TEACHING TIMBER ENGINEERING

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ABSTRACT: For the future success of timber structures, timber engineering teaching needs to be embedded in the mainstream curriculum for undergraduate students. Course content should be selected for students to gain an essential understanding, with the opportunity for progress to more advanced high level (Masters) courses if the need and opportunity arise. This paper discusses the key issues and proposes teaching content and technique to create a basic understanding of the subject in order to give students sufficient respect for the material, without discouraging them from its use. It outlines the need for Industry input in University teaching and research and discusses the form this should take.

KEYWORDS: Timber Engineering, Teaching

1 INTRODUCTION

Some in the timber engineering industry question why university graduates have limited knowledge in timber engineering. In the UK, university courses provide a relatively short period of full-time education (3 or 4 years) to create an academic base. Professional qualification, through the Institution of Civil Engineers and/or the Institution of Structural Engineers, usually follows after some 4 years of post-graduate, supervised training.

2 THE UNDERGRADUATE COURSE

The academic base for professional design engineers, in the UK, is provided by a “Civil Engineering” Degree. The degree contains a range of subjects including mathematics, the theory of mechanics, materials science, structural engineering and practice (e.g. the background to and use of codes), engineering practice (e.g. management studies), project work and specialist options.

Timber engineering is learnt as part of structural engineering, which itself only accounts for around 15% of the course. Clearly the graduate engineer is unlikely to have gained much specific experience of timber design in their course. But neither are they likely to have achieved much experience in the detail design of steel or concrete. In this context it is important to choose course content carefully.

2.1 PLANTING THE SEED OF TIMBER ENGINEERING

The objective at undergraduate level is to develop analytical and conceptual understanding of structural action through the design of elements and simple structures and to introduce elements of construction technology as applied to timber construction. Structural engineering is much more than sizing members; it is more complex and course content should reflect the need for an overall understanding of the behaviour of timber, embedding sufficient knowledge and skill to enable a graduate to respect the material and yet use it with confidence – knowing when they need to call for specialist advice.

2.2 COURSE CONTENT

Failure of structures often relates to issues not dealt with in codes. [1] gives the following as the commonest causes of failure:

- Bracing to avoid instability problems both in the finished structure and during construction;
- Situations with risk for perpendicular to grain failure (orthotropy);
- Consideration of moisture effects (shrinking and swelling);
- Design of joints. Fire safety and communication in design and building team are also important.

Table 1 shows how course content might give intuitive understanding of behaviour, with the structure of wood as a first step and fire and durability being included at the end, to reinforce their importance. Sizing techniques need to be included to demonstrate how codes incorporate methods to respond to moisture and load duration.

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Table 1: Course Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Origins</td>
<td>Wood Structure; Species; Supply</td>
</tr>
<tr>
<td>2. Code Basis</td>
<td>Action combination; Design values</td>
</tr>
<tr>
<td>3. Properties</td>
<td>Grading; Strength classes; Moisture content; Load duration; Specification</td>
</tr>
<tr>
<td>4. Member sizing</td>
<td>Flexural, Compression, Tension members</td>
</tr>
<tr>
<td>5. Connections</td>
<td>Connections; European Yield Model; Nails; Screws; Bolts</td>
</tr>
<tr>
<td>6. Wood products</td>
<td>Glulam; LVL, CLT, Plywood, + products</td>
</tr>
<tr>
<td>7. Long life</td>
<td>Fire, Durability</td>
</tr>
</tbody>
</table>

2.3 PROJECTS

Structural design is a complex, non-linear process. To enable students to understand they need to work on projects throughout their course. Students need to see and experience precedents and, from the very start, learn approximate solution methods. This gives them a chance to pick up complex design skills and, as the course develops, makes sense of the structural and material behaviour. Ideally, the course should include a design and make element but class size can preclude this at undergraduate level.

2.4 TEACHING AIDS: E-LEARNING

E-Learning offers new opportunities, through interactive examples, for students to reinforce what they learn in lectures and projects. This paper introduces methods currently in development in the department at Bath.

2.5 INDUSTRY CONTRIBUTION

At undergraduate level, industry can enable practitioners to contribute by teaching about real projects and real methods. Industry can give students the opportunity to visit sites and factories as well as give direct work experience in placements, for a summer or for a whole year. As engineers develop their career, Industry should enable them to build specialist skills, by supporting Masters courses and other forms of post-graduate learning. Knowledge Transfer Partnerships [2] can embed and develop specialist knowledge and skill in businesses. In addition, by supporting PhD research, Industry supports development of timber engineering expertise in Universities.

2.6 SITE VISITS

Timber Engineering teaching is not always near to readily available project examples. Industry input in preparing case studies is very important. Content of Case Studies is discussed in the paper.

3 TRAINING POST GRADUATION

Specialist timber engineers often wish to recruit engineers experienced in timber design but they will not find this in a typical graduate. For the reasons given above, a graduate from a general Civil Engineering course is unlikely to have had more than a few days of actual design in timber at University.

It is clear that the graduate engineer is unlikely to have gained much specific experience of timber design in their course. But neither are they likely to have achieved much experience in the detail design of steel or concrete either.

3.1 ADVANCED COURSES

To provide higher levels of expertise, Masters Courses are essential in ensuring that specialist knowledge is embedded in industry.

The paper discusses the content that might be included in a Masters Course, to extend and reinforce the content of the Undergraduate course.

4 CONCLUSIONS

Structural Engineering is about creating real buildings and successful engineers – those who enjoy their work and design buildings to be proud of – are strongly connected to the reality of the construction process. If the timber industry is to embed a basic understanding of use of timber in students, what is needed is its investment, of money (in supporting students), time (in teaching and tutoring) and access to projects, to demonstrate the practical potential for timber use.

All these forms of support have proved effective at the University of Bath, where teaching an introduction to timber engineering to undergraduates, provides support to students in their project work. A strong research group, specializing in timber engineering, provides opportunity for more advanced teaching and graduating masters and PhD students can take specialist knowledge into Industry.

REFERENCES