

Case study: enhancing the learning of structural concepts through using a website and Blackboard

The Seeing and touching structural concepts website was developed in 2006 (www.structuralconcepts.org) and has been used since then in conjunction with Blackboard as a student-centred learning resource for enhancing student understanding of structural concepts through physical model demonstrations and practical examples to supplement current class learning. After studying the contents of the website, students are required to undertake individual pieces of coursework either making/showing a physical model to demonstrate one structural concept or identifying a practical example in which one concept was used in a creative way. The combined coursework submissions form a further resource which is made available to all students allowing them to learn from each other. The feedback from students has been very encouraging. The website may be used by students and lecturers in civil engineering and architecture.

1. Background

Structural concepts are key elements for students to understand, for lecturers to teach and for engineers to use in civil and structural engineering practice. The teaching of structural concepts at university needs to be enhanced to meet changes and challenges in our current learning environment and in the world of work.

In order to improve students' understanding of structural concepts and to deliver lectures more effectively, we have been developing what we have called *seeing and touching structural concepts* to supplement traditional class teaching and learning since 1999. To enable this, three parallel themes have been followed:

- providing a series of simple demonstration models to illustrate structural concepts in conventional class teaching which allow students to gain a better understanding of the concepts
- providing associated engineering examples to demonstrate the application of the structural concepts which help to bridge the gap between the students' knowledge and practice
- converting appropriate research output, which particularly involves structural concepts, into teaching material to improve existing course contents.

We have developed a number of physical models for illustrating structural concepts and identified a number of engineering cases and everyday life examples for illustrating the applications of these concepts. These models and examples are normally not included in textbooks but are useful to supplement learning and teaching. Students can quickly grasp and remember a concept when it is physically demonstrated and its application is illustrated.

As only a limited number of students and engineers will actually see and touch the models developed and receive our lectures a website, *Seeing and touching structural concepts* (www.structuralconcepts.org), was developed in April 2006 and updated in 2008. The website now contains 19 chapters, including 57 sections of model demonstrations (some of the models were made by students), 66 sections of practical examples and 12 video clips. A section of references for each chapter is also added. The homepage of the website is shown in Figure 1.

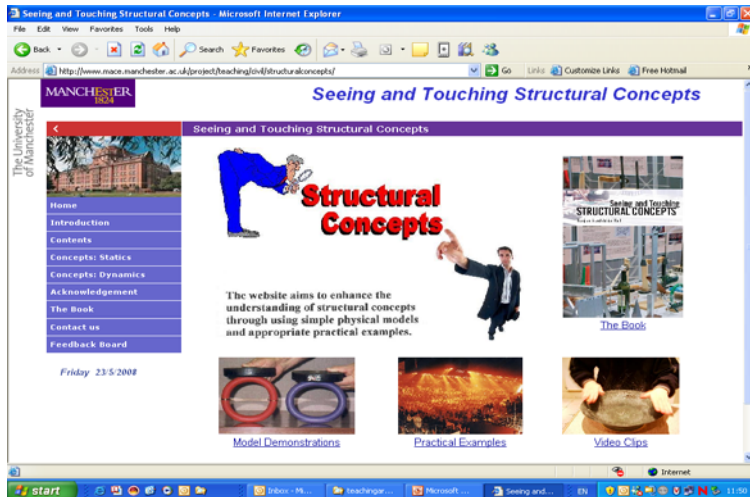


Figure 1. The homepage of the website

2. Structure and contents of the study

The content of the website supplements current class teaching and can be used in different ways. What is reported here is how students at the University of Manchester may effectively and systematically learn and revise many structural concepts through the website. This use of the website is based on the following assumptions:

- students have been taught structural concepts through several course units during the previous two years
- students have different levels of understanding of structural concepts
- students know little of the application of structural concepts in practice.

We have developed a personalised way for students to gain an enhanced understanding of structural concepts through using the website and Blackboard. This activity, *enhancing the understanding of structural concepts*, has been introduced and requires four lecture hours to facilitate and guide study. The contents of the four one-hour teaching periods are as follows:

1. Lecture 1, *Why and how to study structural concepts?* gives students a global view of studying and understanding structural concepts
2. Lecture 2, *Concepts for designing stiffer structures*, shows how textbook contents link with engineering practice and how structural concepts can effectively be used to deal with practical engineering problems. (The practical examples used are given in the website.)
3. Lecture 3 explains and assigns the individual coursework to students and demonstrates good coursework examples produced by previous students
4. Lecture 4 is given at the end of course unit to summarise the coursework submissions and give the prizes to the best three pieces of coursework as voted by the students.

