per week, around 45-50 hours all up. The year at which students generally undertook the timber design subject also varied; in

Canada it was given as the first design subject in the second year, while at most of the US universities the subject was not offered until the fourth year of the course.

In regards course resources, a number of excellent timber texts for local conditions already exist in the US and Canada which are used as prescribed texts (see Section 4.5) and in most cases these are supplemented simply by photocopied notes and tutorials produced at each individual campus (the industry does not currently produce a comprehensive teaching resource - lecture commentaries, overheads and slides - to assist academics to deliver timber engineering courses). Many of the universities in the US also make use of the slides and timber samples included in the 'Teaching Tool Package', a kit of resources supplied by industry which is described in detail in Section 4.4.1.

The Postgraduate Level

Postgraduate studies[Φ] in timber engineering, Masters and PhD, are available at many universities in the US and Canada through Civil Engineering and Forest Products departments. The actual requirements vary, but in general, the Masters Degree can be carried out either by *coursework* (primary emphasis is on coursework with a minor thesis, similar to Australian requirements) or by *thesis* (less emphasis on coursework, however somewhat greater than that required in Australia).

The US Doctor of Philosophy Degree is somewhat different to that carried out in Australia. In general, the US Degree requires considerably more coursework to be carried out than would be expected in Australia, however, less emphasis appears to be placed on the research thesis. The requirement that Doctoral research be original and add to the body of knowledge, however, is similar. Some of the topics currently being researched at the postgraduate level include:

- Effect of adhesives on the deflection of light-framed wood floors - Colorado State University
- Load ratings of hollow timber piles - Louisiana State University
- Modelling of wood truss roof assemblies - Oregon State University (OSU)
- High-strength fibre-reinforced glulam beams - OSU

[Φ] Commonly referred to as 'Graduate Studies' in North America.

- Dynamic behaviour of metal plate connected wood truss joints - OSU
- Dowel and nail bearing resistance of LVL - OSU
- Reliability based design of glulam beams - University of British Columbia (UBC)
- Dynamic behaviour of timber frames with dowel type connections - UBC
- Seismic performance of braced timber frames - UBC
- Investigation of shear strength in structural composite lumber - UBC
- Seismic resistance of shearwalls with steel plate corner reinforcements - UBC
- Investigation of web openings in OSB webbed I-joists - University of Alberta
- Strength and stiffness of wood screws in metal to wood connections - South Dakota State University
- Dynamic embedment of metal plate connections - Washington State University
- Effect of discrete lumber sizes on performance of wood floors - WSU
- Partial composite action effects in compression chords of trusses - University of Texas
- Fire endurance modelling of wood structural systems - Univ of Wisconsin
- Seismic response of timber shear walls - Virginia Polytechnic Institute & State University
- Performance of long shear walls with openings - Virginia Polytechnic Institute & State University

In those areas of the US where the timber industry is active and the links between industry and the local universities are strong, generally excellent postgraduate courses in timber engineering exist. Realistically however, compared to competing materials such as concrete and steel the number of postgraduate opportunities are small.

UBC's Masters Degree in Wood Building Design.

Canada, is attempting to take the lead in expanding the awareness of timber products, particularly engineered wood products for the non-residential market, by establishing a Council for Wood Building Design and Construction and setting up a Centre for Excellence in Wood Building Design & Construction at the University of British Columbia, see Fig 2.3.

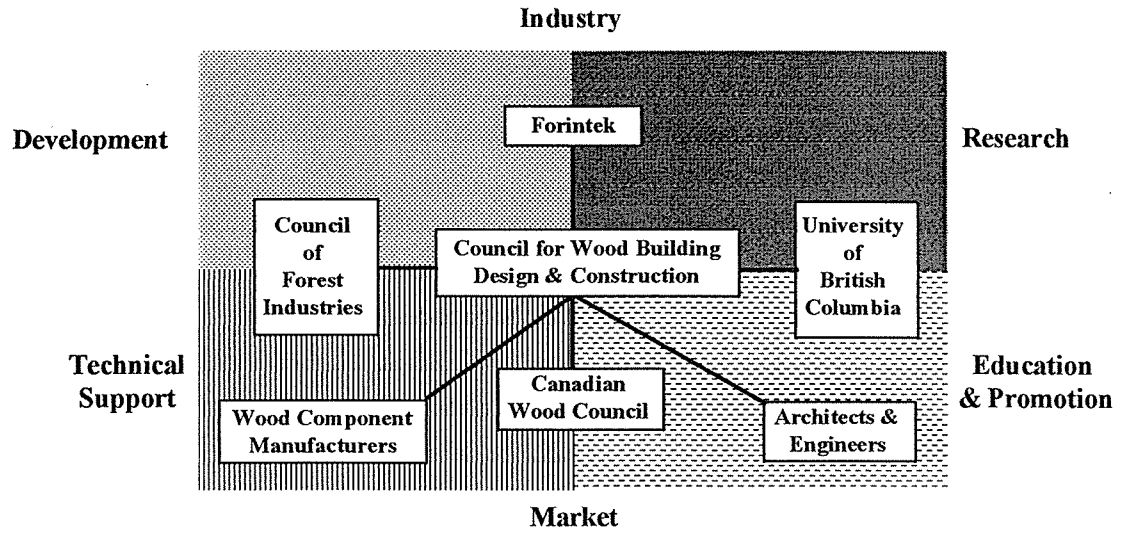


Fig 2.3 Partnership linkages of the proposed Canadian Council for Wood Building Design & Construction[8].

As well as assisting Forintek in research, UBC's proposed Centre for Excellence would also be used to deliver a series of specific educational programs, including:

* *Professional Masters Program* - 12 month full time program targeted at engineers, architects and wood products technical specialists. The program would be course based and include a major project.
* *Bachelor's Program* - 5 year co-op Wood Building Technology Major to produce a specialised undergraduate in Wood Building Design & Construction (modelled on the Swiss school for Wood Engineering).
* *Continuing education* - short courses, workshops for architects, engineers, building code officials, industry marketeer's and sales staff.
* *Applied Research and Development* - to solve practical problems in the structural use of wood, connections, earthquake resistance, architectural design and durability of wood structures.
* *Extension Service* - for designers in the field who require assistance of a specialist nature.

It is expected that the first Master's Degree program will run in September 1997 with approximately ten students and that gradually the numbers will be built up to between

twenty and twenty-five per year. With the program open to graduates of engineering, architecture and wood product technologies, the course should provide a very interesting and varied mix of study; certainly many in the industry are waiting with interest to see how the course addresses such a broad student base.

2.6 Academics' Expectations of Industry Support

In regards industry support, there was unanimous agreement from all the academics spoken to, that industry should really be doing far more to support timber education at the university level in North America.

At one extreme there was an expectation that the timber industry should be highly pro-active, taking a similar approach to that of the Asphalt and Masonry industries. The Asphalt industry, some ten years ago, established a National Center for Asphalt Technology at Auburn University in Alabama. With a budget of around $1 million per annum, the specific aims of the Center are both 'educating the educators' and coordinating industry research. The educational course brings a group of about 15 to 20 academics together for two weeks (initially the course was a month) in early summer with everything paid for: travel, living, food and even wages. The course has an extensive curriculum with lots of hands on lab work. Everything is supplied to the academics to allow them to deliver the course back at their own universities. Keith Faherty, from Marquette University in Milwaukee, who attended the course some years ago, said the course was excellent and extremely worthwhile; Marquette introduced two weeks of asphalt and also some research programs into their curriculum following Keith's attendance at the course and two other Marquette staff have also attended over the years.

Bob Leichti from Oregon State University also described what the Oregon Masonry Institute was doing to get masonry design into university courses. He said the Institute gathered together professors from a number of interested universities for a one week 'educate the educators' course, at which the participants were taken, in detail, through the teaching process and familiarised with all the resources that the Institute provided. In addition, for universities without masonry knowledgable staff, the Institute offered to

fund a practising engineer to come in and deliver the course for the university free of charge in the first year, provided that the lecturer also participated in the course. The lecturers were then expected to present the course in the further years, however, the Institute was prepared to use the external engineer again if for some reason a lecturer was not able to deliver the course.

This 'educating the educators' approach has also been used very successfully by the timber industry in the past through the Heritage Workshops (these are described in detail in Section 4.1.1). A series of four Heritage Workshop were held in the early 80's with a subsequent Workshop presented in 1988 but none have been held since. There was agreement from university, government and industry members alike that it was time that these Workshops were re-run for current educators; the main stumbling block, however, appears to be who is going to pay.

Industry research funding was perhaps the next most common expectation. As mentioned earlier, it was widely felt that industry support of masters and PhD student programs was extremely important, both to provide a future pool of academics and also to ensure a high level of interest at individual universities, so that if the principal lecturer left, then there would either be likely replacements on hand or there would be the incentive for the department to hire another professor knowledgable in timber. However, it was a general feeling amongst academics, in both Canada and the US, that industry funding for research was lacking. Conjointly, this same comment was made by a number of the US timber associations who are in fact struggling to justify research funding in the current economic period. Some academics also felt there was little co-ordination, innovation or drive from industry when it came to research. It was stressed that in general, associations had been quite responsive in their donation of materials when they had been asked for, however, most academics felt that if they were to pursue a project they really had to do everything themselves, from conception of the idea, through initiating contacts and chasing up money and materials - the feeling was that industry should instead be more pro-active with their assistance.

Russ Moody and Mike Ritter from the US Forest Products Laboratory (USFPL) felt that cooperative research programs provided the best approach for interaction between

government/industry and universities. These projects were usually initiated by either academics approaching USFPL about researching a particular issue or the parties coming together through areas of mutual interest such as, conferences, committee meetings, etc. Under a cooperative program the university was expected to contribute around 20% to the cost of the project and there was a limit on the universities overheads. The Forest Products Laboratory believed these cooperative programs were very useful as postgraduate students could do much of the work, reducing labour costs, and also if younger academics were involved they were usually very keen and enthusiastic and quite prolific paper writers. Though USFPL has been active in university co-operative projects in the past, last year due to internal and financial re-structuring the budget was severely reduced. The Forest Products Laboratory has been involved with universities throughout the US including those in the states of Washington, Oregon, Nebraska, Iowa, Alabama, Florida, Maine , Pennsylvania, Michigan and West Virginia.

Provision of resources was also an expectation. In this regard, it was widely suggested that the industry must provide a more united front. The way industry currently functions due to the different internal political pressures and the number of competing players was believed to be a major problem as it made things somewhat confusing for students compared with steel and concrete. It was suggested that the industry's information was too scattered, uncoordinated, diverse and often duplicated, where there was a wide choice of similar products. It was pointed out that the politics and marketing angles were even reflected in the standards which was confusing to students, i.e. Southern Pine's value in the Volume Factor. There were even suggestions that the, soon to be released, limit state design code has not addressed these issues and still suffers from the same shortcomings of the old system.

It was felt that the industry's approach should be far more unified and pro-active in development and distribution of resources such as technical literature (i.e., a folder of literature for each student) and software, etc. It was widely believed there would be real benefits if industry collaborated on a national set of course notes for lecturers, particularly to assist them to shift to a limit state syllabus. This would be of benefit not only to departments who do not currently teach wood design but also to those who do, as converting a course is a major exercise certainly something that cannot happen

overnight (re-running the Heritage workshops could be the catalyst for this, as teaching resources could be developed and presented directly to the academics).

Financial assistance for students was also suggested, such as subsidising design codes, commentaries and texts (the US steel industry for instance subsidises students design codes and puts a big stamp on the cover saying this). It was also put forward that industry should sponsor lecturers to conferences and encourage dedicated educational conference sessions. It was also thought associations should do more in the advertising arena focussing on what attracts people to timber and the environmental benefits both to nature and lifestyle of using it. Finally, it was believed that what industry really needed was key people who understood the importance of education and were prepared to encourage and support it.

CHAPTER 3

The Educational Role of Industry Organisations

3.1 Industry Dynamics

The forest industry in North America invests over $100 million per year in research, education, standards development, regulatory and legal issues, quality assurance and inspection. Market promotion is substantial, but it is highly fragmented with over 85 formal private and public organisations and trade associations. The Canadian industry has attempted to streamline the system and reduce duplication by channelling much of the aforementioned activities through the Canadian Wood Council (CWC), an association of associations, and Forintek, a unique organisation dedicated entirely to Canadian solid wood product industry research. Industry alliances in the US are not nearly as strong and instead there are a number of major industry associations and corporations who in many respects are competing over either regional market access or product penetration. Industry dynamics and market influences also appear to be forging a new hierarchy in the US with the dominance of solid wood producers and associations under pressure from the growing range of engineered wood products producers. However, realising the inefficiencies of duplication, in some areas the US industry associations are attempting to work together on programs of mutual benefit under the banner of the Wood Products Promotion Council.

In this chapter a brief background is presented on the structure and approach of those organisations who address the education issues in North America. The educational activities and resources that these organisations undertake and provide will be highlighted here and then discussed in further detail in Chapter 4.

3.2 Canadian Wood Council (CWC)

In Canada, university education programs are the responsibility of the Canadian Wood Council; a national federation of forest product associations representing over 1200 Canadian manufacturers of solid timber, plywood, oriented strandboard, treated wood, glulam and trusses. The Canadian Wood Council was formed

> *"**to ensure market access** in order to **maintain and expand markets** for Canadian wood products **in North America**"* [9].

The cornerstone of CWC's work is the development and maintenance of codes and standards and the production and communication of technical information,

- → this they believe is the most effective way of "*ensuring market access*".
- → "*Maintaining market share*" refers primarily to residential markets, while
- → "*expanding market share*" refers to the development new markets in commercial construction, with
- → "*in North America*" covering the markets in Canada, the US and Mexico.

Based in Ottawa, the Council employs fifteen staff, including support staff, and its operating budget is around four million Canadian dollars per annum with funding coming primarily from a levy on timber shipped into North America ($0.19 / 100 board feet of timber). As well as education and codes and standards, the Council also undertakes work in areas such as market research, business development and product promotion.

In the promotions area the council is extremely active holding regular seminars for builders across Canada, exhibiting at trade shows in both the US and Canada and organising the Woods Solutions Fairs for architects, engineers, builders and building officials in Vancouver and Boston. The Council publishes an excellent wood product

and construction magazine, Wood Le Bois, which it distributes to around 17,000 construction industry members as well as maintaining a highly interactive Internet home page[Φ] .

The Council's flagship, however, without a doubt are its excellent publications, certainly the most comprehensive and informative timber industry association publications in the world to date, a selection of these are shown in Photo 3.1. Amongst others, these include the:

- *Wood Reference Handbook* - a comprehensive and highly visual 'encyclopedia' of timber products (600 pages, $80 Can)
- *Wood Design Manual* - a detailed engineering reference, which also includes the complete CSA Engineering Design Code (900 pages, $80 Can)
- *Wood and Fire Safety* - (270 pages, $30 Can)
- *Introduction to Wood Design* - a specific learning guide to supplement the Wood Design Manual (350 pages, $40 Can)

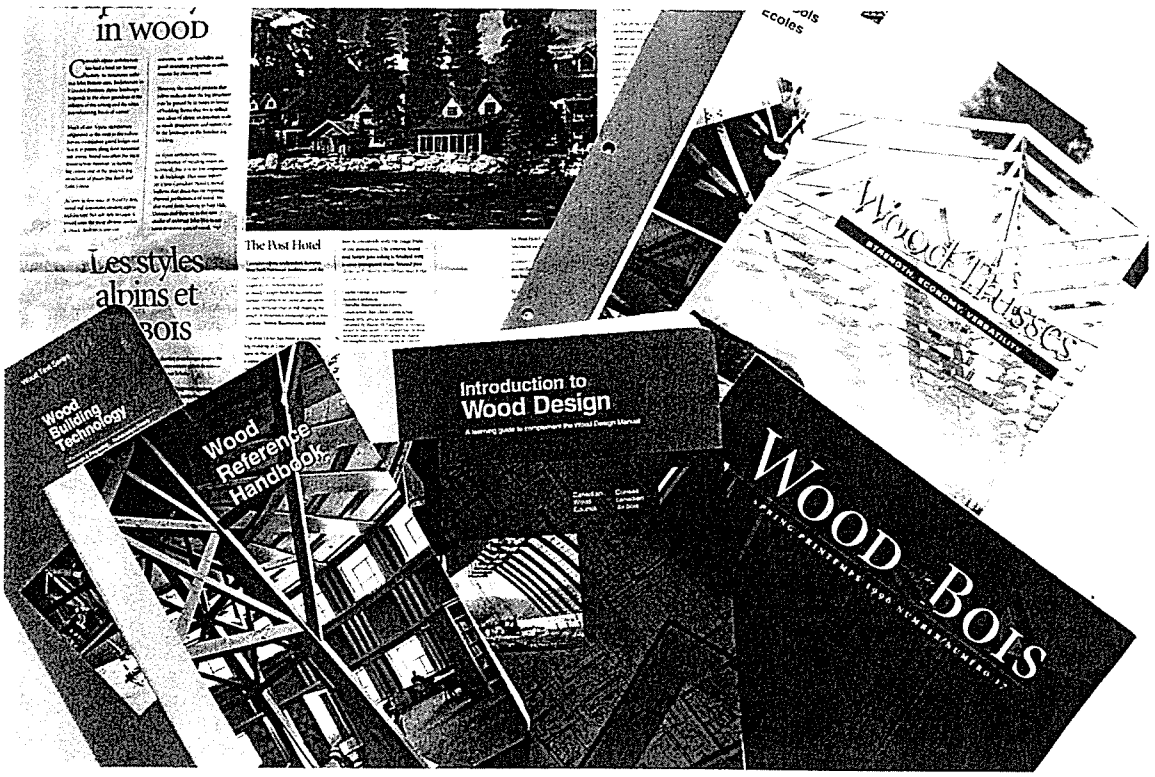


Photo 3.1 A selection of the Canadian Wood Council's publications.

Φ http://www.cwc.ca

The Council has also developed and distributes two computer structural analysis programs, based on the Canadian design standards: "Wood Works - Sizer" for timber member design ($389) and "Wood Works - Connections" for connection design ($149). The Council now also sells amended versions of these programs, based on the US standards, in the US through the American Forest and Paper Association, though these programs contain no reference to the Canadian Wood Council.

The Council's educational program is currently managed by Catherine Lalonde and under the CWC's three year strategic plan (1996-1998), the goal of the program is to

> "*increase the existing number of instruction hours for wood content in Canadian universities and colleges by 10%*".

The program is focused mainly at the university level, and to date, the emphasis has been on engineering and wood design courses; the Council provides no programs for trade level courses. The main activities of the program, all of which are discussed in detail in Chapter 4, currently include

- distribution of an educational engineering text,
- development of a university teaching package, and a
- bi-annual timber design workshop for university professors,

The Council also provides support to both the

- University of British Columbia's (UBC) Masters Degree in Wood Building Design , discussed in Section 2.4 and
- Carleton University's distance education course in Wood Design, discussed in Section 5.1.

In regards to professional development programs, the Council also organises a series of free, 3 hour, Breakfast Seminars annually for professional engineers, architects and building officials, (see flyer Appendix C). Though not directly part of the university education program, academics are also encouraged to attend. Seminar topics vary each year and the 1996 seminars, which were held in six cities across Canada, covered the changes to the National Building Code that affected wood construction as well as the types and uses of engineered wood products.

3.3 Forintek Canada Corp

Forintek, is Canada's solid wood products sector's national wood products research institute. Forintek's mission, according to its 1996 Annual Report, is to:

> *"be the leading force in the technological advancement of the Canadian wood products industry, through the creation and implementation of innovative concepts, processes, products and education programs"* [10].

The Institute's partners include the Federal Government, six Provincial Governments and over 150 industry manufacturers of lumber, plywood, OSB, particleboard, MDF, LVL and other value-added products. The Institute has an annual budget of around fifteen million Canadian dollars of which around 50% is supplied by industry and 50% by government.

Currently, the core programs include: resource assessment, advanced manufacturing - lumber, advanced manufacturing - composites, drying & protection and building systems (building systems can be further divided into structural safety, fire safety, durability and environmental compatibility).

Strategic direction and priority setting for the Institute is determined by the Board of Directors (26 representatives from industry & government), a National Research Program Committee (16 representatives from industry & government) and 5 National Technical Advisory Committees, representing the core programs mentioned above.

Much of the Institute's research is currently focussed around offshore export opportunities including Japan and other Pacific Rim nations and includes investigation of seismic, high wind and fire performance of timber elements and structures. This focus is the result of a re-assessment of market strategies brought about by volume restrictions recently imposed by the US; the aim of the Canadian wood products industry is to reduce the reliance it currently has on the US commodity market.

Also, with restrictions on Canadian softwood exports to Europe, due to the perceived threat of pinewood nematode in green wood, the industry is investigating what potential niche markets might be available in Europe in value-added products, such as window components, specialty joinery and engineered wood products. In this regard, much effort is being invested in a life cycle analysis computer software program, ATHENA™. Forintek believes this more sophisticated approach to addressing environmental issues will appeal to the Europeans, enhancing Canada's image and prestige in the market and providing an edge over competing products.

To stretch the impact of their people and their dollars, Forintek also promotes the use of alliances, especially with a number of universities in Canada, Japan and Italy and with other like-minded research institutes in Japan, New Zealand, China, Taiwan and Europe.

Being the coordinating body for national timber research, Forintek, obviously has a pivotal role in the link between industry and universities. Forintek's approach to university research to date, has been to advertise a list of projects to the universities with the expectation that individual professors would then submit proposals to seek funding for specific projects. Funding was not to have been seen as simply a university grant, rather that the participants were expected to treat the project as a joint venture, to provide regular results and to complete the project within a set time. This was seen as a problem by some academics who felt that Forintek's research programs were being driven too much by money managers, rather than scientists, and results often were expected within unrealistic time frames, i.e. pandering too much to industries whims rather than encouraging pure research. Forintek's answer to this is contained in their Annual Report which states: "*Business environments change quickly. Business cycles are shorter. It is therefore vital to balance short and long term research and stay focused on the future*". In theory at least, this view should in fact provide excellent collaborative opportunities for Canadian universities to complement and extend Forintek's research capabilities.

One of the main problems academics face when looking to establish a research area is where to go within industry to find technical and financial support. Forintek's unique situation as the single coordinating national research body, however, overcomes this

problem. This structure also provides great potential for industry to influence university research on a broad scale. Through a properly structured educational research plan the industry has the opportunity to provide complementing centres of timber research in all the major Canadian universities. Currently, it appears that the major support goes only to a few select universities, which include the University of British Columbia ($500,000/annum), the Universities of Alberta and New Brunswick ($20,000/annum each) and Laval University in Quebec, however, the infrastructure is certainly in place for the industry to extend its influence throughout the university system if the future need requires.

3.4 Wood Products Promotion Council (WPPC)

In the US, the situation is far more fragmented with many large regional or product specific organisations involved in timber production, promotion and marketing. Though most of these organisations have some direct interaction with the universities, particularly in their own local area, few have their own specific university education programs. Realising the need to address timber education nationally and in an effort to reduce duplication, however, a number of associations are now working together on educational issues under the banner of the Wood Products Promotion Council (WPPC).

The Wood Products Promotion Council was formed by industry agreement in 1982 to provide the infrastructure for industry associations to assist one another on specific programs of mutual interest. It was believed that the synergy developed in coordinating programs of various associations with a common marketing direction would be greater than the sum of the individual association programs.

The main associations coordinating the WPPC's programs are:

- APA - The Engineered Wood Association
- Southern Forest Products Association (SFPA)
- Western Wood Products Association (WWPA)
- American Institute of Timber Construction (AITC)
- Wood Truss Council of America

Other associations such as the American Forest & Paper Association's, American Wood Council and the Canadian Wood Council also co-operate on certain joint promotional activities within the US.

