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Quality Awareness in Education Practice

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What is new in education?

The objects to be touched and the objectives to be achieved by universities in the education of structural engineers are subject to growth and change. As a consequence a selection of subjects to be taught and a diversification based on future career profiles has to be made. This is not an easy task as objects for education reach from certain aspects from social systems to basic material characteristics. And the objective aims at the development of an attitude as a professional civilian as well as to an engineer who understands basic physical phenomena. Just in the middle of these extremes are the knowledge and certain abilities to design simple technical systems out of components being dealt with in codes and rules. Although this is the area of certification in professional practice, real quality is only added by basic understanding and a certain attitude towards a wider scope.

How to select from more for teaching?

A first selection can be made by considering three categories of careers when planning an education system. First, the non structural engineer, like traffic engineers and sanitary engineers, who will delegate structural engineering to others. Second the structural designer, trained for technical responsibility and engineering management and third, the specialist to work in research or for dealing with specific detailed problems of structures.

The next point for selection is the awareness of strength and weaknesses of present engineers as established in several studies, like the one referred to, named: 'The profile of the structural engineer in the nineties', issued in The Netherlands in 1989. Use of mathematical models and capabilities for analysis is considered as good, but the ability to select and interpret information, engineering judgment and knowledge and abilities in design methodology, are considered as a threatening weakness.

The paper explains by an example the relative value of technology embedded in codes. It refers to a Swiss experiment where 32 designers had to detail the same structure with the same code, which resulted in a wide range of solutions. This supports, that knowledge of codes should only be instructed in order to train students by executing cases in which code-checking forms part of the process of course.

A last point of attention when selecting for a curriculum are the secondary mechanisms in certain subjects that develop structural feeling. Sketching classic structures and analyzing structures by influence lines or hardy Cross Method did contribute to spatial consciousness and imagination of force distribution through structures. These secondary teaching effects are often lost because the primary cognitive meaning of these exercises is abandoned because it got out of date.

Educational experiments

An experiment in Delft is described where students were asked to adopt the principles of Quality Assurance in a case study. It was hard in the beginning, as the QA attitude of self control is completely different from classic teaching, where work is always corrected and approved by the teacher. The results improved in later years by specific teaching.
An other experiment describes the use of an intelligent CAD system for a case where students design a simple reinforced concrete building. The program has two levels of code checking. In first instance the sizes of concrete members selected by the students for beams, columns and slabs are checked against the Dutch code for under-reinforcement, over-reinforcement and potential economy. In a second check, the reinforcement as detailed and put into the system is checked against the Dutch code and commented.
This system is now in use for 9 years and over a 1200 students went through. It shows that IT systems can be used for a simple quality check in education, without substantial interference of staff. Some new problems are however introduced, like a trial and error approach towards the design and the hard yes or no judgment of the computer system. Efforts to extend the system internationally based on EURO-Codes failed because of the lack of interest in the university world being dominated by research and not by tools for productivity increase. For the same reason it was not possible to develop and implement a module to perform parameterstudies in the program for optimizing sizes of concrete members based on costs.

Research being carried out in Delft on different computer aided learning systems concludes that development of CAL-systems is rather difficult. It involves a level of teamwork and inter-discipline interaction as very unusual in academic circles. Apart from that thorough preparation and evaluation of implementation has to be performed in order to get a self learning system in an area where hardly any experience exists. Because of the high costs an economic evaluation of these systems has to be performed right from the beginning, as idealism and ambition as required for successful traditional education are not sufficient.

Conclusions

Conscious selection of objects and objectives in education of structural engineers is required and should be based on a future differentiation in career, on actual observed weaknesses, on the relative importance of factual knowledge and on implicit and explicit course contributions towards the development of structural feeling.
An audit on the quality of education in structural engineering could use these issues as a guideline.
CAE systems being used today are not at all integrated in overall design systems. Many things have to be learned about processes, the role of information and human action. This should reflect in education schemes.
It is hard to predict what structural engineering students should actually be taught in detail. It can however be certain that the complex process of teaching engineering judgment based on reference and the analytical approach of teaching to go through rational processes have both to be practiced.
The quality of education in structural design needs more attention and international collaboration.

References

A list of 11 references supports and completes what has been stated in the paper.