Students are required to learn from the website at their own pace in conjunction with the assignment of the individual piece of coursework. They are asked to design/show a physical model that demonstrates one structural concept or identify an example from engineering practice or everyday life where a structural concept has been used creatively. As a guide rather than as a limitation, students are asked to submit a two-A4-page piece of coursework on a template designed by a previous student - allowing them to focus on the quality of the contents. We have found that students have been stimulated by the coursework which was individual in nature.

All the coursework submissions are made through Blackboard. They are edited slightly for consistency of format and compiled into a single directory or file. This is compiled into a booklet, effectively written by the students and is 'published' through Blackboard so that students can learn from the work of each other and further improve their understanding of structural concepts. Figure 2 shows the covers of the booklets for the 2008 and 2009 submissions, which were voluntarily designed by the students attending the course unit. This piece of work has been undertaken by our third year Civil Engineering undergraduates since 2006 and by our MSc students in Structural Engineering and Mechanical Engineering since 2008, with improvements made every year.



Figure 2. The covers of the booklets for 2008 and 2009 submissions

3. Feedback

Feedback has been collected through questionnaires on the website and questionnaires on the coursework between 2006 and 2008. The feedback from our students has been very encouraging. Two examples of student comments are:
It is a very good website for improving the understanding of structural concepts, as it has many good models and practical examples with demonstrations and specific descriptions, which make the concepts easier to understand. This website makes me realise the importance of structural concepts and provides useful materials for my current and further study. I really appreciated it.

I feel this was a very worthwhile coursework exercise. I felt engaged due to the fact that I actually decided what topic and concept I was going to develop. It was an active learning process which was far more valuable than solving a numerical question as I could relate the theory to a real life structure.

Feedback has also allowed us to improve the quality of the website and the coursework. For example, video submissions were introduced this year. Furthermore,

the booklet has evolved from hard copy, to a Blackboard presentation, to a single PDF file which students can download.

One interesting observation is that the number of coursework submissions has been larger than the number of students in the class, indicating that some students were enthused to make double submissions!

4. How can other academics reproduce this?

The website is in the public domain and can be reached through www.structuralconcepts.org. One of the ways to use the website has been illustrated above. Academic staff may directly use this method or improve it further. It may be relatively easily incorporated into related course units and students may study and work at their own pace using the website.

Academic staff may also download related photos of models and examples from the website to assist their current teaching and/or direct their students to study particular chapters in the website associated with their class teaching to help students to gain an enhanced understanding of structural concepts.

5. Benefits

The website provides contents which are not normally available collectively in textbooks and this may supplement current teaching and learning. Students may benefit from seeing many physical models and real examples which help to improve their understanding of structural concepts and motivate their interest in studying structures. Lecturers may benefit from the resources available to help their teaching.

6. Reflections and further development

After reading through coursework submissions, we felt that the individual submissions have been interesting and varied and have included some really creative components. The coursework has been revised and improved on the basis of previous submissions in the years 2007 and 2008. It was hoped that the coursework would encourage students to:

- consider and explain structural concepts in a simple manner
- look for examples in everyday life motivating further study
- develop a greater understanding and awareness of structural concepts.

We believe that this has proved to be the case. For further and continued development of the website we plan to add more models, examples and video clips.

7. References

Ji, T. and Bell, A. (2008) *Seeing and touching structural concepts*. Available online at www.structuralconcepts.org. [Accessed 19 May 2009].

The Standing Committee on Structural Safety (1999) *Structural safety 1997-1999: review and recommendations, the twelfth report of SCOSS*.

Background information

Discipline	<i>Civil Engineering; Structures</i>
Participants	<i>80 students and one lecturer in 2009.</i>
Level	<i>Third year. It can also be used for the second year or MSc.</i>
Pedagogical approach	<i>Personalised learning or student centred learning based on an available website resource.</i>
Teaching methods	<i>Three one-hour lectures are given to explain the study and coursework, which stimulate students' interest. Students then study the contents through a given website by themselves and complete individual pieces of coursework. The fourth one-hour lecture summarises the coursework submitted by the students.</i>
Materials required	<i>A web-resource provided.</i>
Assessment used	<i>Coursework is marked by the lecturer. Students vote for the best three pieces of coursework among the collection of all the submissions.</i>
Contact Details	
Author(s)	<i>Tianjian Ji, 0161-3064604, Tianjian.ji@manchester.ac.uk Adrian Bell, 0161-3064593, Adrian.bell@manchester.ac.uk</i>
Date	May 2009