Wood Engineering Education – Trends and Challenges

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Abstract

An overview of the factors impacting the wood engineering/design education in the U.S. has been presented. The actions that need to be taken by the engineering departments and the wood products industry to ensure that wood engineering continues to be covered in the engineering programs have been discussed. The authors recommend a multi-faceted approach to promote wood engineering education in civil engineering programs in the U.S.

Introduction

In most U.S. universities wood engineering/design is taught in one or more of the following four departments: Agricultural Engineering, Architectural Engineering, Civil Engineering, and Wood Science (or Forest Products). On a few campuses, these departments cover this area either jointly or separately. Over the past few decades there has been a steady decline in the percentage of programs actively engaged in delivering wood engineering education and a consequent decline in the number of students getting exposed to wood design in their curriculum. This trend is very disturbing and if unabated could have a negative impact on the nation’s wood product industry (Testa and Gupta 2004).

A recent survey of basic education for structural engineers in colleges and universities demonstrated that about half of the respondents do not even offer a course in wood design (Structure 2004). The percentage of civil engineering students required to take wood design in their curriculum has dropped from 14% in 1978 to 9% in 1994 (Marx 1996), and is definitely much lower today. In the early ‘70s nearly sixty percent of the Agricultural Engineering programs offered a course in wood design. Now, most of these programs have changed their focus and only a few (or probably none) offer a course in wood design. Also, only a third of the Architectural Engineering programs teach a wood design course though three-fourths of these programs teach a course on wood as a building material. The decline in the Wood Science programs over the last two decades hasn’t helped foster wood engineering education (Lyon et al. 1995). Given the decline in the opportunity to gain exposure to wood design, it is not surprising that most design professionals are more at ease with design of steel and
concrete structures and tend to shy away from considering timber structures as an alternate system even when it is viable and economical.

There are a variety of factors that have contributed to the current state of affairs in wood engineering education. They are in order of importance:

- The decline in the number of credit hours—required for graduation—and program specific criteria mandated by ABET for accreditation of an engineering undergraduate curricula.

- Decline in research funding in the wood engineering area. Research funding is instrumental for training and producing doctoral students who become the next generation of wood engineering educators.

- Lack of coordinated industry support for training of wood engineering educators and keeping them abreast of new developments, technologies and teaching tools.

- Lack of adjuncts faculty—generally local consulting engineers—qualified to offer wood design courses.

Each of these factors is discussed in this paper and recommendations are made on how to deal with these factors to promote wood engineering education.

**Credit Hour Requirement and Program Specific Criteria**

The steady decline in the number of credit hours required for graduation from an ABET accredited engineering program has forced departments to drop a number of hereunto required courses in order to meet the credit hour cap. Departments are reluctant to be out of line with the credit hour requirements at peer institutions lest they become non-competitive in attracting students. The reduction in the credit hour requirement has led several analysis/design courses such as indeterminate structures, steel, concrete, and timber design to be offered as technical electives rather than as required courses. Since most students feel that steel and concrete design should take precedence over timber design, they find limited opportunity to include timber design in their selected list of technical electives.

In addition to lowering the credit hour requirement to stay competitive, the departments also face the task of satisfying the program specific criteria established by ABET. This often limits the ability of the departments to permit the students to graduate with a strong slant in any given sub-discipline area. For example, the civil engineering program specific criteria require that the curriculum be designed to ensure the students gain proficiency in four broad areas within civil engineering and have faculty qualified to cover these four areas. To satisfy the term “proficiency” in the ABET criteria, civil engineering programs often require their undergraduate
students to take at least two courses in each of the broad areas. This leaves fewer
hours for technical elective in the program.

The combination of the reduced credit hours in the curriculum and ABET’s program
specific criteria offer an interesting challenge to the department that offer wood
design courses. The low credit hour requirement for earning a bachelor’s degree
essentially requires students to pursue a master’s degree upon graduation in order to
receive the necessary level of training to be successful in their professional career.
This is particularly true for civil engineering graduates who clearly recognize the
need for a master’s level degree to advance in their professional career. Given this
situation, the departments could offer a dual level—senior and graduate level—course
in wood design that can attract both undergraduate (seniors) and graduate students.
What is important is that all students graduating with a degree in Civil or Structural
Engineering degree should be exposed to at least one course in wood design as
emphasized in recent articles by practicing engineers (Barnes 2004 and Huang 2004).

Decline in research funding

Research funding in the wood engineering area has been declining steadily over the
past two decades. Very few departments in the country can boast of having an active
and vibrant research program in the wood engineering area. Without sustained
research funding it is difficult to support graduate students who become the next
generation researchers and educators in the field. In structural engineering faculty
searches it is almost impossible to find even a single applicant out of a hundred who
has done his doctoral work in the wood engineering area. This is very disturbing and
clear evidence of the impact of the low level of research activity in the field of wood
engineering. The industry needs to view this situation as a clarion call to move
aggressively to reverse the decline in research funding that is critical to producing the
next generation of qualified researchers and educators in the field.

To a large extent, the decline in wood engineering instruction across the country can
be attributed to the absence of an acceptable level of research activity in the wood
engineering field. Unfortunately, the proprietary nature of the products marketed by
the wood products industry has led them to do most of their research in house and
fund only limited amounts of research at universities. Young faculty members who
are under pressure to generate research funding and publish cannot afford to devote
their time and effort to an area that offers no prospects of research support. It is not
surprising that junior faculty at most of our nation’s premier universities have little or
no involvement in wood engineering instruction. The wood products industry needs
to engage other industries—such as homebuilders and construction industries—and
national laboratories to address this critical research funding need.