WPPC's annual budget is currently around $500,000 with initiatives being funded on a project by project basis. A Promotion Plan is developed annually, after discussion among the various associations, with separate budgets being assigned to each program. Each program has a nominated association responsible for its implementation who during the year, or at the conclusion to the year, records the programs expenses and bills each of the participating associations accordingly. Individual associations do not have to contribute or participate in all programs only those which fit within their own marketing strategies; if an association marketing program doesn't correspond to the WPPC's efforts then it doesn't participate. The Council has no full-time staff, rather, staff from the various organisations either take a lead role or simply support the activities as required; some association staff are more active in some programs and more passive in others. A chairman is appointed from one of the major associations every two years, currently it is Mr Bob Petow from the Western Wood Products Association. A formal Steering Committee does exist, however, it really only meets when a major issue arises. In reality, the coordination of the WPPC's activities is in the hands of the association staff representatives who meet three to four times a year (one 'spokesman' per association, generally the respective association's marketing manager). Each representative then reports back to their own respective association marketing committee to update them on the WPPC's activities and to seek any feedback. It appears the formality of the structure has relaxed over the past few years, as the key association representatives are now familiar enough with each other and their respective association program directions that they operate with a great degree of goodwill.

In recent times the WPPC has been focussing its joint efforts on the non-residential, residential and remodelling markets. The programs targeted for implementation in 1996 were [11]:

Residential Market

- National Association of Home Builders Trade Show
- High Wind / Seismic Project

Remodel Market

- Builder/Remodeler Seminar Program

Non-Residential Market

- Guide to Wood Design Information
- Wood Construction Seminars

General Programs

- Carl E. Darrow Student Design Competition
- Teaching Tool Packages
- ACSA Constructional Materials Institute
- Environmental Communication Program (Wood Works)

The main educational initiatives under the WPPC program include the Wood Construction Seminars which are often held at local universities (these are discussed in Section 4.2), the Carl E. Darrow Student Design Competition for architectural students (described in Section 4.3.2) and the development of a Teaching Tool Package for university lecturers (discussed in detail in Section 4.4).

Cathy Marx, the Engineering Systems Manager of the Southern Forest Products Association (SFPA), is currently the driving force behind the WPPC's educational program, particularly the Teaching Tool Package, committing an enormous amount of her time to ensure its success. She is also assisted, where required, by representatives from each of the other industry associations involved.

The WPPC also looks to the American Society of Civil Engineers (ASCE) Committee on Wood's, Education Sub-committee for guidance. The committee is made up of 21 academics, association and industry members and its purpose is to promote and develop mechanism for effective structural wood engineering education in the academic and professional arenas by:

(a) developing educational resource material (teaching tools),

(b) by organising national-level wood engineering instructional programs, and

(c) fostering wood design competitions for civil engineering students.

The ASCE committee provides advice which assists the WPPC in focussing its educational programs, however, the committee usually only meets once per year and then only for a few hours so its effectiveness as a group is in some respects limited.

A number of the WPPC educational initiatives have been very successful, however, in spite of this success the prevailing view appears to be that the US timber industry, as a whole, is still not totally committed to education. In fact it was suggested that prior to Cathy Marx's paper on '*Wood Engineering in the US*' at the recent International Wood Engineering Conference '96 in New Orleans, that the industry really did not have a good picture as to what was going on at all. Despite the existence and activities of both the ASCE educational sub-committee and the WPPC, the industry is yet to formally develop a coordinated, integrated education plan. The projects, therefore, undertaken to date have really been instigated because of their obvious need rather than any overall strategy.

University research is also another area which requires a far more coordinated approach. If industry wants more universities involved in teaching timber then it must also assist academics in accessing industry research funds and technology.

3.5 Corporate Timber Industry Members

Many of the larger corporate timber industry members have also formed strong symbiotic relationships with universities throughout North America. The reciprocity of these partnerships provides unique advantages to both parties, the companies having access to the universities facilities and students; potentially future employees, and the universities enjoying both financial and technical assistance.

As part of this study tour, discussions were held with representatives of MacMillan Bloedel, Trus Joist Macmillan and Weyerhauser as to their educational activities. The companies all had strong ties to specific universities particularly those in the states in which they operated or in which they derived their workforce. In general, these relationships involved research funding, provision of timber products for student investigations and intern or cooperative education programs.

3.5.1 Intern or Cooperative Education Programs

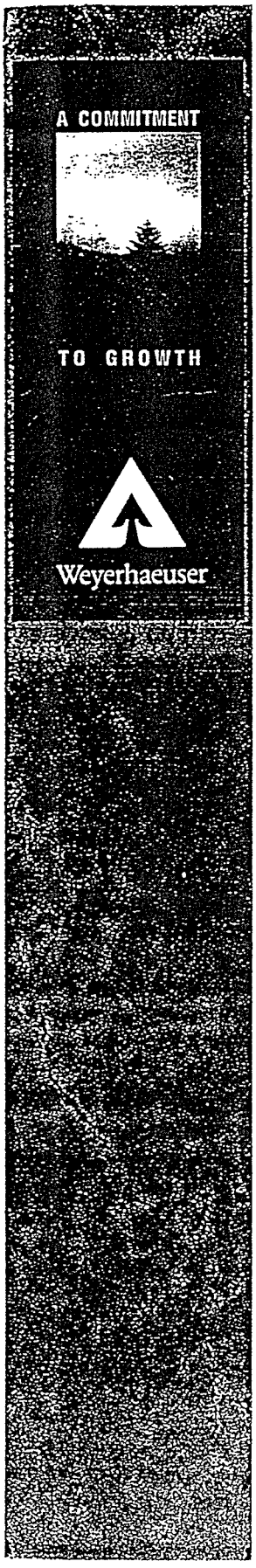
The intern and cooperative education programs are run by many of the larger companies and involve students working with a particular company on a full time basis for periods of usually between 3-6 months. At Weyerhauser for instance, applications are taken from students in many areas including Forestry and Civil Engineering, see Fig 3.1. All candidates go through a progressive selection process of application, interviews and in some companies even drug testing. The companies involved believe the program provides many benefits, as the interns have the opportunity to:

- get real world experience,
- apply what they have learnt at school,
- improve their understanding between theory and practice,
- work as a member of a professional team,
- gain exposure to current technology,
- learn to work in unstructured situations,
- improve their communication and interpersonal skills,
- build self confidence,
- identify career options, and
- gain valuable contacts and references.

The companies also benefit in that the programs provide a steady stream of potential future employees and the opportunity to intimately assess the qualities and work standards of the individuals prior to offering them full-time employment.

3.5.2 University Research Partnerships

Many of the larger companies also cooperate directly with universities on joint research projects. MacMillan Bloedel for instance, though a member of Forintek, also has its own extremely well funded research and development arm. When MacMillan Bloedel is interested in answers to broader, non-proprietary questions, where the results are not



Technology Research and Development

Internship and Cooperative Education Opportunities 95/96

Attention Engineering and Science Majors!

Are you looking for an internship program that is custom-designed for you? Does it sound too good to be true? Well, that is exactly what the Technology Research and Development (R&D) Cooperative Education and Intern Program strives to achieve for our interns.

If you are selected as a Technology R&D intern, we match you with a position that fits your skills and interests. Then we tailor the assignment to meet your objectives. We might provide more than one assignment so you can develop career goals while experiencing the diversity of opportunities in the technology field. We have opportunities for freshmen through graduate students.

Weyerhaeuser Technology R&D

Weyerhaeuser Research and Development stresses sound science and engineering fundamentals. It provides support services across the company that are cost-effective, yet give Weyerhaeuser a competitive advantage.

To achieve that competitive advantage, Research and Development:

- Teams with business research units for successful transfer and implementation of technologies.
- Maximizes excellence in research and development through the recruitment and development of its human resources.
- Focuses on leading the industry in forest management and manufacturing excellence through core competencies in environmental science and technology, forest biology, manufacturing technology, and developing new materials from wood and wood fiber.

Areas that may provide opportunities include:

- ☐ Analysis and testing.
- ☐ Environmental engineering.
- ☐ Environmental forestry.
- ☐ Energy and recovery.
- ☐ Integrated waste management.
- ☐ Manufacturing technology.
- ☐ Materials technology.
- ☐ Pulp, paper and packaging R&D.

Here are examples of some intern assignments:

- Develop material and energy balance calculations for testing recovery boilers and document the procedure *(Paper Science and Chemical Engineering)*
- Evaluate raw materials to determine best strategies for improving fiber length and strength for papermaking *(Paper Science and Chemical Engineering)*
- Develop an image analysis method for measuring lint particles and other small particulates *(Paper Science and Chemical Engineering)*
- Write computer programs to develop test methods to measure and improve paper properties *(Computer and Electrical Engineering)*
- Develop mathematical models and implement advanced control methods *(Chemical Engineering graduate program)*
- Design, develop, test and implement process control systems *(Chemical, Computer and Electrical Engineering)*
- Work with a team of engineers to solve the problem of mechanically sorting construction wood waste *(Mechanical Engineering)*
- Model mill energy systems using advanced energy conversion technologies *(Chemical, Mechanical and Electrical Engineering)*
- Participate in pilot studies to evaluate biofiltration, thermal oxidation and other potential air-pollution control technologies *(Chemical and Environmental Engineering)*
- Study the variability of wastewater treatments *(Chemical and Environmental Engineering)*
- Automate hazardous-waste characterization data *(Chemical and Environmental Engineering)*
- Participate in fundamental studies to improve understanding of how air pollutants are formed in forest products manufacturing and combustion processes. *(Chemical, Environmental and Mechanical Engineering)*

Fig 3.1 Weyerhauser Internship & Cooperative Education brochure.

Technology R&D
Internship and Cooperative Education Opportunities

Elements of the Technology Intern Program

- Internships and cooperative education opportunities may be from three to six months in length. Most are on a full-time basis.
- Interns are paid competitively.
- Interns typically register for academic credit.
- Interns must return to school after their internships to complete their degree requirements.
- Weyerhaeuser focuses on the development of its interns and offers many developmental activities, such as tours, training, speakers, and films. Workshop topics include Total Quality, safety, environmental stewardship, communication and interpersonal skills, and uses of technology in various business areas.

  Another way Weyerhaeuser helps its interns develop is to provide a mentor.

The Technology Intern Program is committed to providing a proven, qualified pool of candidates for entry-level positions in the technology community.

Benefits of being a Technology R&D Intern

During your internship, you'll have the opportunity to:

- ❑ Get real-world experience.
- ❑ Apply what you've learned in school.
- ❑ Improve your understanding of the relationship between theory and practice.
- ❑ Work as a member of a professional team.
- ❑ Gain exposure to current technology.
- ❑ Learn to work in unstructured situations.
- ❑ Improve your communication and interpersonal skills.
- ❑ Build self-confidence.
- ❑ Learn about your strengths and weaknesses.
- ❑ Identify career options.
- ❑ Gain valuable contacts and references.

Selecting the best

A typical selection process begins with an initial interview. Individuals who rate high in our selection criteria are invited for a final assessment at the Weyerhaeuser Technology Center.

All offers are contingent upon satisfactory results of pre-employment drug testing.

Majors include:

Chemical Engineering
Computer Engineering
Electrical Engineering
Environmental Engineering
Forest Engineering
Materials Science
Mechanical Engineering
Paper Science and Engineering
Wood Science and Engineering

Key selection criteria:

- ❑ Academic strength
- ❑ Integrity
- ❑ Communication and interpersonal skills
- ❑ Team player
- ❑ Initiative and self-motivation
- ❑ Self-confidence
- ❑ Customer and quality orientation

Weyerhaeuser Company's principal businesses are the growing and harvesting of trees; the manufacture, distribution and sale of forest products including logs, wood chips, building products, pulp, paper and packaging products; real estate construction and development; and financial services. Weyerhaeuser is the world's largest private owner of merchantable softwood timber, and producer of softwood lumber and market pulp. It is also one of North America's largest producers of forest products and recyclers of office wastepaper, newspaper and corrugated boxes.

Weyerhaeuser has been managing forestlands since 1900 and currently supports the largest private silvicultural and environmental research staff in the world. The company is committed to continuously improving its performance as responsible stewards of environmental quality.

How to apply:

Send your resume, with a cover letter specifying your areas of interest, availability and geographical restrictions, to:

Debbie Angel
Technology R&D and Intern Program Manager
Weyerhaeuser
WTC 1G42
Tacoma WA 98477

Fig 3.1 Weyerhauser Internship & Cooperative Education brochure.

required immediately, they often encourage the use of outside research facilities such as Forintek or universities such as the University of British Columbia.

Weyerhauser, similarly has a strong and active relationship with Washington State University both through seats on the advisory board of a number of timber related courses and through support of the university's Wood Materials and Engineering Laboratory (WMEL). The WMEL's approach to industry/university education is to develop a team of industry personnel and faculty to address problems of mutual concern and interest. The teams develop the proposals, including budgets, which they then submit to a review panel of faculty and Advisory Board members. The panel prioritises the proposals and recommends which ones are to be funded. The proposals are then developed as "seed money" or "initiation" projects. If the seed money project is successful then additional funding is pursued from federal or state agencies or from the wider industry as a separate project. This approach has been found to be very successful in the funding of large on-going research projects.

3.5.3 Professional Development

Though in general individual industry members have not really been very pro-active with student education, they are quite active with professional specifiers, such as engineers, architects and builders through personal contact and industry seminars. Truss Joist MacMillan, (TJMM) for instance, employs 3 staff in Vancouver alone whose job is to go out and speak face to face with specifiers; about 6-700 are contacted a year. TJMM also provides computer design software to practising engineers and architects, though at this stage they do not provide it to educational establishments. Formal seminar programs are also presented on a regular basis or are run to coincide with the release of new products.

3.5.4 Perceptions of Current Educational Activities

The representatives of the industry organisations were asked what they thought of the industry associations approach to education. In the US, it was felt that the formation of the WPPC to try and get around some of the potential association political problems was a good approach, however, it was suggested that some of the WPPC's resources and activities still suffered from this problem. There was a general feeling that some of the

associations might be at the whim of the bigger industry members, many of which did not have a good picture of what was going on or the importance of long term, future programs.

The main concern was the continuation of funding, as the industry association income was directly linked to the prosperity of the association members, when times were good, funding was available, however, whether the program would be continued in less prosperous times was questionable. An interesting view shared by a number of representatives was that due to the need for the industry to trade more viably both overseas and to compete with Canadian imports that there would be a major unification of a number of the current associations sometime in the future.

In general it was felt that the resource programs and activities carried out by the WPPC were good, however, it was suggested that a more coordinated, pro-active approach was really needed.

CHAPTER 4

Educational Activities & Resources

Though there is no coordinated overall approach, as yet, to education in North America, a number of excellent educational based activities have and do take place, including professorial workshops, university seminars and student competitions. Realising the inefficiencies of duplication of effort many of the associations and industry groups are also working together in regards educational resources such as teaching packages and text based material. In this chapter these activities and resources are presented.

4.1 Professorial Workshops

One of the major reasons given for timber's poor representation in Civil Engineering courses was the lack of academics knowledgable in timber design. In an attempt to address this problem, a number of workshops specifically for university faculty have been undertaken by the North American timber industry.

4.1.1 Heritage Workshops

A series of workshops were conducted in the 1980's as a result of a bequest from Clark Heritage a former researcher with the Forest Products Laboratory (FPL) and director of research at Weyerhauser. The purpose of the Heritage Workshops was to develop a set of educational resources in a form adaptable for use in university timber engineering courses.

Initially, four workshops were presented each covering a specific theme. For each theme, seven or eight educational modules were written by specialist authors, both practising engineers and academics. The authors then presented each module in lecture form to an audience of around 30 engineering professors who were invited to critique the material and contribute comments and suggestions for its improvement. The revised modules were then published serially in the Journal of Materials Education after which they were compiled into a series of four books, see Photo 4.1:

Vol I: Wood: its Structure & Properties

Vol II: Wood as a Structural Material

Vol III: Adhesive Bonding of Wood and Other Structural Materials

Vol IV: Wood: Engineering Design Concepts

Photo 4.1 Clark C. Heritage Memorial Series books.

The modules within these books were presented in such a way that they could be easily incorporated into any existing timber design courses or form the basis of a new course. The modules included design examples, to provide the students with specific applications

of design principles to typical design problems and also, drawing on the extensive experience of the authors, examples of good and bad practice.

In 1988, using the remaining money from the Heritage bequest, a two week Summer Institute on Wood Design was held at Marquette University in Wisconsin. In this instance invitations were sent to 215 civil, 45 agricultural and 10 architectural engineering departments. Over 100 academics responded positively to the invitation and from these 26 were selected. All costs to the participants including transportation, housing, meals and course fees were covered. An extensive program of lectures were presented interspersed with design tutorials, field trips, discussion sessions and technical tours. Over a dozen presenters were involved from academia, industry, government and private practice. A two volume ring-bound set of course notes was provided to each of the participants, see Photo 4.2, along with an extensive slide set (these notes and slides were also later made available to those academics who had applied but who had not been selected for the course).

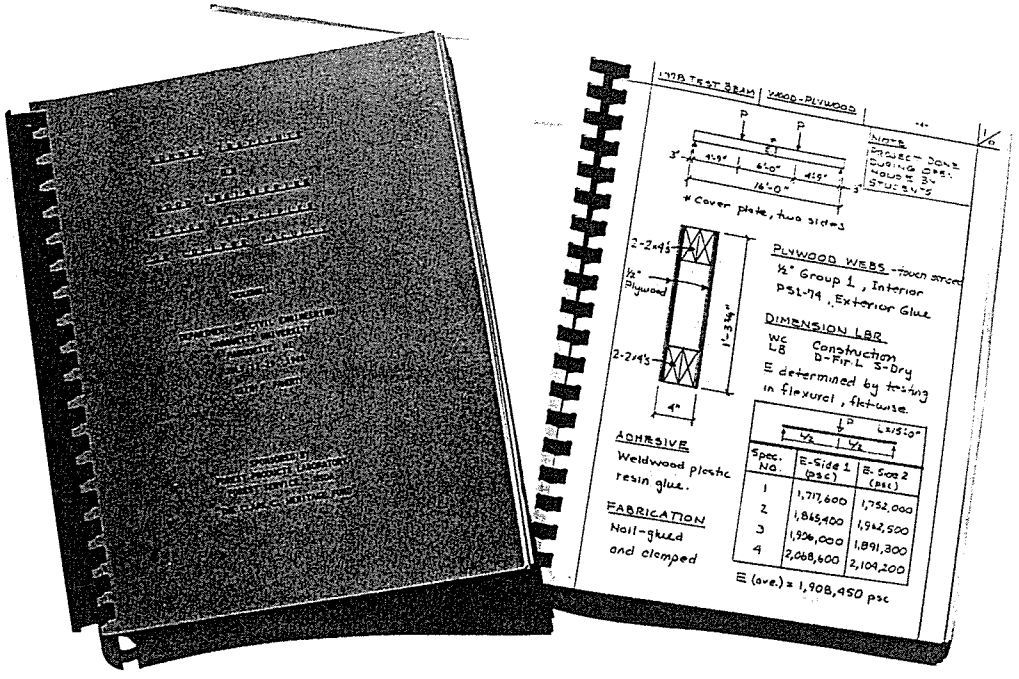


Photo 4.1 Summer Institute on Wood Design course notes.

A participant survey carried out following the summer institute, of which 21 of the 26 participants responded, found that whereas prior to the institute only nine had been teaching a course in timber, following their attendance, an additional ten had or intended to introduce a course. Despite this success rate and the fact that only one quarter of the academics who initially applied were able to attend, the US industry has not conducted any further major workshops specifically for academics over the past ten years. During this study tour many of the academics and industry members commented on the success and usefulness of the Heritage Workshops and all believed it was time that industry sponsored a new series for current engineering professors.

4.1.2 CWC Professorial Timber Design Workshops

The Canadian Wood Council also organises workshops for Canadian university engineering professors. These workshops are run every two years and are generally a single day or a weekend in duration. The venue for the workshop is usually Toronto as many universities are within driving distance. All expenses are paid for each participant which in the past has averaged out at around $1000/ person. The last workshop, whose theme was Industry/Education Research Partnerships, included representatives from 25 different universities: 18 engineering professors and 7 architectural. Most academics who participate find the workshops extremely beneficial particularly for the interaction they provide with other academics and industry members and the networks which are established.

4.2 University Wood Seminars

In the US, a series of University Wood Seminars are carried out annually in an attempt to supplement students wood design education, particularly at universities where courses are lacking. The seminars have now been carried out for 32 years and it is estimated that over this time in excess of 77,000 students have attended; for some this would have been the only exposure they may have had to timber design during their course. Around 30 seminars are held annually at universities across the US to introduce students of engineering, architecture and building to the fundamental concepts of timber construction and to stimulate their thinking on timber design. The seminars generally run for two and a half hours and are divided into thirty minute presentations covering structural timber,

glued laminated timber, structural panels and pressure treated timber, followed by a question and answer period. Many university academics charged with organising these seminars also advertise them to other local building professionals such as engineers, architects and government employees. All those attending the seminar receive a free binder comprising a selection of technical information from all the participating associations.

The seminar program is coordinated by the Southern Forest Products Association and is sponsored by the American Institute of Timber Construction, APA - The Engineered Wood Association, Southern Pine Council and the Southern Pressure Treaters Association. Representatives of each of the aforementioned groups participate in the presentations with out-of-pocket expenses averaging out to around $15,000 per association. Virtually all academics and industry members spoken to about these seminars enthusiastically endorsed them. The general feeling was that the mix of information was good and pitched at the right level and that the content was generic enough to overcome any perceived political concerns.

4.3 Student Competitions

Student competitions are seen as another way of generating an interest in wood at the university level. Currently, two major national competitions are supported by industry members. The National Timber Bridge Design Competition for engineers and forestry students and the Carl Darrow Student Design Competition for architectural students.

4.3.1 National Timber Bridge Design Competition

The National Timber Bridge Design Competition (see brochure Appendix D) was initiated to compete with a number of other student competitions established by the steel and concrete industries in the early 90's. The competition is open to all student chapters of the American Society of Civil Engineers and the Forest Products Society in the US and Canada. Over 40 universities have participated over the first four years and in 1996 there were 14 entries, involving 81 students, that devoted over 2850 hours to the competition.

The objectives of the competition are:

1. to promote an interest in the use of wood as a competitive bridge construction material,
2. to generate innovative and cost effective timber bridge design techniques, and
3. to develop an appreciation of the engineering capabilities of wood.

The competition requires each team to design, build and test, at their own university, a 3m span bridge constructed from commercially available wood structural members. Individual timber pieces in any member cannot exceed 1.4m though there is no limitation on built up or laminated timber members provided that the individual pieces do not exceed the specified maximum length. The bridge must be able to support, within set deflection criteria, a 20 kN load for one hour. The teams are required to submit a 12 minute video and photographs documenting all stages of construction and testing and a technical report which must include a description of the structural system, tables of all test results, an itemised list of materials used, drawings, photographs and a summary describing the bridges behaviour under load. The entries are judged on four weighted criteria with the entry with the lowest score being the winner:

Criteria	**Weight Factor**
Maximum deflection	40%
Total bridge weight	30%
Report, pictures, video	20%
Percent Non-wood	10%

The prizes total over $3,000 and include a number of special awards:

First Place	$750	
Second Place	$500	
Third Place	$300	
Special Award A	$200	for the most adaptable design for real life construction
Special Award B	$200	most economical and cost competitive design
Special Award C	$200	most aesthetic timber bridge
Special Award D	$200	most original and innovative design

Participation Awards	$100	to top ten entries that meet the design criteria but fail to capture one of the above awards

The timber bridge competition is coordinated by Southwest Mississippi Resource Conservation and Development Group with assistance from the Mississippi State University. Financial support over the last five years has come from the US Forest Service, however, due to the competition's growth, support for future competitions is being sought from corporate, association, private and industry sponsors.

4.3.2 Carl E. Darrow Architectural Student Design Competition

The Carl E. Darrow Student Design Competition provides architectural students the opportunity to broaden their experience with wood design through their participation in a major architectural competition. The competition was initiated in 1981 by the then president of the American Wood Council, Carl E. Darrow, and since its conception many thousands of architectural students have been exposed to the benefits and challenges of working with timber.

The competition is open to any students whose schools are members of the Association of Collegiate Schools of Architecture (ACSA) and involves the design of a specialty type structure. In 1994/95, the competition addressed the issue of renewable resources and their sustainable management and challenged the students to design a small forest research/education facility studying the use of forest products and demonstrating through its educational component, how the use of renewable resources could contribute to a sustainable and ecologically sound environment. The submissions were required amongst other things to demonstrate:

- the elegant and expressive use of wood as a material and determinant of form,
- the level of attention paid to preserving and enhancing the surrounding environment and ecosystem, and
- the utilisation of the many forms of wood building materials.

In 1995/96, the structure chosen was a Child Care and Development Centre, and in this case, the students were required to craft their design to emphasise the tactile characteristics of timber, its flexibility and versatility in form and its importance as a

sustainable material. Under the competition requirements the students must submit a series of board mounted architectural drawings showing floor plans, sections, elevations and perspectives; they may also include any other illustrations that communicate the nature of their solutions. A brief design essay must also accompany each submission describing the important concepts and features of the design project and how they fit within the project theme. In 1995/96, the cash prizes totalled over $10,000. The competition has an annual budget of around $52,500 with the WPPC contributing approximately 60% and the remaining 40% coming from private and corporate sponsors. Administration of the competition is undertaken by the AF&PA's American Wood Council.

4.4 Teaching Tool Packages

4.4.1 WPPC Teaching Tool Package

The extensive survey of North American engineering schools carried out by Keith Faherty in 1985, (described in Section 2.2), identified the need for a number of educational resources including slides, videos and product samples to assist academics in the delivery of their timber design courses. In an effort to address this need, the Wood Educational Sub-Committee of ASCE's Committee on Wood instituted a project to develop a specific Teaching Tool Package that could be distributed to university Engineering, Architectural and Building Construction departments. Coordination and financial support of the program was offered by the WPPC with the Southern Forest Products Association undertaking the major project management role.

The first two hundred Teaching Tool Packages containing literature, product samples and slides were distributed to selected university faculty in 1990 with a further 200 distributed in 1992. The recipients of the packages were then informally surveyed in July 1994 to determine the package's effectiveness [12]. Of the 400 recipients, 130 responded to the survey. The results indicated that 86 of the recipients were using the package and of these 86, 40 indicated that the availability of the package had in fact influenced whether a course was taught at all. Suggestions were also offered for improvement including providing case studies, sample homework, demonstration laboratories, relative cost comparisons, typical design calculations, videos, CD's and current software. Based

on the results of this survey, the package was expanded in 1995 by the inclusion of two videos, sample overheads and a wood design software demonstration program, see Photo 4.3. These updated packages were recently distributed to around 500 accredited engineering architectural, forestry and wood science departments.

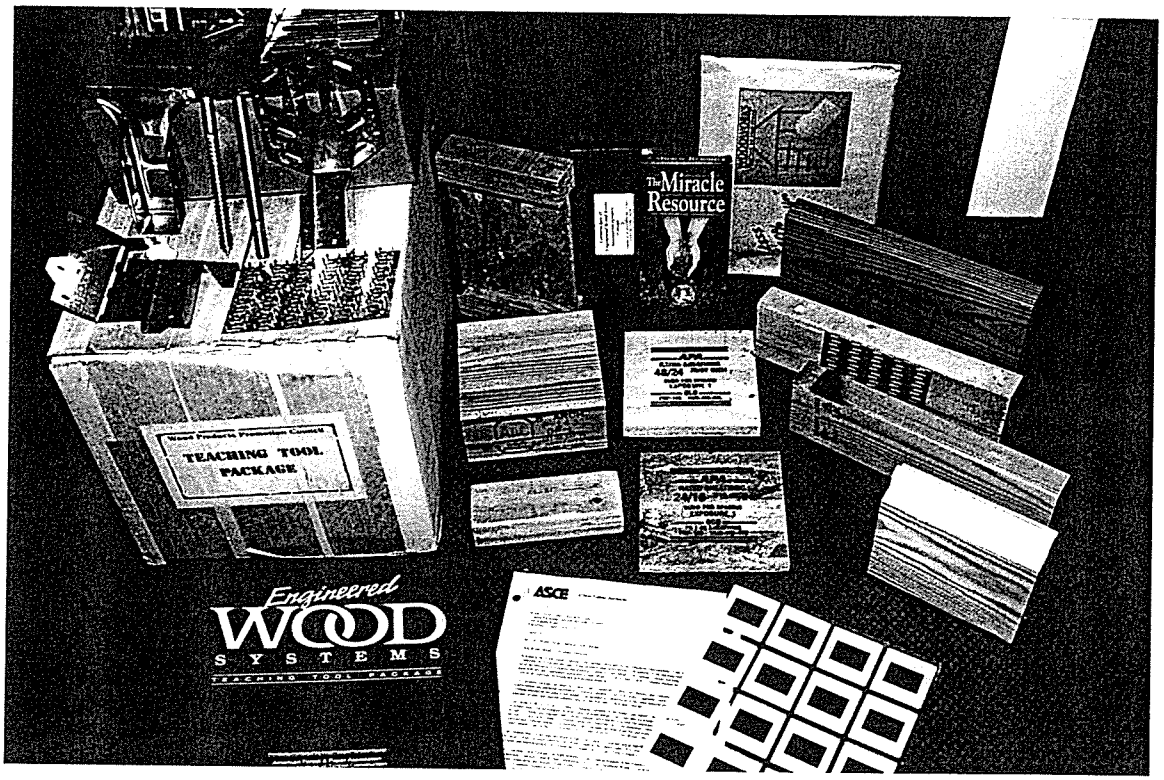


Photo 4.3 US Teaching Tool Package.

The current Teaching Tool Package consists of the following[Φ] :

1. Technical Binder (see Photo 4.4) containing:
    - 40 slides, giving a general overview on timber applications and a commentary on each slide,
    - 4 brief suggested course outlines,
    - 33 miscellaneous paper based overheads,
    - a bibliography of all the technical wood design information of the cooperating timber organisations, (see Photo 4.5), and

[Φ] A full description of the Teaching Tool Package contents is given in Appendix E. A full copy of the Package is held by the Timber Promotion Council, Victoria.

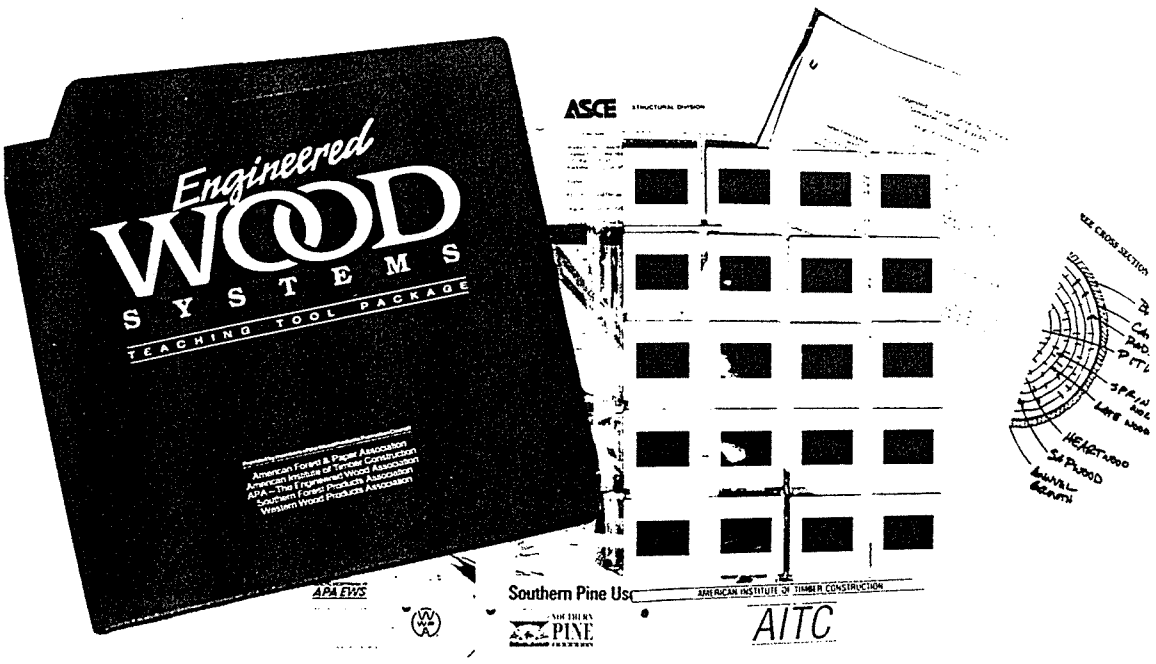


Photo 4.4 Teaching Tool Package: technical binder.

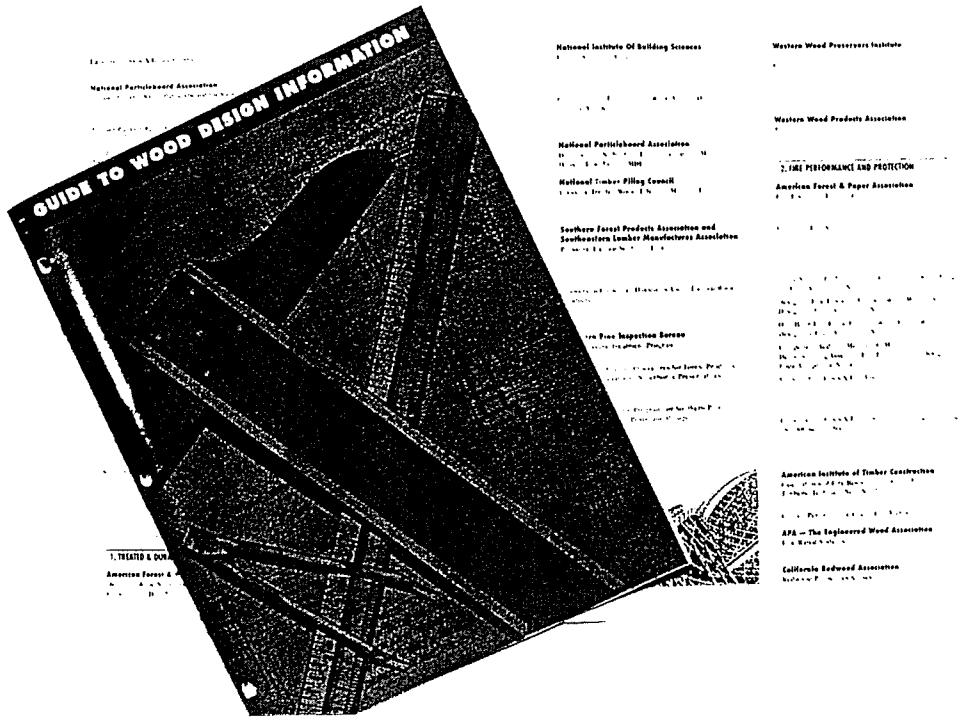


Photo 4.5 Teaching Tool Package: bibliography of timber publications.

- selected industry association trade literature covering topics such as wood frame construction, post-frame construction, product identification, commercially available timber, structural panel products, glued laminated timber, trusses, fasteners and connectors, fire performance and treated wood products.

1. Nine product samples (see Photo 4.6), including: 2x4 MSR Douglas Fir, 2x6 CCA-treated Southern Pine, Glulam, I-joists, LVL, plywood, OSB, plated truss joint and laminated decking.

2. A selection of metal connectors and fasteners (see Photo 4.7), including: truss plates, joists and various other hangers, connectors, anchors, clips, bolts and coach screws.

3. Two videos: "The Miracle Resource" - dealing with the environmental aspects of timber, produced by the Temperate Forest Foundation (15 min) and "Construction of Engineered Wood Roofs" - produced by the Southern Pine Council (12 min).

4. A demonstration copy of the timber design computer software "Wood Works".

Most academics spoken to on this study tour believed that overall the Teaching Package was a valuable resource particularly the samples and slides. There were mixed views though from some academics on the worth of the technical literature and even some disquiet from the associations involved. It appears that there was much debate during the planning process as to what information should be included and therefore in the end it was decided that only generic association technical information should be used. A similar political problem occurred with the timber samples. A Parallam sample was included in the first release of the package which interested many departments, however, due to Truss Joist MacMillan's reluctance to support the initiative, the planning group decided not to include any company proprietary brand material in the updated packages; the Parallam samples are now not included.

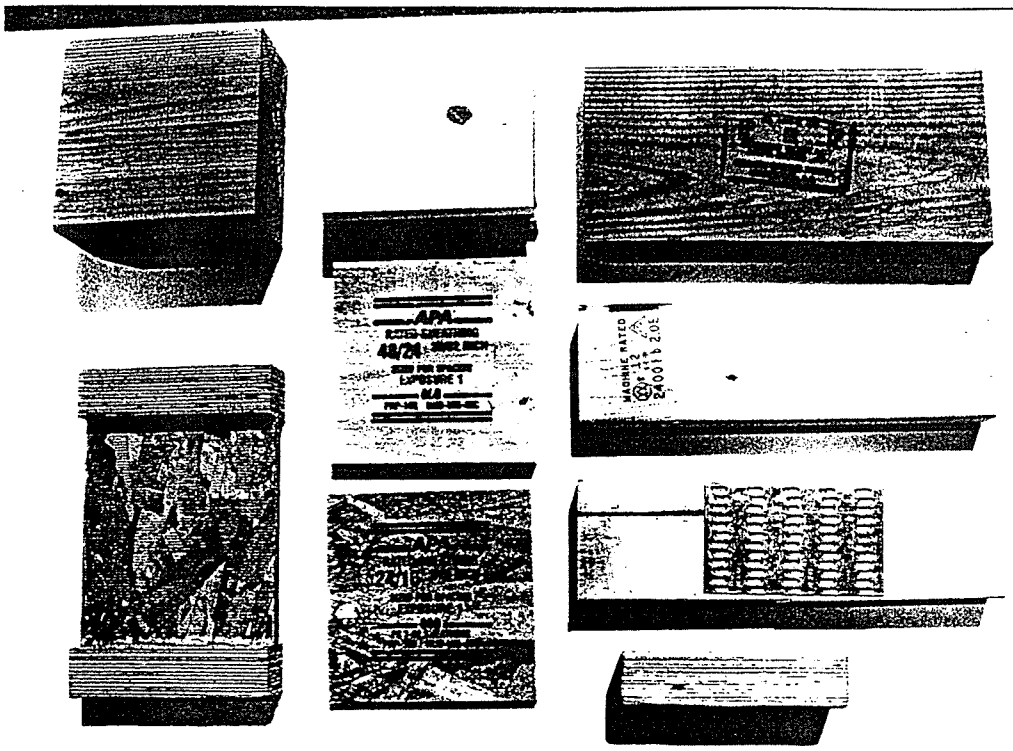


Photo 4.6 Teaching Tool Package: product samples.

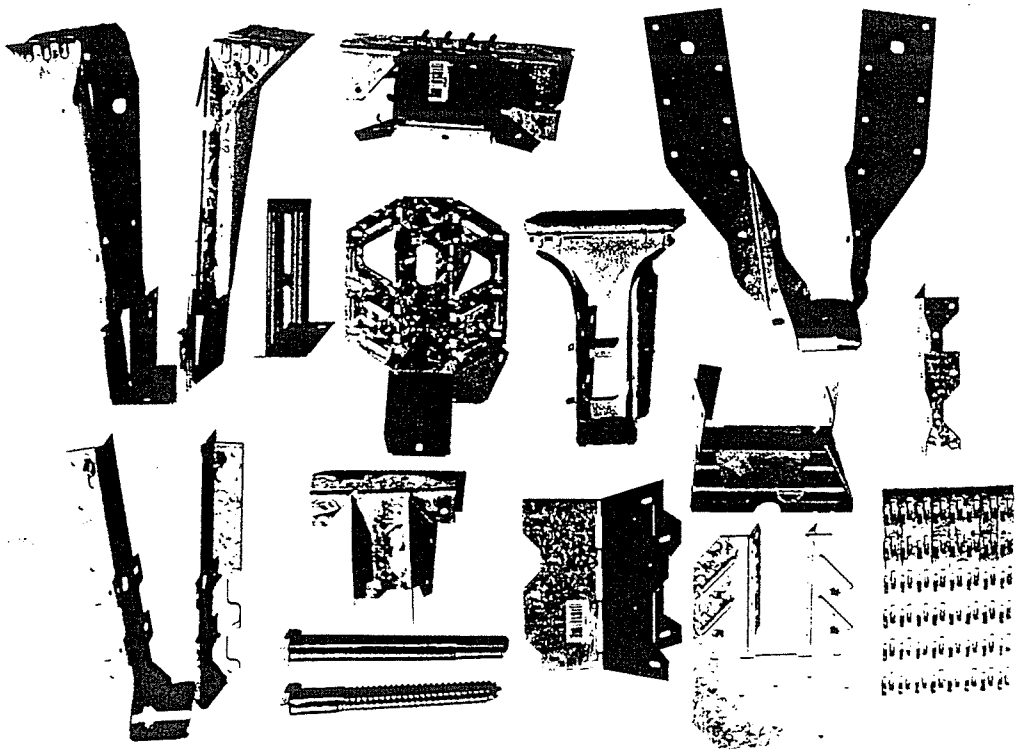


Photo 4.7 Teaching Tool Package: metal connectors and fasteners.

The request for industry produced teaching overheads and course guidelines also generated some debate in regards how much information should actually be supplied to the lecturer. There were mixed views as to whether a total course with overheads, slides, lecture commentaries, etc, should be produced or whether it should be up to the lecturers to put this information together on their own. In the end, it appears the consensus was that the lecturers should be given as much assistance as possible and that lecture overheads should be provided. However, their preparation for the updated package was left to the last minute and therefore only a selection of overheads were included. *(It was decided at the outset for the Teaching Packages being developed in Australia that they should provide all the necessary information to allow a lecturer to competently deliver the topic. To this end, the Australian educational packages consist of lecture commentaries, lecture summaries, topic specific slides, overheads and textbooks where applicable, see Section P.3.2. This approach ensures at least a consistent minimum level of information is being delivered nationally. It is anticipated that most lecturers would build on this resource through their own experience, research and continuing education.)*

4.4.2 CWC University Teaching Packages

With the success of the US Teaching Tool package, the Canadian Wood Council is also planning during 1997 to develop a similar type of teaching package. The actual content has not yet been finalised, however, at this stage it is anticipated that it will include a selection of slides, timber samples, the Wood Works software and the relevant CWC publications, described in the following Section. The present budget does not allow for these packages to be distributed to every relevant university department in Canada, so preference will be given to new professors wanting to establish a timber design course. At this stage it is not planned to include lecture guides, commentary or overheads because of budget restrictions.

4.5 Text Resources

A number of excellent text books, reference manuals and specifications for timber design have been produced or are in the final stages of production. A selection of these are described in this section.

4.5.1 Canadian Wood Council Publications

The Canadian Wood Council produces a number of publications which are used widely throughout Canada to educate both building professionals and students on all aspects of timber design; these would be a major component of the CWC's proposed educational resource package. The most recent addition is the *'Introduction to Wood Design'*, a text written specifically to facilitate and encourage the instruction of wood design at Canadian universities and colleges, see Photo 4.8. Though the focus of the text is on the engineering aspects of design, the Council believes the information provided is also of value to architectural students for developing an understanding of structural design principles.

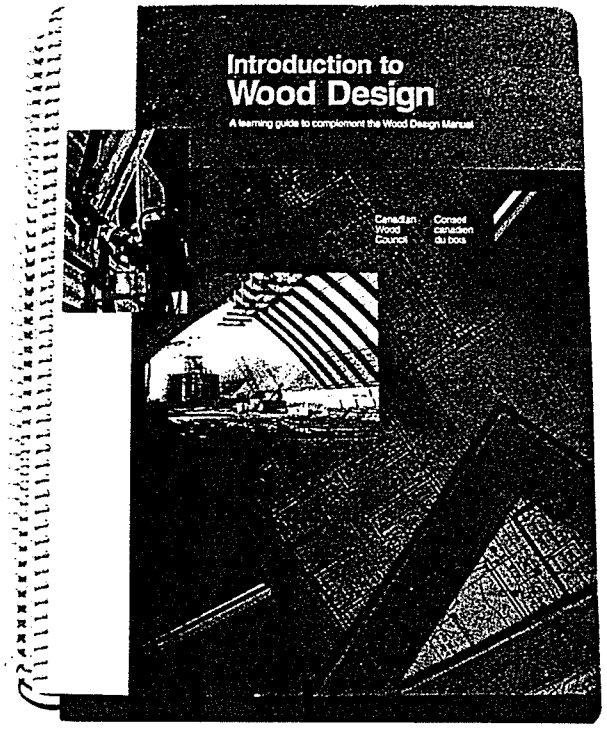


Photo 4.8 The Canadian Wood Council's Introduction to Wood Design.

The text is extremely well illustrated and technically comprehensive. Chapters are included on:

- safety, reliability & serviceability,
- loads,
- structural form,
- design properties,

- wood products,
- bending, compression, tension and combined action,
- connections, and
- lateral load resisting systems, as well as
- design computations and details for sixteen major structural components of an office and warehouse structure.

Each chapter, where relevant, contains detailed sample calculations, in SI units, and specific references to the Canadian engineering standard. It is intended that students would use the '*Introduction to Wood Design*' text in conjunction with both the CWC's *'Wood Design Manual'*, a comprehensive sourcebook for practicing designers (it also contains the complete CSA engineering design standard), and the CWC's *'Wood Works'* computer software.

The Council provides an educational package to students which includes both the '*Introduction to Wood Design*' and the '*Wood Design Manual*' for only $67 (the CSA engineering standard, reproduced in the *Wood Design Manual*, would cost them $75 if they had to purchase it separately). Complimentary copies of all publications are available to educators, while students get a 40% discount. The Council also provides educational software site licences for their *Wood Works* programs. Institutions get the first copy for 40% of cost and then if they wish they can apply for an unlimited site licence at no cost.

4.5.2 US Text Resources

Load and Resistance Factor Design Manual

It is hoped by many in the US timber industry that the release of their newest resource, the *'Load and Resistance Factor Design Manual for Engineered Wood Construction' (LRFD)* [13], will provide the catalyst for an increase in timber design in US engineering courses. In the US, as in Australia, universities currently teach limit states steel and concrete design whilst timber is still taught using a working (allowable) stress approach. The shift to a consistent format, particularly limit states, where the design process is more material-independent, will certainly simplify the learning requirements for students

students and at the same time it should also open up opportunities for lecturers to use timber to illustrate design concepts, rather than just concrete and steel.

The LRFD Manual, produced by the AF&PA, is one component of a three part total design package, the other two components being the ASTM D5457 standard for development of design values and the AF&PA/ASCE 16-95 design standard. This package is the result of many millions of dollars and over 15 years of development, refinement and trial use. The LRFD Manual itself consists of two volumes, see Photo 4.9, 'Manual of Wood Construction LRFD', which contains engineering design aids and reference information and 'Supplement & Guidelines to Manual of Wood Construction LRFD', which contains non-proprietary design values for sawn timber, glulam, poles, piles, panels and connectors and also design values for proprietary products such as I-beams, trusses, composite beams and metal connectors. Around 5-10,000 copies of the LRFD manual will soon be printed and they are expected to be sold at around $90 and discounted to $60 for students.

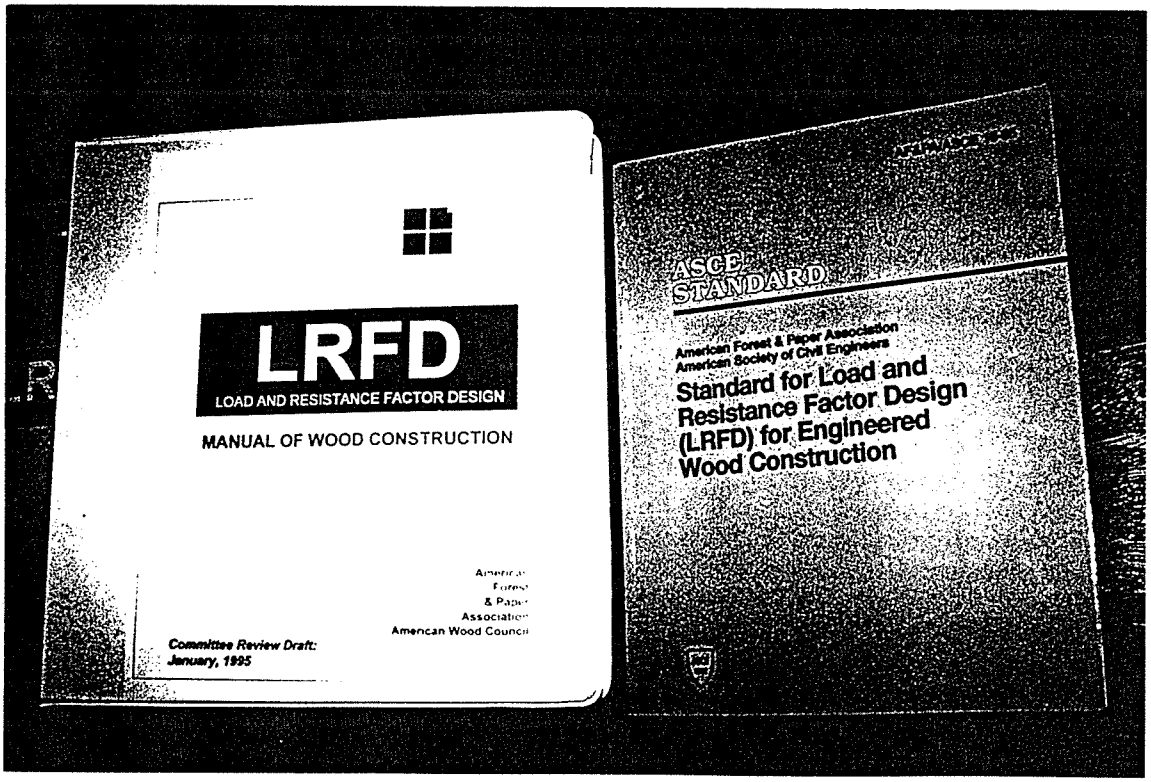


Photo 4.9 AF&PA LRFD Design Manuals and ASCE 16-95 LRFD design standard.