Coordinated Industry Support for Training of Wood Engineering Educators

The wood products industry needs to make a serious commitment to support the
training of wood engineering educators if there were to be a chance for wood
engineering instruction to survive in the engineering curricula in the future. The concrete and steel industries have been very proactive in training educators in designing with their materials. In particular, the steel industry has the most effective educator training programs in the nation.

Although several wood industry organizations offer numerous continuing education courses in wood design to practicing engineers, there is no effort by the industry to train future wood educators. This is in contrast to the steel and concrete industries, which offer summer institutes to university faculty in steel and concrete design. This partially explains why eighty percent of the Civil Engineering programs offer steel and concrete design as required courses. The masonry industry also offers summer institutes to university faculty and is trying to make inroads into the curricula. The last summer institute on wood engineering was offered in 1988 (Keith Faherty, Professor Emeritus, Marquette University – Personal Communication). Following this institute, 19 of the 26 participating faculty either began or continued to offer a course in wood design at their institutions. Prior to the institute, only 9 out of the 26 participants were involved in teaching a wood design course. Clearly, the summer institute did help the growth of wood engineering instruction. A yearly summer institute in wood engineering for university faculty must be supported and encouraged by the industry to strengthen the wood education instructional program in the Civil Engineering curricula.

In an effort to provide teaching material to university professors, a teaching tool package containing technical literature, a variety of teaching aids including slide, product samples, etc., was put together with the support of the wood products industry and sent to numerous universities. This activity occurred from 1990 to 1995. This teaching tools package had a marked influence on the number of wood design courses taught at U.S. universities. It is important to continue supporting, updating and distributing this teaching tools package to universities engaged in wood engineering instruction. The combination of sustained support for summer institutes and teaching tools package will go a long way to ensuring wood engineering education will continue to survive – albeit at a moderate level – in the agricultural, architectural and civil engineering curricula and the wood science program. The following three paragraphs provide an overview of how wood engineering education is being supported in other parts of the world.

Australia, Canada, and Europe have used a unified approach to develop one teaching tool package for their respective regions. The Australian timber industry, recognizing the threat to timber education, has developed a program that provides assistance to lecturers in engineering, architecture, and building construction in Australian universities (Boughton 2002; Boughton and Woodard 1998, Woodard and Boughton 1996)). The program developed a range of resources that are regularly updated and modified. The feedback to date indicates that the program has been successful because it provides good-quality resources tailored to the needs of academics.
The Canadian Wood Council (CWC 2001) has developed a wood education kit to help university and college professors of architecture and engineering teach the essentials of wood products and construction. Each kit is sent to the university professors at no cost.

The Europeans created a Structural Timber Engineering Program (STEP) and produced a timber engineering teaching package to coincide with the introduction of Eurocode 5 (Blass 1996). The STEP teaching package contains written material in the form of 94 lectures (STEP 1 and STEP 2) based on Eurocode 5. The teaching material is designed for use in engineering education in universities. Several other countries (Kohara et al. 2004, Mettem, et al. 2004, Virtanen 2004, Tero, 2004, Murray 2004, Hovde 2004, Zeitter 2004, Sigrist and Brunner 2000, Buchanan and Evans 1988) have also developed various wood design education guides to help meet their specific needs.

**Adjunct Faculty**

In order to offer a wider spectrum of courses without increasing faculty strength, an increasing number of civil engineering and other departments are relying on the use of adjunct faculty members who are generally highly qualified practitioners in the area. While some view this as outsourcing of instructional duties, the departments view it as in sourcing of talent. Often the adjuncts offer courses on a gratis basis or are offered release time by their employers to offer the course at no cost to the university. For example, in the Civil Engineering Department at Oregon State University two elective courses in masonry design and prestressed concrete are taught by adjuncts that are practicing professional engineers. These adjuncts are paid for their effort by their respective employers and offer the courses at no cost to the department. Earlier, wood design was also taught under a similar arrangement for one year in which a consulting engineering firm provided the instructor and support. While the use of adjuncts is a good arrangement, it is heavily dependent on the availability of the adjunct and the funds to support him. Unless a sustained level of funding for adjuncts can be obtained, this arrangement may not be in the best interest of students, Civil Engineering programs and the industry because if outside support is not available for a course in a given year the course may not be taught that year (that was the case for wood design course at Oregon State University for one year). Complete dependence on adjuncts to teach wood design courses can be minimized if the industry takes an active role in training of faculty and providing teaching tools packages. The industry can also assist the departments in identifying suitable adjuncts and securing support for these adjuncts.

**Summary and Conclusions**

An overview of the factors impacting the wood engineering education in the U.S. has been presented. The actions that need to be taken by the engineering departments and the wood products industry to ensure that wood engineering continues to be covered in the engineering programs have been discussed. The authors recommend the
following actions be undertaken by the departments engaged in offering wood engineering instruction and by the nation’s wood products industry:

• Offer at least on course in wood design, if necessary, at dual level (senior and graduate) to attract both undergraduate and graduate students.

• Sponsor and support a yearly summer institute for university faculty to train them in teaching wood design courses in engineering programs, particularly civil engineering programs.

• Develop and maintain a teaching tool package containing a range of resources, and revise and upgrade it periodically.

• Support wood-related research at universities to train future wood educators and researchers.

• Assist departments to recruit suitable adjunct faculty – when needed – to offer wood design courses and secure source of support for the adjuncts.

• Help universities recruit students into wood science programs by providing financial support and competitive salaries upon graduation.

If society is to use wood intelligently, we need a coordinated effort by the industry and the educational institutions to educate and train the next generation of wood engineering researchers and educators.

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