It is widely believed that the LRFD manual will provide a valuable addition to the WPPC Teaching Tool Package. It is anticipated at this stage that the technical information currently in the package will be retained as it is more product specific and visual and should not duplicate the manual information which is far more technical and less proprietary directed. One problem, however, is that the technical information in the package is based on working stress design, and comments from association members suggested that it would be unlikely that industry would be updating their publications to a limit states format in the very near future. It is critical that the information provided to educators be unambiguous, therefore, what information should be included in the Teaching Tool Packages with the shift to a limit states format is obviously going to generate some enthusiastic political discussion.

Textbooks

A number of excellent wood engineering textbooks also exist in the US which are prescribed extensively in engineering courses throughout the country. They include:

- Wood Engineering & Construction Handbook - Faherty & Williamson [15]
- Structural Design in Wood - Stalnaker & Harris [16]
- Design of Wood Structures - Breyer [17]
- Timber Construction Manual - AITC [18]
- Wood Technology in the Design of Structures - Hoyle & Woeste [19]

All are excellent texts, however, unfortunately from an Australian perspective they all use Imperial, rather than SI, units which make use of their examples frustrating and often confusing to students.

CHAPTER 5

Distance Education and Internet Applications

5.1 Distance Education Course, 'Designing with Wood' - Carleton University

Canada, like Australia, is an enormous country with a highly distributed population a fact which provides enormous challenges to the delivery of everyday services. This demographic reality was the catalyst for the Canadian Wood Council to pursue, a number of years ago, the development of a distance education course, "Designing with Wood", to facilitate the instruction of wood design to engineering and architectural students throughout the country. The course was developed in conjunction with the Civil Engineering, Architectural and Instructional Television departments of Carleton University in Ottawa

Carleton University, through their Instructional Television (*itv*) program, has a very strong focus on distance education. Currently, around 2000 students use these off campus facilities, undertaking their courses using either cable television or mailed video cassettes; supported by personal contact with instructors or other students by telephone, voice mail services, electronic mail (E-Mail) and on-line discussion groups.

The focus of the *itv* program is to provide low cost, low production time videos of actual lectures, with the aim being to get content out quickly and efficiently to off-campus students. In many courses the lectures are re-taped each year. Production is

simple and efficient utilising in most cases only two production staff; one in a production booth at the rear of the lecture theatre focussing on the lecturer, operating both a camera and control panel; and one with a camera actually in the lecture theatre to record audience reaction and participation in addition to the lecturer. Using the production control panel the operator can change camera shots from the lecturer, to the blackboard, to a computer or to a desk top display camera. In many cases the lecture is delivered straight to air. If recorded for cassette distribution, usually very little editing is required. Major editing is only undertaken if information has to be removed for legal reasons. Interestingly, Carleton University has found that the introduction of direct videoing has dramatically improved the quality of lectures, as lecturers now put far more preparation into their presentations than they did in the past.

For development of the *Designing with Wood* course the CWC provided Carleton University with a one off payment of $40,000. The university, however, now owns, maintains and administers the course and get all revenues from delivery of the course. Carleton pursues promotion of the course to other universities and students while the Council looks after and funds the promotion of the course to industry.

The focus of the course is 4th year wood design for senior engineering and architectural students. Students must have completed basic and mid-level courses in Statics, Mechanics of Materials, Structural Analysis & Design and be familiar with the basics in Mathematics and Statics. The course consists of 36 hours of taped lectures and the resources include the CWC's, *Wood Design Manual* and *Wood Reference Handbook* and Carleton Universities Tapes on Loan. The course is quite comprehensive and includes all the standard engineering design topics as well as lectures on durability, fire safety and maintenance and repair of timber structures, (see Appendix F for the full course outline).

The students work through the videos following along with the lecturer when text books and references are used or calculations are undertaken. In some respects the videos have advantages over live courses as the student can pause, rewind or review any areas as often as they wish. Weekly self assessment questions are provided to test the students understanding of the topic and problems are assigned for students to practice

the design principles presented. Two exams are used to assess the student, a mid-term exam (35%) and a final exam (65%), these are usually carried out off-campus under supervision.

The *Designing in Wood* course[Φ] was the first distance education engineering program undertaken at Carleton, prior to this it was believed that the computational requirements of engineering courses would make this mode of delivery unworkable. The course was developed in conjunction with Helmut Prion of the Civil Engineering Department at the University of British Columbia (who also assisted in preparation of the CWC's *Introduction to Wood Design* text) and the technical staff of the Canadian Wood Council, taking around 4 months to research and develop the actual course contents. Unlike some of the other Carleton courses, it was intended that the tapes only be made once and not updated each year. Very little post production editing was also done other than adding in search icons to make finding sections on the tape easier.

As the course was designed for both architecture and engineering students the presentation includes both Don Westwood, an architectural professor and Juan Salinas, an engineering professor. In many cases the professors appear together when discussing certain topics, which allows the presenters to work off one another when exploring specific questions; this approach also takes the pressure off a single presenter. Having the course used by both professional groups is also a benefit as it allows each group of students to get more of an insight into the functions and requirements of the other professional group.

To date, those enrolling in the course have included both students and professionals. Enrolments have increased from 20 initially, now to around 60, with most of these being engineering students. The course currently is specific to Canadian codes and regulations which makes distribution outside Canada limited. Interestingly, however, the last intake included a number of students from Japan, one of the countries who trade quite heavily in Canadian timber.

[Φ] A demonstration tape of the Designing in Wood course is available by contacting the author of this report at the Timber Promotion Council, Victoria.

The *Designing in Wood* course can be undertaken by students at other universities in one of two ways. Firstly, any other university could licence the course from Carleton and run it themselves, i.e. collecting student enrolment fees, distributing videos, having their own lecturers provide technical assistance and administering the examinations, etc; however, to date this has not been a method any other universities have chosen to pursue. The second method, which is seeing greater acceptance, particularly at universities which do not currently have a wood design course, is where students enrol in the course directly at Carleton as a true distance education course. Students correspond directly with the Carleton lecturers and their marks are simply credited back to their course at their own university campus. This method means that the student's university does not need to be involved in any subject administration or assessment. Carleton University believes that this type of course sharing is likely to become far more commonplace as it will simply not be feasible in the future, due to increased cutbacks in education funding, for every university to provide the same course subjects.

This mode of course delivery provides real benefits to students in remote areas and to those who need some flexibility in course timetabling and the Council and Carleton university are more than happy with the success of the course to date. Discussions are currently under way on updating the course, marketing options and alternative delivery modes, which may include the course available on CD-Rom sometime in the future.

5.2 Internet Applications

To many, the Internet is as mysterious as its cult based simile, Cyberspace, conjuring up all manner of sci-fi, Orwellian images. In actual fact, the Internet is simply a vast array of linked computers through which individuals throughout the world communicate using a number of Internet applications. These applications, however, if used correctly, can dramatically assist the efficiency and effectiveness of any organisation. A number of these applications are briefly described in the following paragraph and a partial list of their benefits to research groups, educational institutes and industry organisations are suggested in Table 5.1.

SERVICES	BENEFITS		
	Research	**Education**	**Industry**
E-Mail	• Quick and inexpensive direct communication with other researchers within an organisation or between organisations globally. • Facilitation of collaborative work such as research projects or papers (electronic transfer of author contributions or comments).	• Allows direct personal contact with other lecturers or industry members (one on one) around the corner or around the world. • Two-way transfer of tutorials and assignments between lecturer & student.	• Internationalises industry technical advisory services. • Quick and direct contact with clients and other industry members. • Cost effective method of transferring information globally.
Discussion List	• Direct communication between groups with similar research interests. • Specific & efficient dissemination of information, data, results, etc.	• Direct personal contact with others in a common interest group. • Dissemination of course and technical information by lecturer to all students.	• Dissemination of technical, marketing and general industry information to specific client bases and interest groups.
News Groups	• Allows dissemination of knowledge and specific questions to be a posted to a worldwide audience. • Facilitates global contact with others with similar interests.	• General broadcasting of University programs, courses, newsletters, etc. • Lecturers & students can post specific questions worldwide.	• Dissemination of technical, marketing and general industry information to large general interest groups.
File Transfer Protocol (FTP)	• Provides access to research related resources: data, computer programs, publications. • Publishing researchers own results. • Collaborative work: transfer of large files, data, software, dissertations, etc.	• Students able to directly download course materials: notes, resources, software, etc (large reduction in publishing costs). • Transfer of large volumes of formatted information, ie computer programs, assignments, dissertations.	• Facilitates distribution of industry information, product & technical literature, and specific resources, ie educational aids. • Direct file transfer potentially means reductions in publishing and direct mail costs.
Telnet or Rlogin	• Access to remote computer databases, research paper search facilities, library catalogues.	• Access to library catalogues, industry databases, document search & retrieval systems worldwide.	• Allows widespread access by the general public or specific subscribers to industry databases and technical libraries.
World Wide Web (http)	• Establishing a global presence. • Broadcasting organisational functions, staff expertise, research interests, results and contact details. • Promotion & advertising of expertise to potential clients. • Searching for information, contacts, etc, relevant to organisations interests.	• Publicising globally the activities and interests of a university, department or lecturer. • Networking with others with similar interests through linked home pages. • Searching information through other home pages ie academic, industry, research, etc.	• International exposure for industry associations and manufacturers. • Global broadcasting of services, products, technical information, and pricing details. • On-line catalogues and direct ordering facilities (eliminating paperwork & middleman costs).

Table 5.1 Partial list of benefits of common Internet applications [14].

- *E-Mail* - An electronic version of mail. Simple text based messages or complex formatted files (attachments) can be sent to specific user addresses.
- *Discussion Lists* - E-Mail based distribution list. List members subscribe to an E-Mail distribution service dedicated to a certain topic. Messages from anyone in the group are then automatically distributed to all the other subscribers.
- *News Groups* - A more general interest group facility. Effectively, users post news articles to topic specific electronic bulletin boards where other users can read them.
- *File Transfer (FTP)* - A facility which allows the transfer of large files between one point and another.
- *Remote Login* - Allows a user access to a remote computer or database from their own office. Protocols often used are TELNET or RLOGIN.
- *World Wide Web (WWW)* - The most well known Internet application (many people mistakenly believe this to be the only Internet application). The WWW is a global, interactive, hypermedia, information system that runs over the Internet. Users store their information at a specific address (URL: uniform resource locater) in the form of a 'home page', most are simply electronic corporate brochures, though others are far more useful. Users can then directly access the home page through the URL or possibly through other linked home pages or search engines.

Though virtually all of the companies, associations and universities visited in this study tour had at least a presence on the Internet through a home page on the World Wide Web, very few were actually using any sought of Internet application in a commercial or educational sense. The exceptions to this were the Canadian Wood Council and the APA - The Engineered Wood Association, both of whom who have excellent interactive and informative home pages.

A number of the academics were looking at how they might use the Internet in the future to supplement and assist their own course delivery. Most academics now use E-Mail regularly and most were aware of the benefits of setting up class discussion lists for the dissemination of information to students. In regards to supplementing their own teaching though, the main benefit they saw, was the ability for students to access industry based WWW home pages, if and when industry started to publish relevant, topical information or technical data in this form. The WWW provides enormous opportunities

and efficiencies for industry as well. With relative ease, accurate, up to date information on any topic can be made globally accessible if it is presented in a WWW home page. In this form the information can be expanded, clarified, deleted or modified in any way as often as one wishes making it a far superior method to paper based resources.

An excellent suggestion from one academic was that industry should establish a library of relevant images that could be download by academics when they needed slides to illustrate parts of their course. This has certain benefits to industry as well. If slide resources were to form part of any teaching kit provided by industry for academics then making the images available through a WWW home page would eliminate the cost to industry associations of having to duplicate copies of the slides for each individual educational institute. The academics could download the images then either project the downloaded images from their own computer or have the images developed into slides themselves. It also saves the cost of duplicating slides which may not be used and provides a far more efficient way of keeping the slide resources up to date.

CHAPTER 6

Conclusions & Recommendations

6.1 Conclusions

Prior to this study tour, little had been known in Australia, and even less written, on the types and extent of university timber educational initiatives under way in Canada and the US. The general feeling, including the one held by the author, had been that the North American industry would have had been highly active in the education arena, simply because of the sheer size of the industry, if nothing else. This study tour however, has revealed that this is not the case.

Whilst the North American timber industry is producing some excellent resources, and undertaking some worthwhile activities, it would be fair to say that nationally, particularly in the US, there is little overall coordination or planning in regards education. The idea of trying to use the Wood Products Promotion Council to address education issues to minimise the amount of duplication by individual associations is an excellent one, however, the simple fact that the Council is funded by a group of often competing associations means that it is unavoidable that politics will influence policy; a particularly debilitating situation for any generic type program. The other substantial problem that the North American industry faces is one of sheer logistics. The US education program currently appears to be riding on the backs of a mere handful of enthusiastic, dedicated and overworked individuals. It is impossible for them alone to provide the type of face to face service that is really needed, to all the relevant universities throughout the US.

Despite the political and logistical problems, the North American industry has involved itself in some excellent resource development programs and educational activities from which we in Australia can certainly learn. It is suggested the following recommendations (which are not listed in any order of priority) can and should be integrated into the existing Australian national educational program.

6.2 Recommendations

6.2.1 Administration

Recommendation 1 - *Core education programs must be provided through a nationally planned program, coordinated by a single, generic organisation.*

Education should be one of the most generic functions of any industry, transcending all sectorial boundaries and for an education program to be credible and effective it needs to be provided by an impartial, generic organisation. Though this is hardly a new revelation, the US experience certainly confirms this view and reinforces the approach being pursued in Australia, where *all* industry members contribute to a *coordinated* and focused *national* education program which is managed by an eminently qualified and impartial coordinator (the proposed Australian program is discussed in detail in the following Postscript).

Planning and coordination are two of the critical ingredients of any successful program. However, equally important is the establishment of a delivery infrastructure to facilitate the implementation of the program. If this is neglected, then it does not matter how good the developed resources are, or how much money was spent in their development the critical factor is getting the resources into the hands of the end user then ensuring that they do in fact use them. A valuable lesson learnt from the Australian education programs to date, (both national and Victorian), is that the most effective way of implementing change at a particular educational institute is through face to face discussions, maintaining a personal involvement and building up a rapport with the institute's staff. Excellent relationships currently exist with a number of universities and TAFE's throughout Australia, however, the challenge now is to build similar relationships with all the relevant institute departments. To achieve this, a coordinated body of representatives will need to be active in each of the states to deliver the

educational program at the local level; the program in Victoria provides a model for these state activities.

Recommendation 2 - *A national industry program should be established to facilitate and coordinate university timber research.*

One of the major criticisms made by the North American academics was that industry was not pro-active enough in seeking or encouraging academics to be involved in collaborative research projects. This is certainly also the case in Australia.

Research is an integral function of any university, in fact at most universities it is critical to an academic's tenure, because of this it has the potential to be a very powerful tool in both promoting industry/academic alliances and ultimately in influencing how a department, particularly an engineering department, structures its course curriculum. Industry should be highly active in nurturing those university staff currently with an interest in timber and even more active in encouraging the interest of new academics.

One of the biggest problems academics encounter in establishing a research program is finding suitable projects, partners and funding. It is suggested that to facilitate university/industry cooperative research, industry should establish a central hub to coordinate and promote industry based research projects. This would provide a focal point for academics seeking to maintain or establish a research program, or for industry when seeking a potential university research partner. In Australia, the infrastructure is perhaps already in place through the Forest & Wood Products Research & Development Corporation (FWPRDC). Under the proposal presented here, it is not suggested that it should be the FWPRDC that funds all projects, rather, that the organisation simply provides the linkages between the interested parties. New potential research topics will almost certainly be by-products of current FWPRDC projects. A database of these topics and other research issues could be established and distributed annually to university academics to encourage their involvement within the industry; an involvement which is critical if the industry wishes to have timber related subjects taught within that university in the future.

Recommendation 3 - *Industry must actively involve itself in postgraduate education if there is to be a pool of postgraduate qualified professionals from which future academics may be drawn.*

In addition to increasing the current numbers of academics with an affinity for timber, it is also critically important that the industry start investing in the future academics. Today, the minimum qualification for any university academic is a postgraduate degree, preferably a PhD, therefore, if the industry wants a pool of future academics it must start encouraging students to undertake postgraduate study. There are obvious links between this recommendation and recommendation 2, as postgraduate opportunities will only be available if there are confident, enthusiastic academics to supervise and administer the programs.

Again a number of existing programs exist in Australia which could be utilised in pursuit of this recommendation. Firstly, it is suggested that through the FWPRDC's current Postgraduate Scholarship program a new postgraduate timber engineering research scholar be funded each year. A widely promoted, nationally coordinated competition could be used to attract proposals for the annual scholarship with the successful candidate being selected by an appropriate industry review panel. The successful submission would be judged not just on the project's objectives and outcomes but also on the attributes of the proposed student candidate and the supervisor. There are far reaching benefits to this approach. Firstly, the national promotional coverage would raise the awareness of the industry and timber research at universities throughout the nation. Secondly, the process of developing up the proposal should help to focus the universities more on timber research opportunities, and even provide the catalyst for future university/industry alliances. Thirdly, the program will hopefully bring to light a range of excellent potential research projects, and though only one may be successful for the scholarship in that year, others may still be funded through other mechanisms.

The second program which should be pursued is an industry backed postgraduate timber course. The industry obviously does not have the resources to fund a dedicated course in each state so it is suggested that instead, one central university be used to administer a course which could then be delivered nationally, through interested affiliated universities in each state, using Internet and current telecommunication protocols. The

central university would be the main provider running administration and organising lectures which would either be broadcast directly to the other states using video-conferencing facilities or video recorded for later viewing. Classes could be held at any number of universities in each state which had supervising lecturers and the appropriate facilities, i.e. testing labs, videoconferencing room, lecture theatres, etc. The research component of the degree would also be undertaken at each of the individual state universities with the timber industry providing assistance through a co-ordinated university research program, see recommendation 2. The obvious benefits of this system are that the course is available nationally, yet students do not have to travel a great distance to access the course; a consistent, structured level of information is being delivered nationally; and expert guest lecturers throughout the nation can be utilised with minimum disruption to their schedules. The key to this approach is coordination and planning and therefore it would be critical that the representatives of the national and state education programs, discussed in recommendation 1, be utilised at the local level. The basis for this program could be the former Capricornia Institute's Timber Postgraduate program which is soon to be resurrected by the University of Technology, Sydney.

6.2.2 Implementation

Recommendation 4 - *"Educate the Educator courses" should be carried out in each state to ensure the relevant academics have a consistent level of timber knowledge.*

Past industry based "educate the educator" courses in the US have proven to be extremely popular with academics and have in many cases lead to an introduction or expansion of a course at a university. This approach is also used in Australia by the steel industry who has been active in this area for many years with great success. The Australian timber industry has not formerly conducted a national series of "educate the educators" courses, however, with the near completion of a number of new educational resources, the time is certainly ripe.

The aim of this course would be to provide the participating academics with both an extensive overview of the industry and an intimate knowledge of its teaching packages and resources allowing them to easily absorb the information into their own courses. In addition to the workshop component, the course would also include forest, sawmill and

value-adding facility visits. It is anticipated the course would be a minimum of at least four days (perhaps a weekend and two working days). Depending on numbers, it might be most efficient to hold a course in each of the major states as this minimises the number of participants who need to be transported and accommodated.

Recommendation 5 - *In select cases, where it is critical industry has a presence at a certain university, a practising building professional should be engaged to assist in delivery of the course in the first year.*

As government educational funding dries up, more and more universities are looking at how they can reduce expenses, often this means cutting staff numbers or requiring staff to teach courses outside their areas of expertise. In these cases it may be necessary for industry to assist more directly in provision of a course at a university, including actually funding a practising building professional to deliver the course; this approach has been successfully used by the Asphalt Industry in the US. This service would obviously need to be used sparingly and then it would only be provided on the proviso that the future lecturer would carry out the course administration and would also attend the lectures so that he, or she, could deliver the course in the future. Using the national timber teaching packages, this would not be an onerous task and certainly qualified professionals who could deliver the course exist in each state.

Recommendation 6 - *A committee should be established to coordinate the inclusion of timber related papers at professional conferences and to encourage academics to become involved.*

One of the functions of the American Society of Civil Engineer's Wood Education Sub-committee is to coordinate and encourage industry members and academics to produce papers for professional conferences. This is an approach that should also be adopted in Australia both to further encourage lecturers to be involved in timber design and also to lift the awareness of timber issues to a broader professional audience. It is suggested that as well as setting up a similar committee to target the relevant conferences, lobby the organisers for timber sessions and coordinate the papers, industry should also actually consider paying the academics to produce the papers. How the author used the funding would be up to their discretion; it might be used to subsidise the conference costs or the author might use the funding for their own research or personal

needs. This initiative should not be restricted to only Engineering faculties, academics from Architecture and Building departments should also be involved as should teachers within the TAFE sector.

6.2.3 Resources

Recommendation 7 - *Any teaching packages developed by industry should be comprehensive and focused on the teachers' and students' specific needs.*

The US timber industry has spent an enormous amount of money in the development and distribution of their Teaching Tool Package and though it contains some excellent resources the main criticism from academics is that it does not go far enough in addressing their specific course needs. It was concluded after discussions prior to the most recent update of the US package that additional course information should be provided, including specific teaching overheads; only a sample few ended up being included. The unanimity of these comments by the US academics reinforces the view taken in the Australian education program that any industry based teaching packages should be as comprehensive and as helpful as possible. To this end, the proposed Australian timber teaching packages will include for specific subjects: lecture commentaries, lecture summaries, overheads, slides and where relevant computer packages, CD-Roms and videos (these resources are discussed further in Section P3). The importance of this approach from an industry perspective, is that providing a self-contained, subject specific resource, dramatically increases its chances of being adopted and in addition it ensures that lecturers, particularly those new to the topic, are delivering at least a minimum consistent level of information.

Recommendation 8 - *A bibliography of national timber publications should be produced.*

The collaborative production of a national bibliography of timber publications by a number of individual timber organisations in the US has also proved to be extremely successful and again this is an excellent initiative that should also be adopted in Australia. No one source currently lists all the relevant Australian timber publications, which is a problem for members of our own industry who want to know what information is available, let alone the users of our industries products. A national collaborative publication such as this would not only overcome this problem but it would also have the

benefit of generating for the users, the impression that they were in fact dealing with a single significant entity rather than a fragmented collection of individual organisations.

Recommendation 9 - *It is critical that environmental issues be adequately addressed under future educational programs.*

In Australia, as in North America, there is a strong case to show that distorted environmental perceptions are 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; students and academics are no exception. The opportunity to explain why timber, from sustainably managed plantation and native 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 academics, students and the public, alike, about timber's unique environmental credentials. Addressing these environmental misconceptions should be a major focus of any educational program.

Recommendation 10 - *Industry should establish and support a program of national student competitions to broaden the awareness of timber at educational institutes throughout Australia.*

National student competitions have also proven to be an effective way of increasing the awareness of timber at universities throughout North America. Though a number of competitions have been run in the past in individual states of Australia, no national competitions currently exist. It is suggested that the establishment of series of national competitions for students of engineering, architecture and building be investigated, similar to those offered in the US. The timber bridge competition in particular, (see Section 4.3.1), is one which could easily be implemented and administered and could also be offered across all the building disciplines.

Recommendation 11 - *The planning of current educational resources should include forethought of how they might be used to form the basis of a future timber design Distance Education Course.*

Development of a distance education course in timber design should certainly be a future vision for the industry; not only because many universities will shift to this mode of educational delivery in the future, but also because it provides a far more efficient way for practising building professionals, who need flexibility in their timetables, to continue their education. To be effective, the delivery method for the program needs to be simple and it is therefore suggested that a video based format be used, similar to the CWC/Carleton University distance education program, described in Section 5.1; virtually every household has a video player. If planned and shot with forethought, the video footage could also be incorporated extensively into any future multimedia based application.

The effort to develop a distance education course may not be as much work as it first might seem. Much of the preliminary work is already being undertaken with the development of the timber teaching kits, which in some respects are distance education courses for the lecturers, and a far greater amount would be carried out if the postgraduate course, outlined in recommendation 3, were to go ahead. Planning and coordination are again the two key ingredients

Recommendation 12 - *Industry should investigate how it can utilise the advantages and flexibility of the Internet in the provision of educational information.*

Despite the enormous advantages and potential of Internet based systems, surprisingly few timber industry organisations in the US are currently using these systems to support their promotional work. From the range of Internet applications, the most powerful for the presentation of information is the World Wide Web. The main advantage of a Web home page is that information only has to be provided at one source, yet it is available to anyone in the world with Internet access. A home page is also a far more flexible and dynamic medium, in that it can be modified and updated as often as needed, an undesirable and expensive task using ordinary print media.

It is suggested that a coordinated series of Internet home pages should be developed addressing Australian timber industry issues, activities and developments. This in itself provides a powerful educational tool for a broad public audience. Specific educational information, however, can also be provided and again it is suggested that future

educational resources be fashioned in such a way that they can also be converted to an Internet mode of delivery. This in fact provides a far more economic way of distributing education packages, shifting the costs of duplicating the material (i.e. print material and slides) from the industry organisations to the individual educational institutes, who simply download the files and images from the Internet and duplicate the material as they need it. The establishment of an industry photographic image library would also be an enormous advantage in this regard. Teachers are always seeking good up to date images to illustrate specific points in their courses. A WWW home page provides an extremely efficient way of having these Australian images available for use world-wide.

Recommendation 13 - *More key industry people must be encouraged to become involved in education.*

For any program to be successful it must have support, in this regard education is no exception. The difference education has with other activities is, however, that without it the industry has no future; a bold comment but easily defendable. Education is one of the most important factors in the success of any industry, as it is only through properly structured education programs that the future specifiers can be made aware and kept informed of an industry's products and the contribution that the industry may make to society.

The US program appears to be labouring because too much is expected of too few people. For any timber education program in Australia to be a success it will need widespread industry commitment and this will include the need for more key industry personnel to become directly involved, to share their expertise, enthusiasm and innovation. With this support the program will prosper, without this support the future consequences for the industry will be devastating.

POSTSCRIPT

Postscript

The Proposed Australian Timber Education Model

This study tour has proven to be extremely timely, and the findings have already been used to provide guidance for the industry on its future directions regarding educational policy, program structure and suggested funding mechanisms. The recent rapid demise of the NAFI/NMDC system accelerated the need to determine an industry educational strategy, and in this regard much work has been undertaken, between the study tour and the release of this report, in documenting this program. The study tour has been invaluable in both confirming the correctness of the program's direction to date and in identifying a range of other activities which if adopted will certainly enhance the value of the proposed program.

To ensure the reader is fully briefed, this Postscript has been included to provide the most up to date report on the current and proposed objectives and activities of the Australian educational programs.

P.1 Background to Current Industry Educational Programs

The release of the McDowall Report, in 1993, marked a turning point in the Australian Timber Industry's commitment to education. The report, commissioned by NAFI, investigated the educational resource needs of teachers to provide the minimum timber study component in Australian trade and university curricula and its findings pulled no punches in outlining the demise of the forest products industry if they continued to

neglect education as a priority program. Mc Dowall recommended that all sectors of the industry needed to contribute within this program with NAFI assuming the project management role and the state and sector associations and corporate industry members assisting with the development and implementation of the program.

The Victorian Timber Promotion Council was the first organisation to respond to McDowall's challenge appointing the author as a full-time educational consultant, to establish a state based program in February 1995. NAFI responded twelve months later by establishing, in conjunction with the Forest & Wood Products Research and Development Corporation, a national 'Tertiary Timber Education' program to address the needs of university building related courses, and appointing Geoff Boughton as its director.

P.1.1 National Program

The overall aim of the national program is

1. to develop a national education strategy, program and resources that address educational needs of professions that use or specify timber products, e.g. 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, and
3. to initiate professional development and undergraduate programs where needed in cooperation with target group organisations, institutions and the Timber Industry networks.

In short, the National Timber Education Program aims to offer assistance to already over-worked lecturers as they prepare courses or units that bring students into contact with timber. The focus to date has been on the university sector with the activities centred around the establishment of an industry / academic network and the development of a number of specific teaching packages, (these are discussed further in Section P.3). It is also hoped that the program can be broadened to address the needs of the TAFE sector nationally, and a proposed new funding arrangement to allow this is currently being pursued, this is outlined in Section P.4.

P1.2 TPC Victoria's Education Program

The TPC's 'Timber Education Program' follows a similar set of objectives to the national program, however, it addresses the needs of the broader client base. The aim of the Victorian 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".*

The program targets engineering, building and architectural courses at Universities and a number of building related courses at TAFE's, including carpentry, building construction, building surveying and architectural drafting, amongst others [Φ]. The main focus of the program has been the development of strong active working relationships with all the individual state educational institutes and their relevant departmental staff; a critical ingredient for the overall success of any industry educational program. A number of educational resources have also been developed under the Victorian program including timber product information boards, Timber Framing Manual computer software and a national timber industry products CD-Rom, these are discussed further in Section P.3.

The national and Victorian programs have excellent linkages and successfully compliment one another, in that, the face to face activities of the state program serve to facilitate the implementation of the resources developed under the national program. Together, they provide an excellent model to illustrate how both national and state activities can be successfully blended so that the combined result is greater than the sum of the individual programs.

[Φ] Further detail on the structure and status of timber education in Australia is presented in the paper "*Timber Engineering Education in Australia*", reproduced in Appendix B.

P.2 Vision and Objectives of the Australian Timber Education Program

Continued cost cutting by government, has forced many educational institutes throughout the nation to reduce staff numbers and rationalise the courses they offer (or even drop them completely). Educators are being told to 'work smarter, not harder' and to make use of the technology and industry resources that are available. From an industry perspective this approach provides enormous opportunities to assist and thereby influence the material taught in our educational institutes. With the proper vision and planning and through the development of quality teaching material, presented in such a way that it minimises the development and implementation time in each teaching establishment, the timber industry can assist educators in 'working smarter not harder'.

P.2.1 Vision

- *To have timber-related units taught at tertiary educational institutes, nationally, by enthusiastic and well-informed staff who have the full support of the timber industry.*
- *To provide the opportunity for all students to learn about timber. Learning will be well-directed to the needs of the building industry and the ability of the timber industry to supply its products.* [20]

P2.2. Objectives

The current objectives of the program are as follows.

To establish and maintain a planned and coordinated support structure for University and TAFE educators who teach timber related subjects. Such a support structure will:

- Provide answers to questions from the teaching staff on technical issues.
- Offer assistance on teaching methods for delivery of timber units.
- Provide and maintain coordinated, relevant, comprehensive resource packages that assist teaching staff in the preparation and delivery of quality lectures.

- Provide opportunities for lecturers to develop their own interest in timber by participating in cooperative initiatives, research work and professional functions (conferences, etc).
- Provide opportunities for students to undertake timber related postgraduate studies.
- Provide opportunities for students to develop their enthusiasm for timber through nation-wide competitions.

To enhance the levels of cooperation between teachers of timber related units. This will be evidenced by:

- Sharing of prepared teaching and learning resources.
- Minimisation of duplication of resource preparation or research activities.
- Cooperation across institutions and/or across departments or disciplines in learning and research.

To enhance the level of cooperation between industry and education (without necessarily making extra work for either). This will include:

- Improved awareness in tertiary education of timber products and technology.
- Feedback to the timber industry on the effectiveness of timber industry teaching resources and the attitudes of students to timber units.
- More efficient and equitable distribution of industry support and resources among the tertiary education sector.
- Better utilisation of tertiary education problem solving capabilities to assist the timber industry.

To increase the profile of timber related units in tertiary institutions. This may include:

- Increasing the number of hours assigned to timber in course curriculums.
- Increasing the quality of information presented in the time available for timber.

- Including small modules of relevant information on timber in more general units such as materials, construction, building technology, structures or structural analysis units, amongst others.
- Providing self-paced, instructional timber resources where no lecturing support is available within the course for timber related units. Ultimately, these could include distance education courses or multimedia and Internet based resources.

P.3 Resource Development & Delivery Modes

After extensive discussions with educators throughout Australia a number of resources have been targeted for development. At present these are focussed mainly at the university level though some also have application to the TAFE sector. It is proposed under a new funding arrangement currently being finalised that specific TAFE sector resources will be developed in the next financial year, these are outlined in brief in Section P.4.

The resources currently being developed include:

- an engineering textbook
- 4 hour Materials teaching package
- 8 hour Introduction to Timber Engineering teaching package
- 28 hour Engineering Design package
- 4 hour Timber Framing teaching package
- professional development engineering packages
- timber industry products CD-Rom
- computer resources

P.3.1 Engineering Textbook

A major problem in the past in regards engineering courses has been the lack of good educational or professional texts specifically for the local conditions. As a consequence of this, engineering departments to date have independently developed their own course notes and not surprisingly there is a great variation in the quality of these documents. To overcome this problem a more definitive text has been produced entitled "Limit States

Timber Design to AS1720.1" [21]. 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. The text is well structured and richly illustrated and each chapter contains specific examples and solutions to illustrate the topic being presented.

P.3.2 Teaching Packages

A range of comprehensive, structured, self-contained teaching packages are planned for university courses. The aim of these packages is to provide enough information for any lecturer new to the subject to deliver the course. All the packages contain overheads and slides, an accompanying lecturer commentary and a lecture summary. The aim is to ensure that all lecturers are teaching the subject at least to a minimum level, it would be expected that most lecturers would embellish their presentation with their own information or experiences.

4 Hour Materials Teaching Package

This package, recently completed, provides an introduction to *Timber - the Material*, and has been designed for Architectural, Building or Civil Engineering courses which include a Material Science or Building Technology unit. The package covers topics such as:

- use of timber in the building industry,
- basic mechanical properties of timber,
- behaviour of timber,
- grading methods, and
- specifying and ordering.

The package also contains a laboratory exercise which can be used to demonstrate the response of timber to load. The intention of the package is that it be used as a segment within a larger unit that gives a basic understanding of the behaviour of the major building materials. The contents of the package are shown in Photo P1.

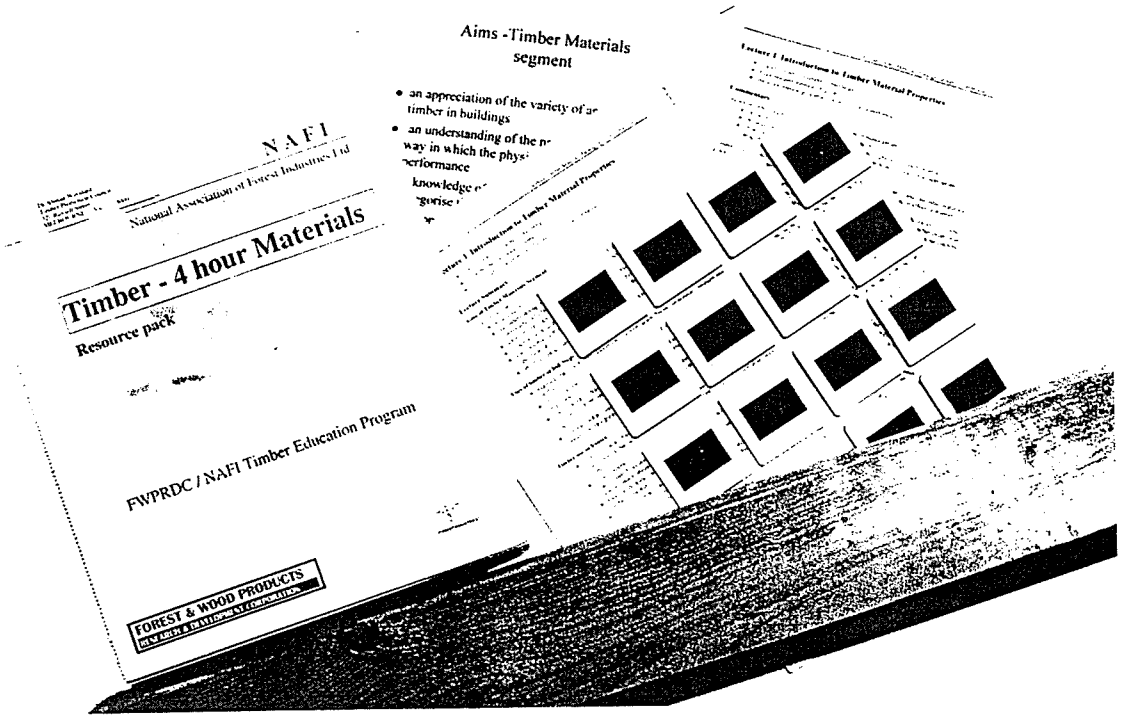


Photo P1. 4 Hour Materials Teaching Package.

8 Hour Introduction to Timber Engineering Package

This package provides an introduction to timber engineering design and is suitable for all Civil Engineering courses and those Architectural and Building courses with strong structural components. The package covers the following topics:

- principles of limit states design,
- performance of timber tension members,
- performance of timber bending members, and
- performance of elementary timber connections.

Providing an introduction to timber design, it is expected this package would be used where timber is taught as one component of a structural design unit. The package includes both lecture and tutorial based material as well as the Limit States Timber Design text, which provides an in-depth background to the material presented. Photo P2 shows the components of the package and the text. This package has recently been distributed for comment and is due for release in the second half of 1997.

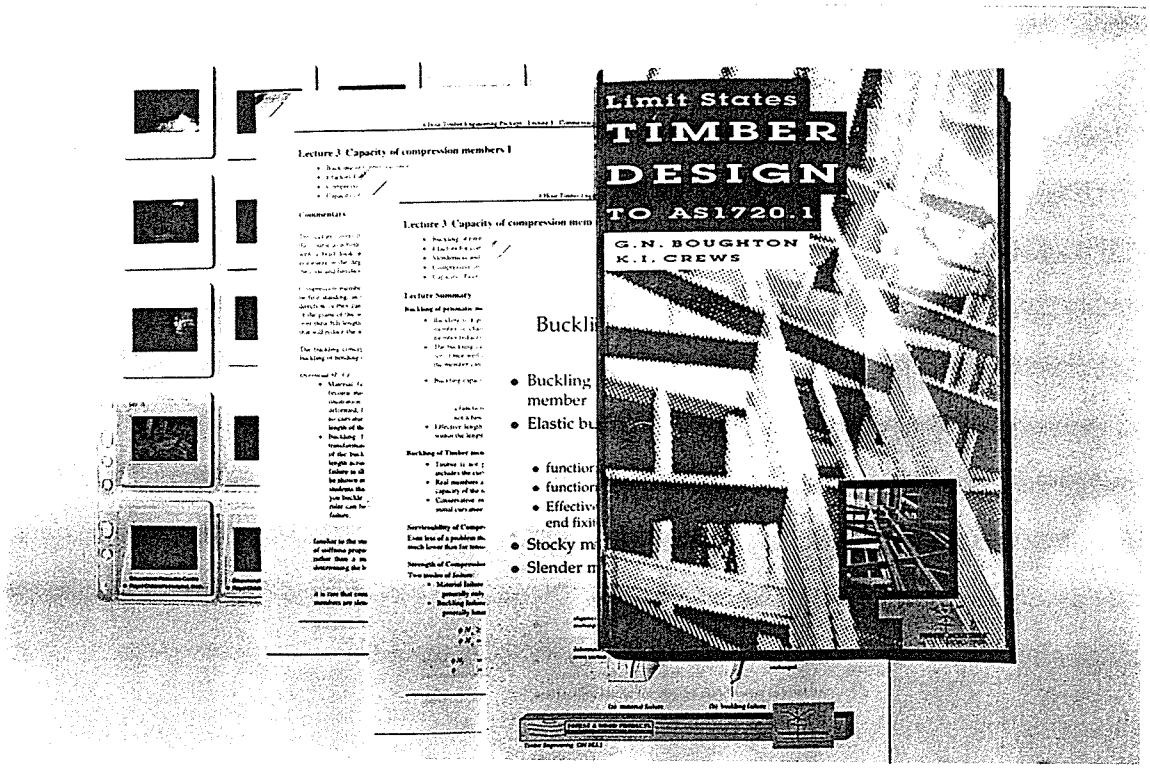


Photo P2. 8 Hour Introduction to Timber Engineering Package.

28 Hour Timber Engineering Package

This package provides a more comprehensive course in timber engineering design. It covers the following topics:

- principles of limit states design,
- behaviour and design of timber tension members,
- behaviour and design of timber compression members,
- behaviour and design of timber bending members,
- behaviour of timber members under combined action,
- behaviour and design of nailed timber connections, and
- behaviour and design of bolted timber connections.

It is envisaged that this package would be used as the content for a full 13 week semester core subject, introducing students to the processes and concepts of limit states design and evaluation of loads. It would be expected that a course graduate would have a good understanding of the behaviour of structural timber members and connections and

be able to apply the Australian Timber Design Code in the design of most timber members or connections. This package is due for release in late 1997.

8 Hour Timber Framing Package

The focus of this package is to provide an introduction to timber framing design for Architectural and Building courses, and those Civil Engineering courses with a strong emphasis on residential construction. The package will cover the following topics:

- principles of framing systems,
- nomenclature and structural systems used in light timber framing,
- selection of framing members using framing manuals,
- selection of framing members using software,
- tie-downs for wind forces, and
- bracing for racking forces.

It is anticipated this package will be ready for release in mid 1998.

Professional Development Engineering Package

Production of a Professional Development package to educate practising engineers on the new limit states version of AS1720 the Timber Design Code is also under way. The package will provide an introduction to timber engineering as well as an explanation of the use of the new limit states code and it will be targeted at those engineers who do not necessarily have proficiency in the design of timber structures. It is envisaged that the package would be used as part of a three day timber workshop which would include both practical exercises and theoretical presentations. These workshops will be run after the release of the new code which at this stage will be late 1997.

P.3.3 Timber Industry Products CD-Rom

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. In some respects educational institutes in particular have been disadvantaged by this approach, as in most cases they do not have the facilities to keep, or up date, this type of hard copy information

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, see Photo P3. 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. This project is well under way and it is hoped that the CD will be ready for release in mid 1997.

Photo P3. Timber Industry Products CD-Rom.

P.3.4 Computer Resources

A number of computer based teaching resources have also been developed or are in the developmental stage.

NAFItads

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, academics and engineers with extensive timber design experience.

From an educational perspective, this program will provide a valuable addition to all the proposed teaching packages. For the Architectural and Building courses the program will facilitate the teaching of residential design while for Engineering courses the program will be used in the analysis and design of primary structural timber elements. A number of screens from the program are shown in Photo P4.

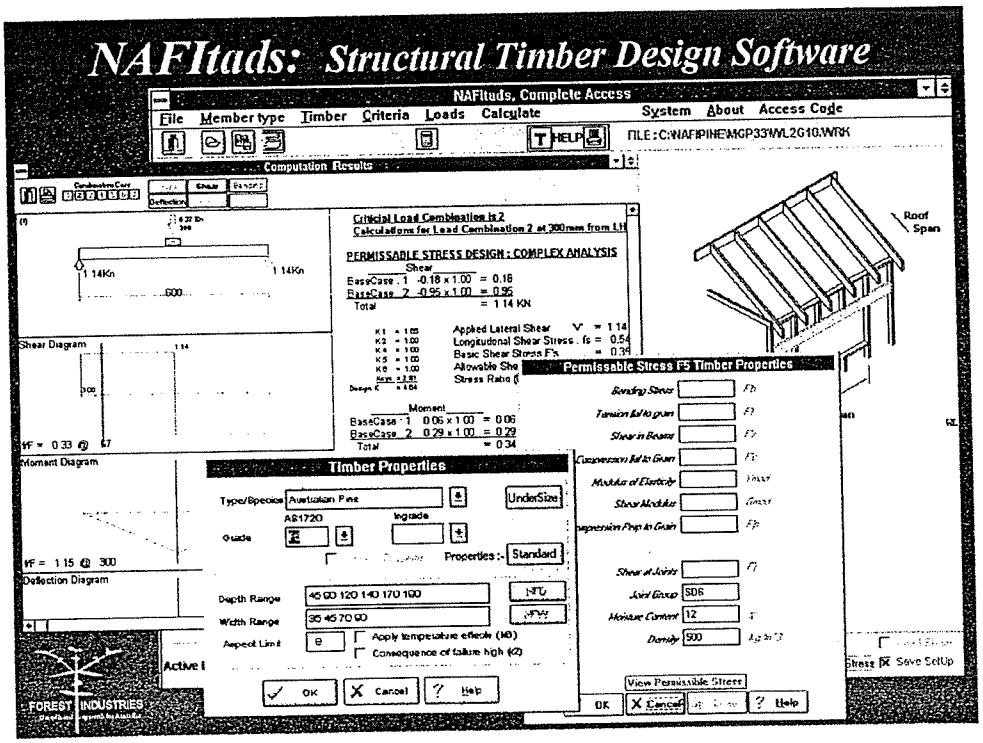


Photo P4. NAFItads computer program.

Timber Framing Manual for Windows®

In carpentry, building surveying, architectural drafting, architecture and some engineering courses, domestic timber framing is taught in detail. Widely used in a number of 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 students at both the university and TAFE level, however, its development has seen it grow to a sophisticated package with great commercial as well as educational potential. A number of screens from the program are shown in Photo P5.

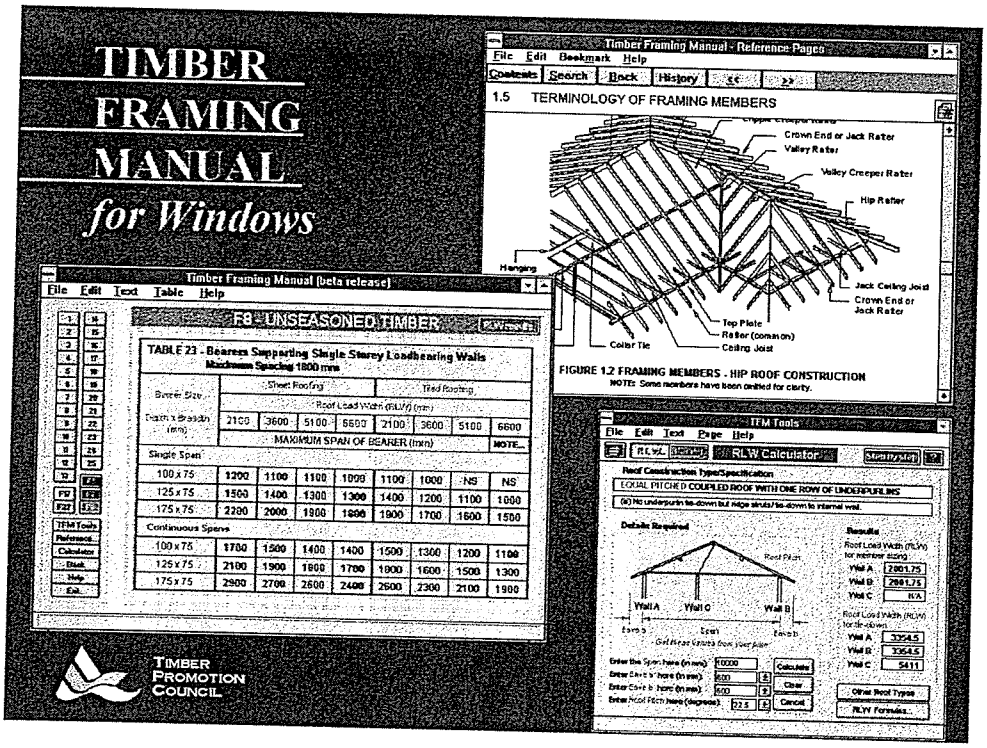


Photo P5. Timber Framing Manual *for Windows®*.

The program was released in late 1996 and to date the sales have been excellent. Because the program is far more versatile than the hard copy of the Manual, many TAFE's and university departments have already purchased site licences, installed the program on their computer networks and integrated the program into their course curriculum.

Multimedia - Integrated Learning Packages

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. The first industry educational multimedia package is currently being developed by the University of New South Wales 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 new limit states Timber Design Code and its use in structures at their own pace, see Photo P6.

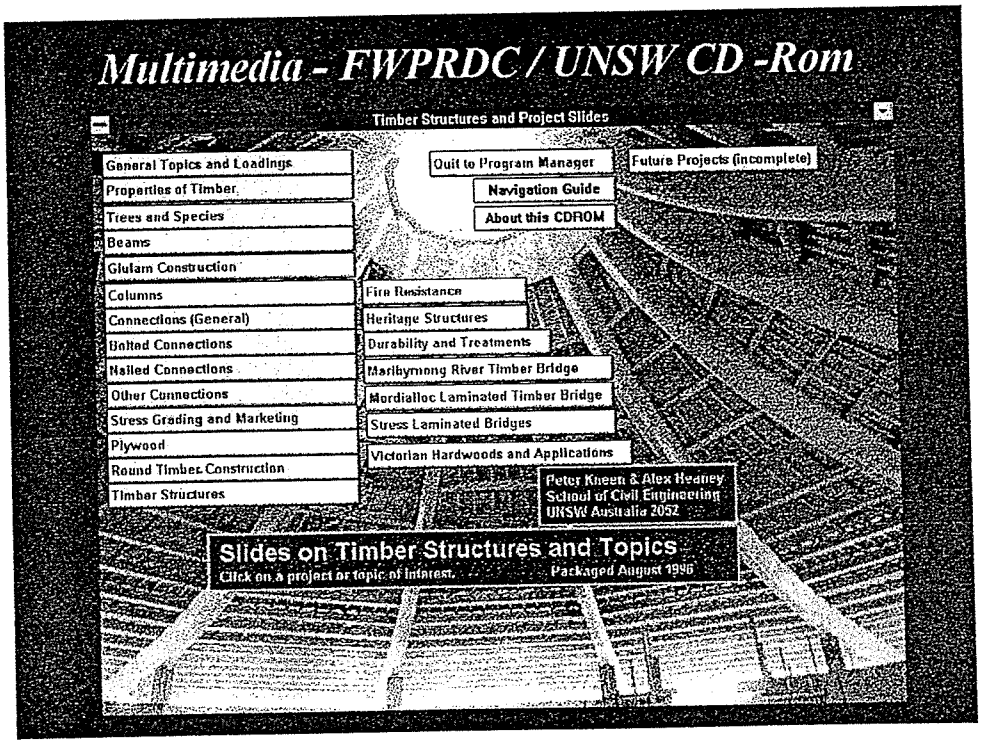


Photo P6. FWPRDC/Univ of NSW, 'Design of Timber Structures' CD-Rom.

Plans are also under way to develop a series of integrated 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. This approach is certainly of interest to the TAFE sector whose competency based learning practices mean that students can be tested as soon as they reach an accepted level of proficiency. Two screens of a prototype program are shown in Photo P7.

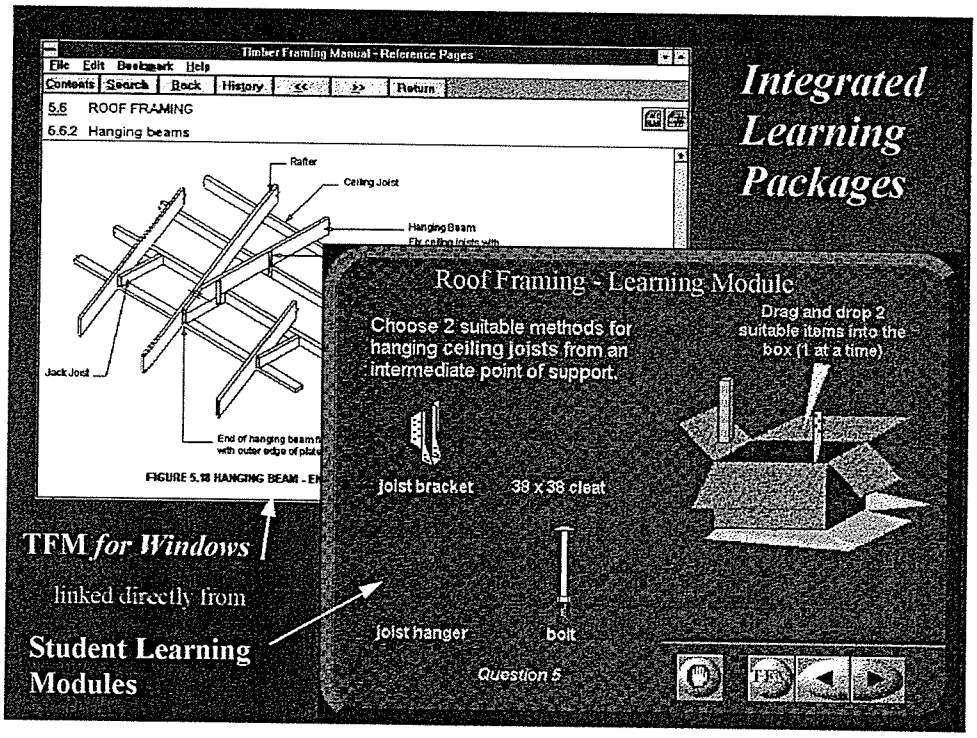


Photo P7 Proposed integrated multimedia learning packages.

The aim of these computer based packages is to try and bring some theatre and interest back into the process of learning, especially at the TAFE level where students have little interest in reading and digesting highly technical documents. 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!

P.4 Proposed Future Structure & Funding Arrangements [22]

The national education program was established in 1996 through a two year joint funding arrangement between the FWPRDC and NAFI's National Market Development Committee (NMDC). This funding was renegotiated part way through 1996 and is currently being underwritten entirely by the FWPRDC. The demise of the NMDC has forced the industry associations across Australia to review the current programs to ensure they clearly reflect industry needs and to try and find a more transparent and equitable approach to managing the funding arrangements. The approach currently being discussed is to develop a National Timber Market Development Program (NTDP) which would be funded, subject to Commonwealth government agreement, through a special levy collected through the FWPRDC. The program would be structured as such:

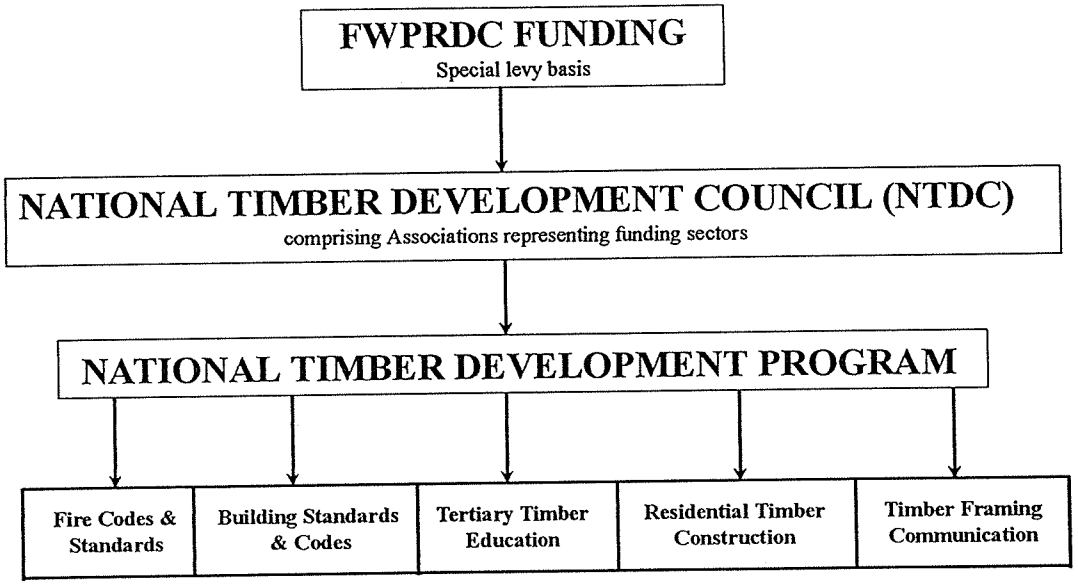


Fig P1. Proposed National Timber Development Program.

P.4.1 Program Structure

The proposed Tertiary Timber Education Sub-Program would build on the current national education program, completing the resources planned for the university sector and also addressing the needs of the TAFE sector. This sub-program consists of six major areas, which are shown in Figure P2.

Project No.	Project
301	Support of university staff
302	Resources for university courses
303	Resources for professional development
304	Support of TAFE staff
305	Resources for TAFE courses
306	Communication & information technology

Fig P2. Proposed Tertiary Timber Education Program.

Project 301 Support of University Staff

Objectives: To establish and maintain a network for the support of teaching staff at universities.

Methodology: To keep the teaching and administrative staff in universities supplied with information about timber that will establish its relevance to the building industry. This will be achieved through:

- newsletters,
- personal contact,
- question & answer services (E-mail, phone, fax),
- assistance with setting assignments and exams,
- competitions, and
- seminars.

Project 302 Resources for University Courses

Objectives: To establish and maintain quality teaching and learning resources for university lecturing staff.

Methodology: To maintain teaching resource packages containing slides, overheads, student summaries and lecture commentaries that will enable lecturers to easily prepare and effectively deliver appropriate information on timber to engineering, architecture and building students (many of these resources, described in Section P3, have already been developed under the previous funding arrangements). As educational delivery methods change, it will be necessary to introduce and maintain more computer based learning resources.

Specifically, these issues are addressed by the following packages:

- basic timber materials,
- introduction to timber engineering,
- introduction to timber framing,
- timber engineering - level 2,
- self paced learning for timber engineering,
- durability of timber,
- construction in timber, and
- specialist timber areas in architecture.

Project 303 Resources for Professional Development

Objectives: To establish quality resources for continuing education for practitioners in the building and construction industry.

Methodology: To prepare and maintain teaching resource packages containing slides, overheads, student summaries and lecture commentaries that will enable effective delivery of appropriate information on timber to practising engineers, architects and building professionals. As educational delivery methods change, and to facilitate continuing education for practitioners in remote locations, it will be necessary to introduce and maintain more computer based learning resources.

Specifically, these issues are addressed by the following packages:

- limit states timber engineering conversion,
- timber framing,
- timber engineering ,
- specification of timber,
- advanced timber engineering ,
- durability of timber,
- specialist timber areas in architecture,
- Internet learning on timber engineering, and
- Internet learning on timber framing.

Project 304 Support of TAFE Staff

Objectives: To establish and maintain a network for the support of teaching staff at TAFE institutes.

Methodology: The large number of TAFE institutes around Australia means that centralised support must make use of state based staff to perform some face-to-face functions. This project simply coordinates the local liaison and provides a centralised network for wider communication with all TAFE lecturers across the nation.

The project will provide a service that answers questions from teaching staff as they prepare material for presentation to students, and offers suggestions and assistance in the delivery of relevant information, through:

- newsletters,
- coordinating state efforts to meet with teaching staff,
- question & answer services (E-mail, phone, fax), and
- dissemination of national timber information.

Project 305 Resources for TAFE Courses

Objectives: To establish and maintain quality teaching and learning resources for TAFE courses.

Methodology: Undertake a nationwide study to determine the most effective form for resource production for the different TAFE levels and courses; this will also produce a prioritised list of the resources that are required. Once the needs have been prioritised, prepare and maintain the appropriate teaching resource packages, containing all or some of the following:

- specially produced TAFE training videos,
- selected local slides to illustrate course material,
- specific explanatory overheads,
- lecturer commentaries, or
- on-line (multimedia) teaching resources.

The target topics may include:

- timber technology,
- timber framing,
- tie-down and bracing,
- commercial structures, or
- MRTFC, amongst others.

Project 306 Communication and Information Technology

Objectives: To produce, publish and maintain the most up to date information on the selection, specification and use of timber and timber products.

Methodology: The project will ensure that national information resources are well maintained and remain relevant. In particular:

- the updating, revision and re-printing of NAFI Timber Manual datafiles to ensure the information is current and relevant,
- organisation of generic timber data presented on the Timber Industry Products CD-Rom to reduce overlap or conflict, and
- coordination of Internet based WWW publishing.

P.4.2 Proposed Program Funding

The anticipated annual costs of these projects over the next two years is as follows[Φ] :

Project No.	Project	1997/98 $	1998/99 $
301	Support of university staff	103,000	79,000
302	Resources for university courses	35,000	98,000
303	Resources for professional development	--	38,000
304	Support of TAFE staff	75,000	73,000
305	Resources for TAFE courses	84,000	175,000
306	Communication & information technology	--	78,000
	Total	297,000	541,000

Fig P3 Proposed Tertiary Timber Education Program funding.

Funding under this scheme, through an industry wide levy, means that all sectors of the industry contribute (hardwood, softwood, engineered products, importers, etc); a far fairer system for generic programs such as education, where in the end everyone benefits from an overall lifting of awareness. Government funding is also attracted under this scheme, which apart from reducing the burden on the industry, is appropriate, as the products of these education support programs, in the end, assist government funded teaching bodies.

[Φ] Note: these figures are subject to finalisation of the overall NTDC program.

P.5 Conclusion

Changes to the economic climate now mean that industry has a vital role to play in education. As an investment in its own future the Timber Industry must 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, cooperation and commitment. A model has now been presented which has the potential 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 design will flourish rather than wither and die.

ACKNOWLEDGMENTS

Acknowledgments

Firstly, I offer my sincere thanks to the trustees of the J.W. Gottstein Memorial Trust Fund for awarding me a 1996 Gottstein Fellowship and making this study and report possible.

Secondly, I'd like to thank Norman Huon, the former Executive Director, and Graeme Gooding, the current Executive Director, of the Timber Promotion Council of Victoria, for the support and encouragement to undertake this project and also Boris Iskra for his comments on this report. Thanks must also go to Geoff Boughton, Director of the NAFI Timber in Tertiary Education Program, for his advice on the trip itinerary, his assistance with the information given in the Postscript and for his continuing support and friendship.

I would also like to pass on my heartfelt thanks to the many people who so willingly gave of their hospitality during the tour; listed here in sections, in the order in which I visited them:

Academics

Professor Dave Barrett	University of British Columbia
Professor Ricardo Foschi	University of British Columbia
Professor Borg Madsen	University of British Columbia (Retired)
Dr Rod MacNeill	British Columbia Institute of Technology
Mr Rick Dohl	British Columbia Institute of Technology
Mr Thomas Abbuhl	British Columbia Institute of Technology

Mr Eric Worthy	British Columbia Institute of Technology
Dr Robert Tichy	Washington State University
Professor Tom McLain	Oregon State University
Assoc Prof Bob Leichti	Oregon State University
Assist Prof Rakesh Gupta	Oregon State University
Dr Dave Bohnhoff	University of Wisconsin
Professor Keith Faherty	Marquette University
Mr Robin Allardyce	Carleton University
Professor Don Westwood	Carleton University
Professor Juan Salinas	Carleton University
Professor Vijaya Gopu	Louisiana State University
Assoc Prof Mike Folse	University of New Orleans

Industry Association Representatives

Dr Jean Cook	Forintek Canada Corp
Dr Kevin Cheung	Western Wood Products Association
Dr Russ Moody	US Forest Products Laboratory
Dr Lawrence Soltis	US Forest Products Laboratory
Dr Jerrold Winandy	US Forest Products Laboratory
Ms Catherine Lalonde	Canadian Wood Council
Dr Alf Warnock	National Research Council of Canada
Ms Catherine Marx	Southern Forest Products Association

Industry Producer Representatives

Dr Robert Pike	MacMillan Bloedel Ltd
Mr Ken Lau	MacMillan Bloedel Ltd
Mr Rob Imbrogno	Trus Joist MacMillan
Mr John Kerns	Weyerhaeuser
Mr Dave Gromala	Weyerhauser

Without wishing to downplay my thanks to anyone listed above, I would particularly like to thank Cathy Marx, Catherine Lalonde, Borg Madsen, Keith Faherty and Dave Bohnhoff for their assistance and friendship over and beyond the call of duty. I look forward to reciprocating this hospitality here in Australia in the very near future.

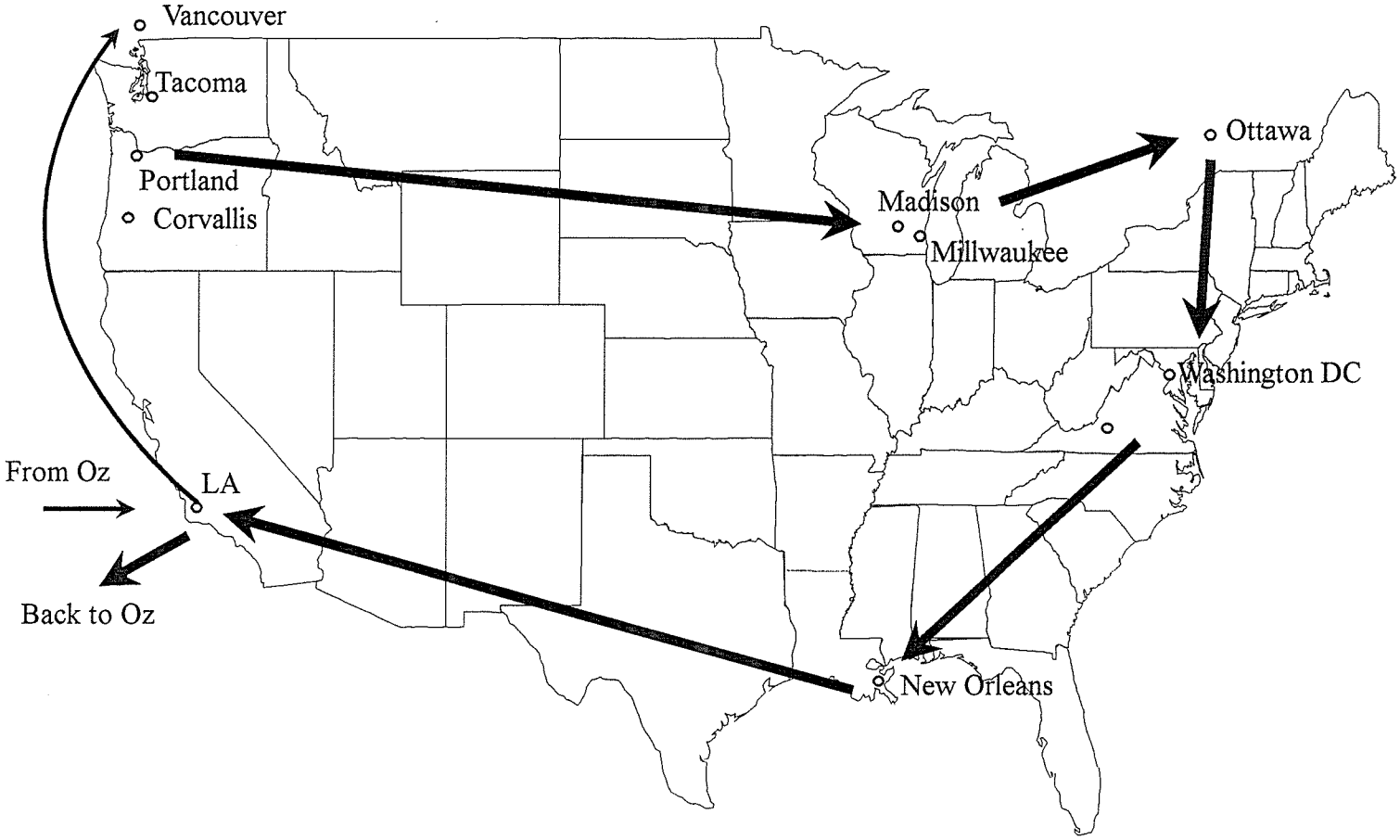
APPENDIX A

Trip Itinerary

Itinerary - Gottstein Fellowship *October 1996*

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
6 Fly Melb - Vancouver Ar 1438 VANCOUVER	7 COFI (cancelled) am Ken McKeen --- Forintek - pm Dr Jean Cook UBC Prof Ricardo Foschi VANCOUVER	8 UBC am Prof Dave Barrett --- Borg Madsen pm VANCOUVER	9 BCIT am Eric Worthy Dr Rod MacNeill Rick Dohl Thomas Abbuhl --- Mac Mill Bloedel - pm Dr Robert Pike Ken Lau Rob Imbrogno Burnaby VANCOUV	10 Fly Vanc - Seattle APA - (cancelled) Tom Williamson TACOMA	11 Weyerhauser John Kerns Dave Gromala --- Washington State Univ Dr Robert Tichy TACOMA	12 Free day TACOMA
13 Drive Tacoma - Corv CORVALLIS o/n	14 Oregon State Uni am Prof Tom McLean AProf Bob Lechti Aprof Rakesh Gupta CORVALLIS Drive Corv-Portland PORTLAND o/n	15 WWPA am Dr Kevin Cheung PORTLAND --- Fly Port - Madison MADISON o/n	16 Univ of Wisconsin Dr Dave Bohnhoff MADISON	17 USFPL Dr Russell Moody Dr Lawerence Soltis Dr Jerrold Winandy MADISON	18 Madis - Milw (bus) Marquette Uni Keith Faherty MILLWAUKEE	19 Fly Mill - Ottawa Dep 805 Ar 1225 OTTAWA
20 Free day CWC Chairman's Dinner OTTAWA	21 CWC - CWC Indust Panel Discussion - National Research Council of Canada OTTAWA	22 CWC Catherine Lalonde Carleton University Robin Allardyce Prof Westwood Prof Juan Salinas OTTAWA Fly Ott - Wash Dep	23 Washington DC Fly Wash - New Orl NEW ORLEANS o/n	24 SFPA Cathy Marx Louisiana State Univ Prof Vijaya Gopu NEW ORLEANS	25 SFPA Cathy Marx Univ of New Orleans Aprof Mike Folse NEW ORLEANS	26 Free day NEW ORLEANS
27 Free (morning) IWEC (afternoon) NEW ORLEANS	28 IWEC NEW ORLEANS	29 IWEC NEW ORLEANS	30 IWEC NEW ORLEANS	31 IWEC NEW ORLEANS	1 Fly New Orleans - Aust Dep 2130 Arrive 3rd Nov 1025	2

Week 1		Week 2		Week 3	
Vancouver	- Forintek	Corvallis	- Oregon State Uni	Ottawa	- CWC
	- UBC: Civil Eng & Forestry	Portland	- WWPA		- Carelton Univ
	- BCIT	Madison	- Univ of Wisconsin		- Canadian Research Council
	- MacMillan Bloedel		- USFPL	New Orleans	- SFPA
Tacoma	- Weyerhauser	Millwaukee	- Marquette Uni		- Louisiana State University
					- University of New Orleans



Gottstein Fellowship Visit to the US and Canada 1996

APPENDIX B

"Timber Engineering Education in Australia" - IWEC '96 Paper

Timber Engineering Education in Australia

Alastair C. Woodard, Timber Promotion Council, Victoria, Australia
Geoffrey N. Boughton, Curtin University of Technology, Australia

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.

Paper presented at the International Wood Engineering Conference '96, new Orleans, Louisiana, USA.

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).

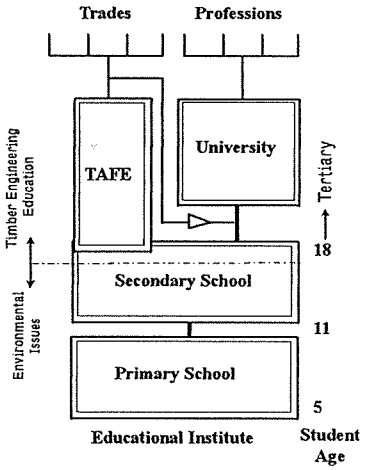


Fig 1. Simplified structure of the Australian education system.

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

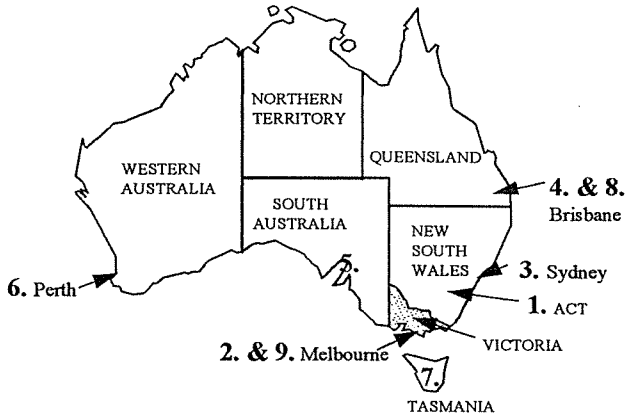
Research is clearly part of a University's charter. In many Australian universities, the principal criterion for promotion is research output. Good teaching is often associated with state-of-the-art knowledge, and research output is one indicator of this. As an educational tool, research has a role, 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

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.



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

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

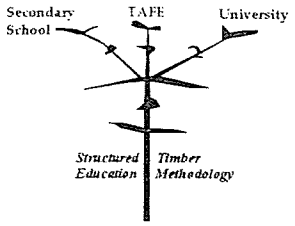
This national program is intended to coordinate support and resources offered by the timber industries to University level courses across the country. It complements the work performed at the state levels and has the following objectives:

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.

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

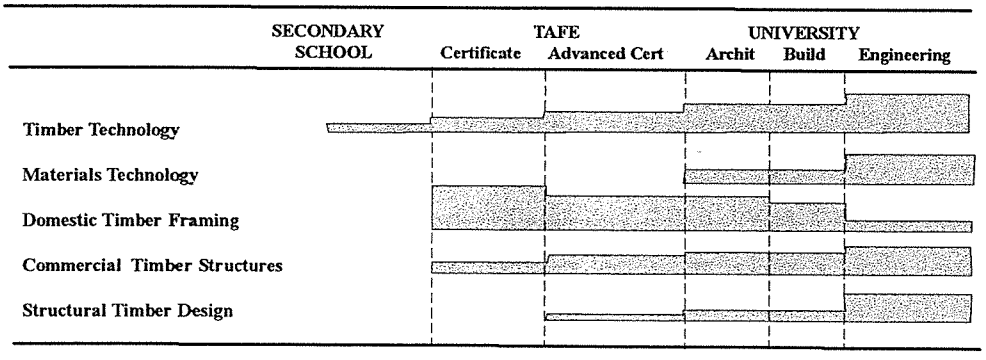


Fig 3 - STEM: Structured Timber Educational Methodology

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.

References

Aarsheim, E. 1994. Glulam Trusses for the 1994 Winter Olympics. *In: Proceedings of the 1994 Pacific Timber Engineering Conference*, July 1994; Gold Coast, Australia.

Boughton, G.N.; Crews, K. 1996. Limit States Timber Design to AS1720.1, Perth, Australia: Curtin University Publishing.

Foliente, Greg C.; Woodard, Alastair C.; Boughton, Geoffrey N. 1996. Internet Information Systems in Timber Engineering, Research and Education. *In: Proceedings of the International Wood Engineering Conference*; October 28-31; New Orleans, Louisiana.

Lyon, D.E.; Beall, F.C.; Galligan, W.L.; 1995. The Crisis in Wood Science and Technology Education. *Forest Products Journal*: 45: 6: June 1995.

Nolan, G. 1994. The Culture of Using Timber as a Building Material in Australia, *In: Proceedings of the 1994 Pacific Timber Engineering Conference*, July 1994; Gold Coast, Australia.

Pellerin, R.F.; Galligan, W.L.; Barnes, M.A.; Kent, P.M.; Leichti, R.J. 1990. Developing Continuing Education in Wood Engineering for Design Professionals. *In: Proceedings of the 1990 International Timber Engineering Conference*; October 1990; Tokyo.

UKTEG 1991. Timber a Neglected Structural Material (The Role of Education and CPD). *The Structural Engineer*; October; 69: 19.

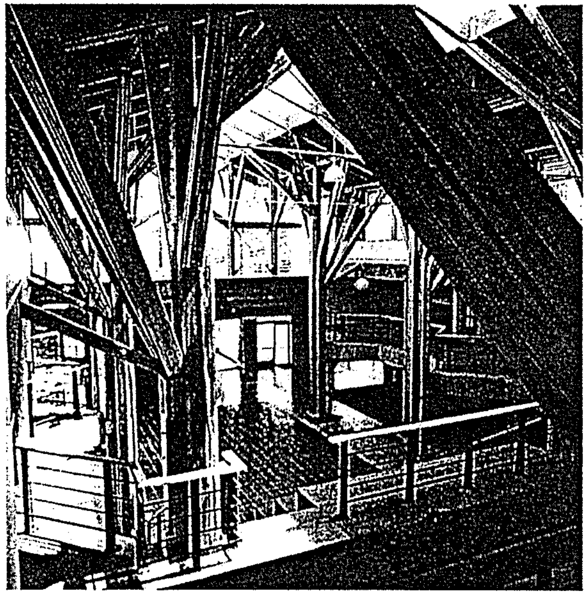
APPENDIX C

Canadian Wood Council - Breakfast Seminar Flyer

1996

CWC Breakfast Seminars

Winnipeg
London
Kitchener
Moncton
Halifax
Fredericton



Wood and the 1995 NBCC
Engineered Wood Products

Free admission and complimentary breakfast to all pre-registered guests

Canadian Wood Council
Conseil canadien du bois

Don't miss the

CWC Breakfast Seminars

Information packed seminars
Displays by wood manufacturers

The Event

We are serving up breakfast and valuable information on wood design in cities throughout Canada. Come and join us and learn about the following:

Wood and the 1995 NBCC

Speaker: Catherine Lalonde, CWC

This seminar will highlight the changes to the *1995 National Building Code* that affect wood construction:

- Changes to the 1995 Span Tables
- New fire and sound resistance tables
- Sprinkler changes
- In Ontario, the proposed changes to the 1997 OBC

Engineered Wood Products

Speakers: Gary Williams, Timber Systems
Kris Dick, A&K Technical Services, (Winnipeg seminar only)

This seminar will feature the use of the various types of engineered wood products:

- What they are
- Practical applications
- Demonstration of projects

Canadian Wood Council
Conseil canadien du bois

CWC Breakfast Seminars Registration Form

To pre-register detach and fax or mail the completed registration form to the Canadian Wood Council.

Please Print Information

Name: __________
Company: __________
Profession: __________
Address: __________
Postal Code: __________
Tel: __________
Fax: __________

Canadian Wood Council
350-1730 St. Laurent Blvd.
Ottawa, Ontario K1G 9Z9
Tel: (613) 247-7858 Fax: (613) 247-0685

Seminar Location:

- ☐ 1 Winnipeg — Wednesday, November 6, 1996
- ☐ 2 London — Wednesday, November 20, 1996
- ☐ 3 Kitchener — Thursday, November 21, 1996
- ☐ 4 Moncton — Tuesday, November 26, 1996
- ☐ 5 Halifax — Wednesday, November 27, 1996
- ☐ 6 Fredericton — Monday, November 25, 1996

Who should attend?

These seminars are prepared for the decision makers in the construction industry – **architects, engineers, building officials** – the people who need to know what products are available and how they can be used.

Dates and Locations

Breakfast Seminars, 7:30 am to 10:30 am.

Wednesday, November 6, 1996
Norwood Hotel
112 Marion Street,
Winnipeg, Manitoba

Wednesday, November 20, 1996
Ramada Hotel
817 Exeter Road,
London, Ontario

Thursday, November 21, 1996
Best Western Walper Terrace Hotel,
One King Street West,
Kitchener, Ontario

Tuesday, November 26, 1996
Hotel Beauséjour,
750 Main Street,
Moncton, N.B.

Wednesday, November 27, 1996
Westin Halifax,
1181 Hollis Street,
Halifax, N.S.

Special Afternoon Seminar

A seminar presented in conjunction with the Wood Science Technology Centre, University of New Brunswick.

2:00 pm - 3:30pm
Monday, November 25, 1996
Wu Conference Centre
University of New Brunswick Campus
Fredericton, N.B.

Cost

The CWC Breakfast Seminars are **free to those who pre-register** with the Canadian Wood Council, otherwise admission cost is $25.00.

Register today!

Don't miss this opportunity to see and learn the latest developments in wood construction, the only renewable building material.

Information

Please contact Catherine Lalonde or Audrey Mattila at **1-800-463-5091** or **613-247-7858.**

Confirmation

Every pre-registered visitor will receive a confirmation by fax or mail.

Deadline

Registration forms must be received three business days prior to the seminars.

Canadian Wood Council
Conseil canadien du bois

Canadian Wood Council
Conseil canadien du bois
350 – 1730 St. Laurent Blvd.
Ottawa, Ontario K1G 9Z9

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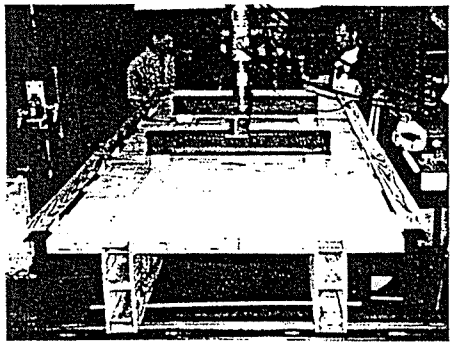
APPENDIX D

US National Timber Bridge Competition Flyer

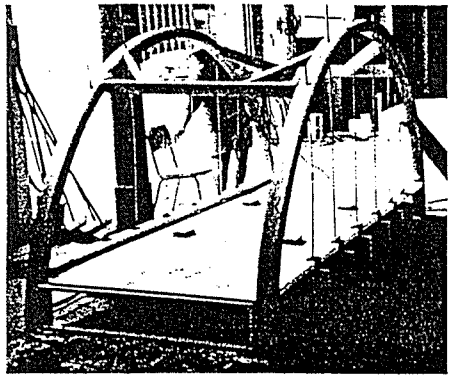


West Virginia University, 1995 - A moment of truth. Students record results during testing of their completed bridge.

SPONSORS NEEDED!

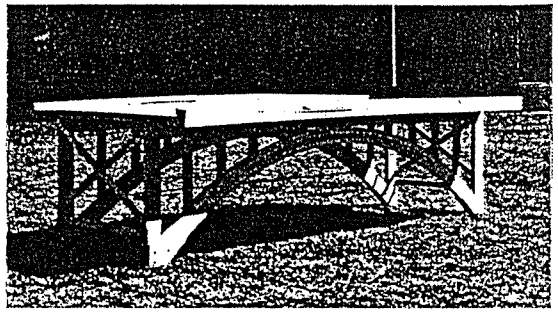
Financial support for this very successful National Timber Bridge Design Competition for student engineers has been provided over the first 5 years by the U.S. Forest Service. For this competition to continue to grow to its rightful status, additional financial support is needed from private and corporate sponsors such as wood products groups and associations, private industry, and engineering and construction firms, etc.

Additional funds are needed to offer regional and national on-site competitions and to increase amount of awards. Interested potential sponsors are encouraged to contact Bennie Hutchins, SW Mississippi RC&D, Inc., 747 Industrial Park Road, NE, Brookhaven, MS 39601, phone 601-833-5539, fax 601-835-0054.



University of Florida ASCE - 1993

NATIONAL TIMBER BRIDGE DESIGN COMPETITION



Most Aesthetic Design - Princeton University 1995

for
Student Chapters
of
American Society of Civil Engineers
Forest Products Society
in the
United States and Canada

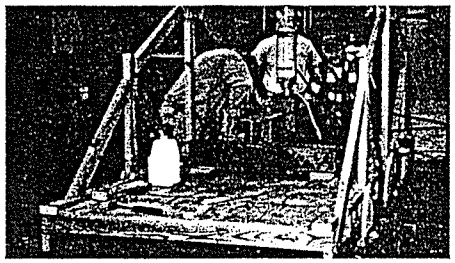
COMPETITION OBJECTIVES

The National Timber Bridge Design Competition is open to student chapters of American Society of Civil Engineers and Forest Products Society. The competition has three major objectives:

1. To promote interest in the use of wood as a competitive bridge construction material,
2. To generate innovative and cost-effective timber bridge design techniques, and
3. To develop an appreciation of the engineering capabilities of wood.

This competition is coordinated by Southwest Mississippi Resource Conservation and Development (RC&D), Inc. with assistance from the Department of Civil Engineering, Mississippi State University, the "host" university. Partial funding is provided by the U.S. Forest Service through its Wood in Transportation Initiative. RC&D is a rural development program of the U.S. Department of Agriculture administered through the Natural Resources Conservation Service.

An adequate transportation system is critical to maintaining quality of life and promoting economic development, especially in rural America. However, throughout rural America, thousands of deficient bridges limit the movement of farm and timber crops from the fields to the mills. These failing bridges also limit rural access to goods and services. Modern timber bridge designs appear to be a partial solution to this problem. In addition to being aesthetic, economical and easy to install, timber bridges can boost the local economy through value added to a local, renewable natural resource.



Virginia Tech, ASCE - 1995

Past Winners of the National Timber Bridge Competition

Award	1993	1994	1995	1996
1st Place	U of AL	U of OK	UNC-Charlotte	UNC-Charlotte
2nd Place	West VA U	West VA U	VPI	Rose-Hulman Inst.
3rd Place	U of Maine/ U of OK	MS State U	Washington U	Ohio State U
Most Economical Design	MS State U	U of MO-KC	UNC-Charlotte	San Jose State U
Most Aesthetic Design		Princeton U	Princeton U	Ohio State U
Most Adapt. to Real Life		U of AL	San Jose St. U	
Most Innovative	West VA U			

TESTIMONIALS

Over the first four years of the Competition, students from forty universities across the country have participated. In 1996 alone, 14 entries involved 81 students that devoted 2850 hours to the Competition. Following are comments from students, faculty advisors, and judges:

"After twice advising student groups that participated in the NTBDC, I have concluded that this is one of the most stimulating activities imaginable. Especially because they work with an engineering material less known to them than steel or concrete, they need to find properties and student design options without recourse to the 'tried and true'."
George F. W. Hauck
Professor of Civil Engineering
University of Missouri-Kansas City

"The Competition allowed our team to apply our prior engineering skills while gaining new skills . . . (It) challenged us to sharpen our engineering and communication skills that will be a must in our careers."
Tom G. Makris
The Ohio State University
ASCE Student - 1996

"This program benefits all involved parties — students, technical societies, schools, timber industry, and transportation groups. The keen challenge of advancing ideas in timber bridge construction . . . within a competitive environment, arouses enthusiastic interest. A very worthwhile endeavor, using a renewable natural resource."
James H. Madden, P.E.
Unit Structures, LLC
Magnolia, AR Judge 1996

"This Competition can serve as a model for the utmost in educational potential that any teacher can envision to pass on to his students. It is a challenge to both, the teaching and the learning capabilities of the professor and the students, respectively."
Dr. Ralph Sinno
Professor of Civil Engineering
Mississippi State University

"I strongly encourage the continuation of the Timber Bridge Design Competition at San Jose State University. The level of activity was phenomenal. Enthusiasm, morale, and camaraderie were raised to an unprecedented level. Keep up the good work!"
William J. Venuti
Professor Emeritus
San Jose State University

"As a judge, I was highly impressed with the Competition entries. The designs were all well conceived and a number presented especially innovative structural concepts. I look for the competition to continue and to grow."
Dick Ward
Federal Highway Administration
Judge 1993

DESCRIPTION:

The competition will consist of the construction and testing of a model timber bridge on the home site of each team.

ELIGIBILITY:

The competition is open to all student chapters of American Society of Civil Engineers and Forest Products Society in the United States and Canada. Joint and multiple entries from one school will be accepted.

COMPETITION SPECIFICATIONS:

Each contestant (team) will be required to design, build and test a bridge constructed from wood structural members. The wood used in this project must be from a commercially available species.

DESIGN CRITERIA:

Design Span: 3 meters from center line to center line of supports. The maximum length of an individual piece in any member shall not exceed 1.4 meters. There is no length limitation on built-up and laminated members provided that the individual pieces, including plywood, used in making the member do not exceed the specified maximum length. Maximum width of supporting base plates is 60 mm.

Horizontal and Vertical Clearances: 1.25 m x 0.90 m, respectively (see sketch).

Test Load: 20 kN for 1 hour. (See test set-up for location of loading blocks.)

Load Application and Deflection Measurements: Load to be applied at 5 equal increments of 4 kN each. Deflection readings to be collected at each load increment. Then, four deflection readings to be collected at 15-minute intervals during the 1 hour load duration.

Maximum Vertical Deflection from Original Position: Maximum of 8 mm at end of the test duration. Deflection to be recorded: (a) at mid span half way between curbs (centroid), and (b) the average deflection at mid-span of left and right-curbs. The largest of these two deflection readings will be used for the competition rating on deflection. Subtraction from deflection due to compression of supports will not be allowed.

Bridge Deck: The bridge must have a timber deck capable of supporting an asphaltic wearing finish over the entire exposed roadway surface. Laminated plywood sheets, OSB, particle boards, etc. will not be allowed. Maximum length of 1.4 meters for individual timber pieces shall apply also to the deck.

Prestressing: Prestressing will be allowed provided it is done 48 hours before testing.

Bridge Weight: Bridge must be weighed before testing and must include all bridge parts forming a part of the bridge as a structural system.

DOCUMENTATION:

Contestants will be required to submit a VHS color video (maximum of 12 minutes) and photographs documenting all phases of bridge construction, weighing, loading, and test results at each loading increment and at the 15-minute intervals until the end of the one hour load duration. It is recommended to include within the frame of all photos and video shots a labeling sign stating the significance and sequence of the picture in the testing procedures.

REPORT:

A technical report must be submitted, and to include:

1. A brief description of the structural system used for the design and construction of the bridge.
2. Table of all recorded test results of deflection measurements; centroid and average deflection of left and right curbs at centerline of bridge.
3. An itemized materials list including size and classification such as wood pieces, plywood, steel, rod, cable, nails, lag screw, plate, glue, etc. Non-wood items in the list must show the weight of each entry. The total weight of non-wood material must be less than 25% of the total weight of the bridge.
4. A plot of load versus deflection for each loading increment, and for the intervals of the one hour time-dependent deflection under the full test load.
5. Photographs.
6. A short summary describing the bridge, its behavior under load, and the total weight of the bridge, weight of non-wood material, initial deflection and final deflection measurements. Report must be no more than ten (10) 8½" x 11" pages excluding front and back covers, pictures and drawings.
7. Drawings - must be adequate to inform judges of design dimensions; should include longitudinal and transverse cross-sections.
8. Brief report on number of students involved and estimated hours of student input.

PRIZES:

First Place	$750
Second Place	$500
Third Place	$300
Special Award A	$200
Special Award B	$200
Special Award C	$200
Special Award D	$200
Participation Awards	$100

Special Award A will be given for the design most adaptable to real-life construction.

Special Award B will be given for the most economical and cost-competitive design; when applied to real world situations.

Special Award C will be given for the most aesthetic timber bridge design.

Special Award D will be given for most original and innovative design.

Participation Awards: The top ten entries that meet design criteria but fail to capture one of the above seven awards will each receive a $100 participation award.

DEADLINES:

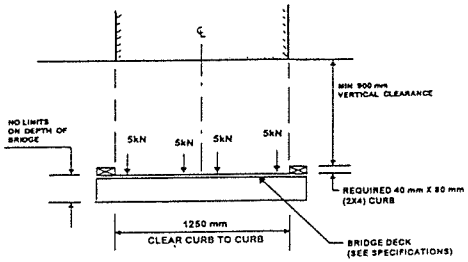
Deadline for receipt of "Certification and Entry Form" along with Report and Documentation is April 18, 1997.

RESULTS:

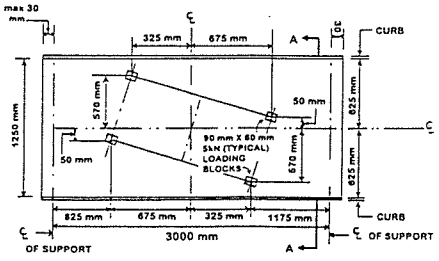
Winners will be announced by the first week in May, 1997. The results of the winning bridges will be publicized and distributed to all participating chapters.

ADDITIONAL INFORMATION:

On technical points, contact Dr. Ralph Sinno, Dept. of Civil Engineering, Miss. State Univ., Phone 601-325-3737, FAX 601-325-7189. On contest operations, contact Bennie Hutchins, SW Miss. RC&D, Phone 601-833-5539, FAX 601-835-0054.



DESIGN SKETCH: SECTION A-A



TEST SET-UP: PLAN VIEW

The United States Department of Agriculture (USDA) prohibits discrimination in its programs on the basis of race, color, national origin, sex, religion, age, disability, political beliefs and marital or familial status. (Not all prohibited basis apply to all programs.)

CERTIFICATION AND ENTRY FORM

College or University_____

Student Chapter(s) Name_____

Student Chapter Address_____

_____

Phone_____ Fax_____

Faculty Advisor_____

Person In Charge of Project (Contact):

_____

Faculty Advisor Certification:

_____

(Signature) (Date)

Deadline for submittal is April 18, 1997.
Form must be attached to inside front cover of technical report.

Mail to: MSU ASCE
P. O. Box 9546
204 McCain
Mississippi State, MS 39762

All materials received by the sponsoring organizations will be the property of those organizations.

JUDGING:

A panel of three independent judges not affiliated with any contestant institutions will select the winners. Bridges will be judged based on the sum of the weighted factors for the following four (4) criteria:

Criteria	Weight Factor
Maximum Deflection	40%
Total Bridge Weight	30%
Report, Pictures, Video*	20%
Percent Non-Wood	10%
	100%

EXAMPLE

Entry XYZ Rank Among all Entries	X	Weight Factor	=	Criteria Total
6th		0.4		2.4
3rd		0.3		0.9
1st		0.2		0.2
7th		0.1		0.7
Entry XYZ score				**4.2**

The entry with lowest total score will be the winner. Entries that do not meet all rules and criteria will be disqualified for consideration for First - Third place awards, but will be eligible to compete for Special Awards.

*Adequate documentation, clarity, neatness, content

APPENDIX E

US Teaching Tool Package - List of Contents

1995 BINDER CONTENTS

Tab 1 -- Teaching Aids

Description of slide set and script

Set of slides in 3-ring plastic folders

Suggested course outlines

Overhead package

Tab 2 -- Design

Order form to receive complimentary NDS and Supplement, plus purchase information for the NDS Commentary for Wood Works Software.

LRFD Manual notice

Manual for Wood Frame Construction, WCD No. 1

Post-Frame Construction

Tab 3 -- Product Identification

ALSC Grade Marks -- untreated

ALSC Quality Marks -- treated

Glulam Product Quality Marks (AWS)

Glulam Product Quality Marks (AITC)

Grades & Specification

Tab 4 -- Lumber

Southern Pine Use Guide

Wood Frame Design

Product Use Manual

Tab 5 -- Structural Panels

Residential/Commercial Design Guide

Diaphragms

Tab 6 -- Glued Laminated Timber

Laminated Timber Design Guide

Glulam Construction Guide

AITC 117-93 - Design

Tab 7 -- Trusses

Form to purchase the Metal Plate Connected Wood Truss Handbook

Standard Responsibilities in the Design Process Involving MPC Wood Trusses

Floor Trusses

HIB-91 Summary Sheet

Tab 8 -- Fasteners & Connectors

Do's & Don'ts of Connection Detailing

Typical Construction Details, AITC 104

Tab 9 -- Fire Performance

Design of Fire-Resistive Exposed Wood Members: Design for Code Acceptance No. 2

Fire-Rated Systems

Glulam Performance Under Fire Exposure

Tab 10 -- Treated & Durable Wood Products

Pressure-Treated Southern Pine

Treated Lumber

Preservative-Treated Plywood

Design of Wood Structures for Permanence, WCD No. 6

Moisture Control of Low Slope Roofs

Designing Structural Glued Laminated Timber for Permanence

Marine Construction Manual

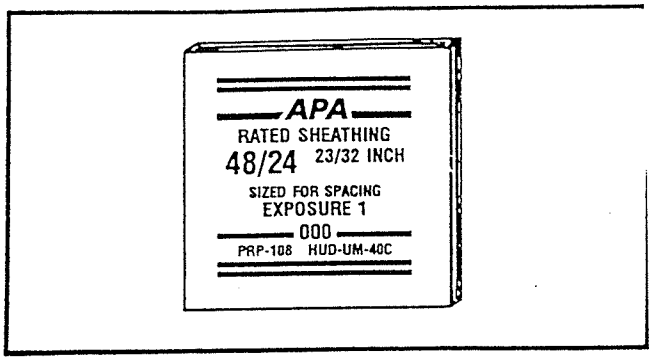
Pedestrian Bridges and Walkways

1995 PRODUCT SAMPLES, VIDEOS, SOFTWARE

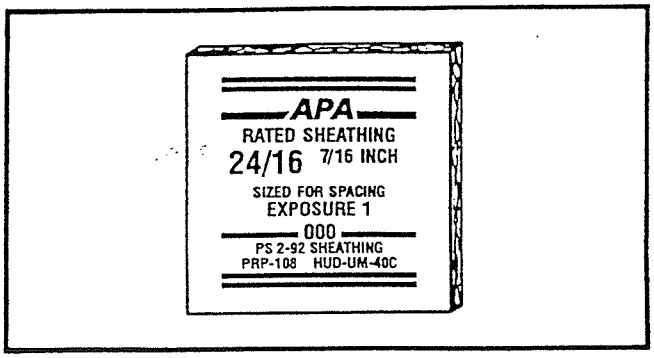
1.	Lumber	12" long, 2x4 MSR Douglas fir with grade stamp
2.	Treated Lumber	12" long, 2x6, CCA-treated Southern Pine (one bd. ft.) with grade stamp and quality mark and end tag
3.	Glulam	6" long, 4-lams deep by approx. 3" wide, with stamp
4.	I-Joists	6" long, 9-1/2" deep, 1-1/2" by 1-3/4" LVL flanges, OSB webs
5.	LVL	6" long, 1-1/2" by 2-1/4"
6.	Panel -- Plywood	6" by 6" with APA mark
7.	Panel -- OSB	6" by 6" with APA mark
8.	Plate Truss Joint	12" long
9.	Laminated Decking	6" long, 3-lam
10.	Fasteners/Connectors	Variety
11.	Video	The Miracle Resource
12.	Video	Construction
13.	Software Demo	Wood Works

Description of Product Samples

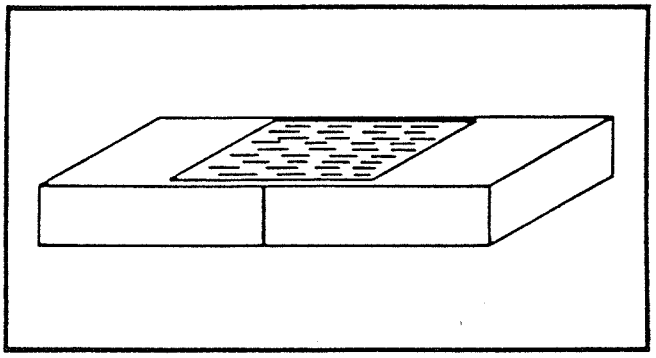
Structural Panel: 6x6 plywood with APA trademark.



Structural Panel: 6x6 oriented strand board with APA trademark.

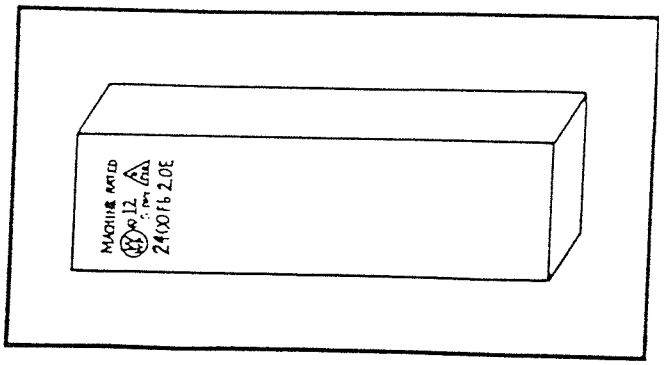


Plated Truss Joint: 2x4s joined with metal tooth connector plates.

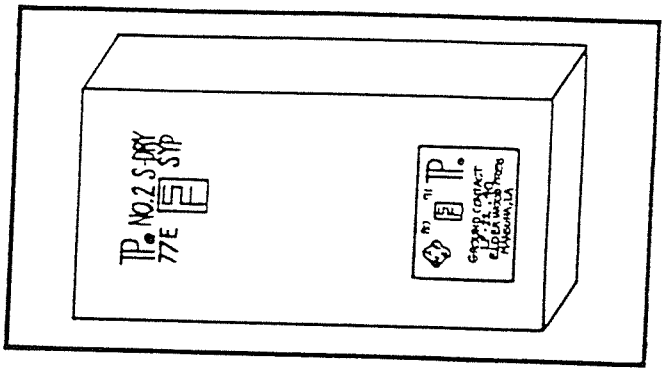


Description of Product Samples

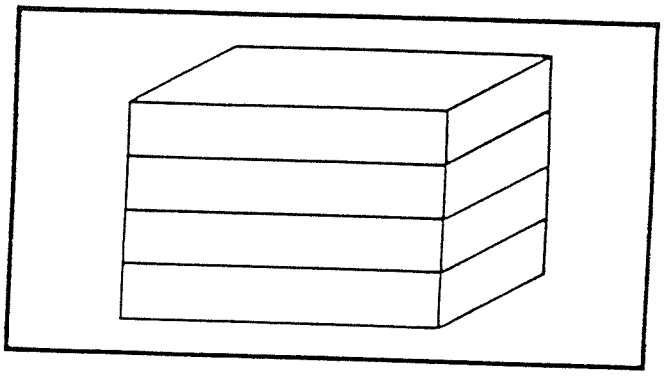
MSR Lumber: Machine Stress Rated (MSR) Douglas fir 2x4 with grade stamp.



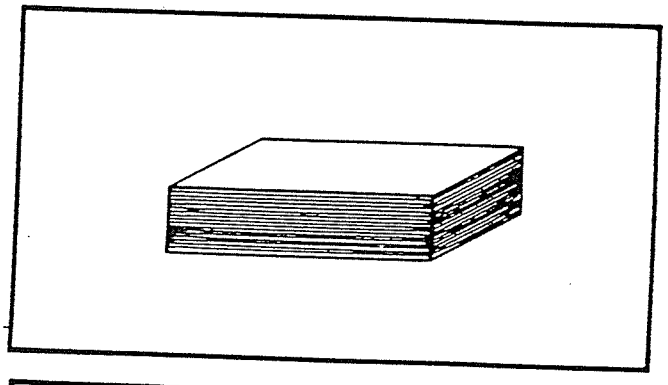
Treated Lumber: CCA pressure treated Southern Pine 2x6, 12" long (one board foot) with grade stamp, treated quality mark and sample end tag. Also treated with a water repellent. Try splashing water on it and compare the result with water splashed on one of the other wood samples.



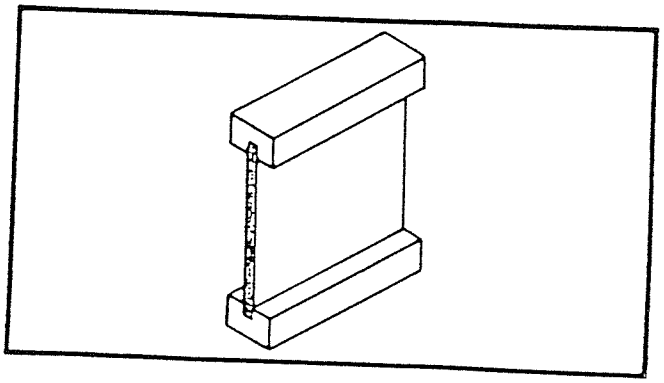
Glued Laminated Timber: 4-lamination Southern Pine glulam, 6" deep by 3" wide, with AITC quality mark.



Laminated Veneer Lumber: 1-1/2" thick by 2-1/4" wide LVL.

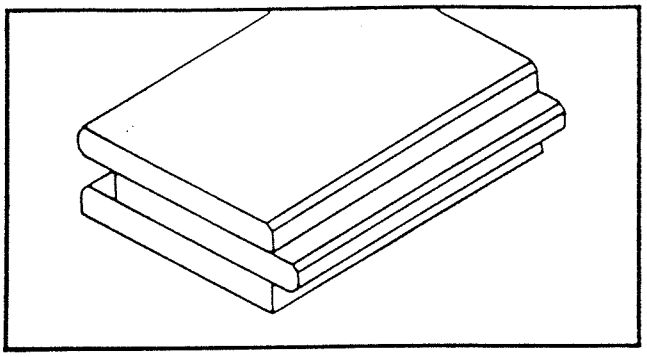


I-Joist: 9-1/2" deep I-joist with laminated veneer lumber flanges and an oriented strand board web.

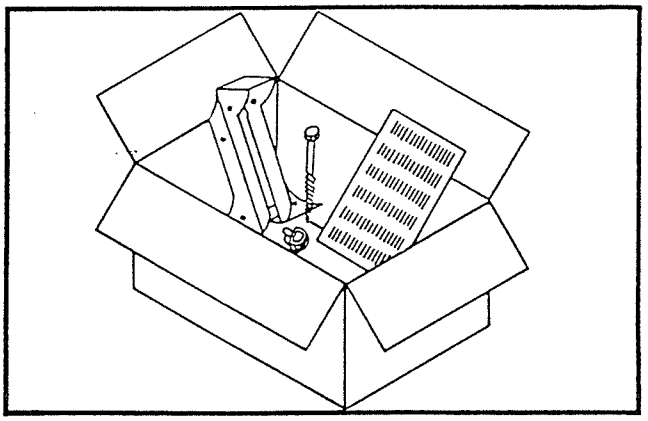


Description of Product Samples

Decking: 2-1/8" by 6" Laminated tongue and groove decking.



Metal Connectors/Fasteners: Several connectors/fasteners including truss plates, joist and various other hangers, shear plate, anchors, connectors, clips, bolt with washer and lag screw.



APPENDIX F

Canadian Wood Council / Carleton University "Designing with Wood" Course Outline

itv Engineering 82.422*V Wood Engineering

Designing with Wood

Instructors
J.J. Salinas
Department of Civil and Environmental Engineering
Carleton University

D. Westwood
School of Architecture
Carleton University

Prerequisites

This course is intended for senior engineering and architecture students. Students must have completed basic and mid-level courses in Statics, Mechanics of Materials, Structural Analysis and Design and be familiar with the basics in Mathematics and Statistics. These prerequisites are easily satisfied by engineering and architecture students entering their fourth year of studies at a Canadian university. Please contact the instructors if you need to discuss these requirements in more detail.

Objective

Wood is an abundant renewable resource which requires minimal energy input to process into functional and economical structures. It has very desirable physical and mechanical properties and has an aesthetically pleasing appearance which makes it an attractive choice for engineers and architects. The main objective of this course is to present wood as an important construction material and as a viable alternative to other construction materials covered in an undergraduate curriculum.

We believe that a good understanding of the principles governing the design of wood structures will result in a more rational utilization of this resource and contribute to the preservation of our forests.

Contents

The course begins with the review of some basic facts concerning the world's forest resources and Canada's role in the development of forest products. We examine several aspects of the geographic distribution of commercial species, ownership and growing stock inventories by province. We then continue to examine the internal structure of wood in order to explain its physical and mechanical properties. We discuss in some detail the relationships between wood and moisture migration including shrinkage and swelling. After a brief review of the design process, as generally understood by the architect and the engineer we examine the concepts of safety and reliability and how they contribute to the development of a Limit States Design methodology. This is followed by a detailed review of dead and live loads and how the requirements of the National Building Code of Canada are interpreted to determine occupancy, snow, wind and earthquake loads.

The determination of characteristic values for the strength of wood products has undergone significant review in the last 20 years and we present a brief review of the most important differences between the traditional Working Stress Design approach and the current Limit States Design philosophy. A detailed review of the most commonly used wood products is followed by an examination of available sizes and grades.

The design of wood structural elements starts with Tension, followed by Compression and Bending. Visually graded and Machine Stress-Rated sawn lumber and glulam are discussed in considerable detail, including built-up and spaced columns, tapered and curved glulam beams and beam-columns. The next part of the course is concerned with mechanical fastenings and after a brief survey of available connectors we present the design procedures for nails, lag screws, bolts, split rings and glulam rivets.

The behaviour and design properties of panel products such as waferboard, oriented strand board, particle board and plywood are presented and their manufacturing and design characteristics are discussed in detail. This is followed by a discussion of the design procedures for plywood box beams, Wood I-Joists and stressed skin panels. The last two lectures cover the design of lateral load resisting systems such as shear walls and diaphragms. A brief review of biodegradation, biological attack and preservative treatment of wood sets the stage for a discussion on the proper way to store and handle lumber. And the course wraps up with the discussion of some important concepts in the repair, preservation and restoration of historic timber structures.

Student evaluation

Self Tests (0 %)

You will receive a set of questions related to each topic covered in the course. These questions can be answered right after you have viewed the appropriate tape (lecture) and are designed to help you have a better understanding of the topic. You can also use these questions to review the course material and as a study guide for the final exam.

Assigned Problems (0 %)

You will also receive a set of problems to help you practice the design principles presented. You are encouraged to work on these problems in groups with other students in the course. Answers may be provided in some cases. If you require assistance please contact the instructors. The Wood Design Course Notes produced by the Canadian Wood Council contain a full collection of sample problems based on the Case Study introduced in the lectures.

Mid Term Exam (35 %)

Students writing the mid term exam off campus must make special arrangements to have this exam proctored at their home institution. Alternative arrangements must be cleared with the instructor(s).

Final Exam (65 %)
To be written at the end of the term. It consists of 4 to 6 questions including problems similar to those found in the assigned problem list and in the Case Study. Open book. Three hours. Students writing the final exam off campus must make special arrangements to have this exam proctored at their home institution. Alternative arrangements must be cleared with the instructor(s).

Required Texts

(1) Canadian Wood Council. (1991) **Wood Design Manual.**
(2) Canadian Wood Council. (1994) **Wood Design Course Notes**
(3) Canadian Wood Council. (1992) **Wood Reference Handbook**

To purchase these publications please contact

Canadian Wood Council
350 - 1730 St. Laurent Blvd
Ottawa, Ontario
K1G 5L1

1-800-463-5091
(613) 247-7856 (Fax)

Other references

(1) Madsen, B. (1992) *Structural Behaviour of Timber.* Timber Engineering Ltd. 575 Alpine court, North Vancouver, B.C. Canada, V7R 2L5 (ISBN 0-9696162-0-1)

(2) Hoyle, R.J and F.E. Woeste (1989) *Wood Technology in the Design of Structures.* Fifth Edition. Iowa State University Press/Ames (ISBN 0-8138-1975-X)

(3) Baird, J.A. and E.C. Ozelton (1984) *Timber Designers' Manual.* Second Edition. Granada Publishing Ltd, 8 Grafton Street, London W1X 3LA, U.K. (ISBN 0-246-12375-3)

(4) Breyer, D.E. (1988) *Design of Wood Structures.* Second Edition. McGraw-Hill Inc. (ISBN 0-07-007675-8)

(5) Canadian Wood Council (1993) *Wood Building Technology.* Materials and Properties, Thermal Insulation, Fire Protection, Construction Details, Sound Control, Inspection and Repair. (ISBN 0-921628-20-X)

(6) Canadian Wood Council (1991) *Wood and Fire Safety.* Fire safety requirements for building construction. (ISBN 0-921628-05-6)

(7) Hansen, H.J. (1971) *Architecture in Wood.* Viking Press, N.Y. (ISBN 670-13148-2)

Lecture outline

Lecture	Title	Topics
1	Introduction	Why wood construction? Wood is an abundant and renewable resource. Its mechanical properties make it a desirable and economical construction material.
2	Course outline	An explanation of the topics to be covered and their sequence. A road map. Professional design practice. Similarities and differences with other construction materials.
3	Wood as a resource	A global perspective on the distribution of forest resources. Geographic, economic and socio-political factors. Canada's role in the world's forest industry.
4	Wood as a material	Molecular & cell structure. Architecture of the wood fibre. Wood anatomy. Basis for understanding material behaviour and strength properties.
5	Physical properties	Density, chemical resistance, thermal conductivity, electrical, acoustical properties.
6	Mass-water relationships	Moisture content, mass density, specific gravity, shrinkage/swelling. Their effect on strength-deformation characteristics. Calculations.
Lab # 1	Mass-water relationships	Measurement of mass, volume. Determination of moisture content, mass density and volumetric shrinkage.
7	Mechanical properties	Allowable stresses. Use of small clear specimens. In-grade testing. Factors affecting strength and mechanical properties.
8	The design process	Engineering and Architecture's perspective. Limitations. Professional practice.
9	Safety and Reliability	Systems approach to define reliability. A demand\supply model for safety considerations. Design methodologies. Working Stress Design and Limit States Design.

10	Dead Loads	Introduction to Case Study Building. Self weight. Tributary areas. Examples.
11	Live Loads	Brief review of National Building Code of Canada considerations for the determination of Live Loads. Use and occupancy, snow, rain, wind and earthquake loads.
12	Specified Strength	Lumber grades and species groups. Canadian lumber properties. Characteristic values and stress modification factors.
13	Wood products 1	Survey of products and systems used in construction. Dimension lumber, Glulam, Decking. Grades, sizes, species, applications.
14	Wood products 2	Panel products, composites, trusses. Roof, Floor and Wall Systems. Characteristics, fabrication standards.
15	Tension	Design of tension members, lumber and glulam. Code requirements, limitations on net area.
16	Compression 1	Design of compression members. Lumber and glulam. Code requirements. A recommended column design procedure. Examples.
17	Compression 2	Special cases. Design of built-up and spaced columns.
MID-TERM EXAM	**2 HOURS**	**OPEN BOOK**
18	Bending 1	Design of lumber beams, joists & planks. Bending, shear, deflections, bearing and lateral stability considerations.
19	Bending 2	A guide to the design of Glulam beams. Straight, prismatic beams. Bending, Shear, Deflections, Bearing and Lateral Stability. Special shear considerations. Shear deflection.
Lab # 2	Flexure	Beam testing. Expected values for bending capacity. Strength-deformation behaviour.

20	Bending 3	Glulam beam design. Tapered straight beams. Special considerations. Curved, and curved-tapered glulam beams. Radial stresses. Vertical and Horizontal deflections.
21	Bending 4	Combined axial load and flexure. Tension and compression axial loads. Magnification factor.
22	Fastenings 1	Introduction. General requirements. Factors affecting the performance of mechanical fasteners. Commonly used fasteners.
23	Fastenings 2	Nails, Spikes and Lag screws. Design formulation and code values.
24	Fastenings 3	Bolts. An overview of design assumptions. Group and end distance effects. Code design values. Examples.
25	Fastenings 4	Split Rings Connectors and Shear plates. Factors affecting their design. End distance, edge distance and spacing effects. Group factor.
26	Fastenings 5	Glulam rivets and truss plates. Use and design assumptions. Examples.
27	Panel Products 1	Fabrication and uses. Mechanical properties. Strength and stiffness. Plywood.
28	Panel Products 2	Plywood and Oriented Strand Board. Design values. Examples.
29	Panel products 3	Applications. Box Beams. Analysis and design. A method for the design of glued and nailed plywood box and I beams.
30	Panel Products 4	Applications. Plywood box and I beams. Design examples. Bending, Shear, Deflections, Bearing and Lateral Stability. Shear deflections.
31	Stressed Skin Panels	Analysis and design formulation. Examples
32	Shear Walls and Diaphragms 1	Introduction to lateral load resistance systems. Analysis.

33	Shear Walls and Diaphragms 2	Design examples.
34	Biological Attack	Bio degradation of wood, agents and treatment. Bacteria, fungi, insects, adverse environments. Performance standards and economic factors.
35	Fire Safety	Principles of fire safety. Ignition. Fire retardants. Regulations.
36	Maintenance & Repair	Storage and handling. Conservation. Heritage. Restoration.
FINAL EXAMINATION		

BIBLIOGRAPHY

Bibliography

1 Juniper, P. 1986, *'A North American Study Tour of the Use of Timber in Non-Housing Construction'*, Gottstein Fellowship Report, 1986.

2 Syme, D.R. 1987, *'A Study Tour of Timber Engineering in Europe'*, Gottstein Fellowship Report, 1987.

3 Crews, K. 1990, *'Research & Development Trends in Structural Applications of Timber for Expansion of the Non-Residential Market for Forest Products in Australia'*, Gottstein Fellowship Report, 1990.

4 McDowall, C.G. 1993, *'A Survey Report on an Educational Strategy to Produce: The Educational Resource Needs of Teachers to Provide the Minimum Timber Study Component in Australian Trade and University Curricula'*, A Survey Report for the National Association of Forest Industries, February 1993.

5 Crowley, J.S. 1993, *'A Situation Assessment and Strategy to Increase Demand for Wood Products in the Non-Residential Building Sector'*, A Market and Industry Assessment, JSC Associates, Cambridge , Ma., February 23, 1993.

6 Faherty, K.F. 1986, *'Survey on Wood Education'*, Marquette University, Milwaukee, Wi.

7 Reed, G. 1994 *'Survey of Civil Engineering Education'*, University of Tennessee, Knoxville, ASCE Dept. Heads Council, ASCE, New York, NY.

8 Crowley, J.S. 1993, *'A Situation Assessment and Strategy to Increase Demand for Wood Products in the Non-Residential Building Sector'*, A Market and Industry Assessment, JSC Associates, Cambridge , Ma., February 23, 1993.

9 CWC, 1995, *'Canadian Wood Council - Annual Review 1995'*, Ottawa, Ontario.

10 Forintek, 1996, *'Forintek - Annual Report 1995-1996'*, Vancouver, BC.

11 WPPC, 1996, *'Wood Products Promotion Council - 1996 Promotion Plan'*.

12 Dolan, J.D. 1995, *'Summary Report On: Results of Questionnaire Concerning the Effectiveness of the ASCE Teaching Tools Package for Wood Design'*, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

13 Gromala, D.S. 1996, *'Implementation of Load and Resistance Factor Design in the United States'*, Proceedings of the International Wood Engineering Conference, New Orleans 1996, October 28-31, vol 3, p 40-47.

14 Foliente, G.C., Woodard, A.C., & Boughton, G.N. 1996, *'Internet Information Systems in Timber Engineering, Research and Education'*, Proceedings of the International Wood Engineering Conference; October 28-31; New Orleans, Louisiana.

15 Faherty, K.F. & Williamson, T.G. 1995, *Wood Engineering & Construction Handbook*, 2nd edn, McGraw-Hill.

16 Stalnaker, J. & Harris, E. 1997, *Structural Design in Wood*, 2nd edn, Chapman & Hall.

17 Breyer, D.E. 1993, *Design of Wood Structures*, 3rd edn, McGraw-Hill.

18 American Institute of Timber Construction 1994, *Timber Construction Manual*, 4th edn, John Wiley & Sons Inc.

19 Hoyle, R.J. & Woeste, F.E. 1989, *Wood Technology in the Design of Structures*, 5th edn, Iowa State University Press, Ames.

20 Boughton, G.N. 1996, *'Vision & Objectives Statement - Tertiary Timber Education Program'*, FWPRDC/NAFI Timber Education Program, December 1996.

21 Boughton, G.N. & Crews, K.I. 1996, *'Limit States Timber Design to AS1720.1'*, Curtin University Publishing, July 1996.

22 FWPRDC, 1997, *'National Timber Development Program - Proposal'*, Forest & Wood Products Research & Development Corporation, February 1997.

Additional Relevant References

Marx, C.M. 1996, *'Wood Engineering Education in the U.S.'*, Proceedings of the International Wood Engineering Conference; October 28-31; New Orleans, Louisiana.

Blass, H.J. 1996, *'Timber Engineering Education in Europe'*, Proceedings of the International Wood Engineering Conference; October 28-31; New Orleans, Louisiana.

Woodard, A.C., & Boughton, G.N. 1996, *'Timber Engineering Education in Australia'*, Proceedings of the International Wood Engineering Conference; October 28-31; New Orleans, Louisiana.