

Simply a Matter of Education and Training?

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Introduction

The construction sector is going through a period of significant change. The power of technology, the drive for improved efficiency and the increasing use of partnership projects will fundamentally affect structural engineers. This will be in terms of how they undertake design and how they interact with members of the project team.

How are we going to embrace the new technologies required to implement these increased efficiencies? Will they be seen as opportunities and challenges or threats?

In order to move forward, we all have a responsibility to look and learn. There are two steps involved in this learning process:-

- **education**, gaining understanding of what the issues are and why they need to be considered, in order to be able to make informed judgements
- **training**, gaining the necessary skills in calculation and use of design tools

If we as an industry are going to move forward effectively and efficiently, there are three key areas where there is a desperate need for both education and training:-

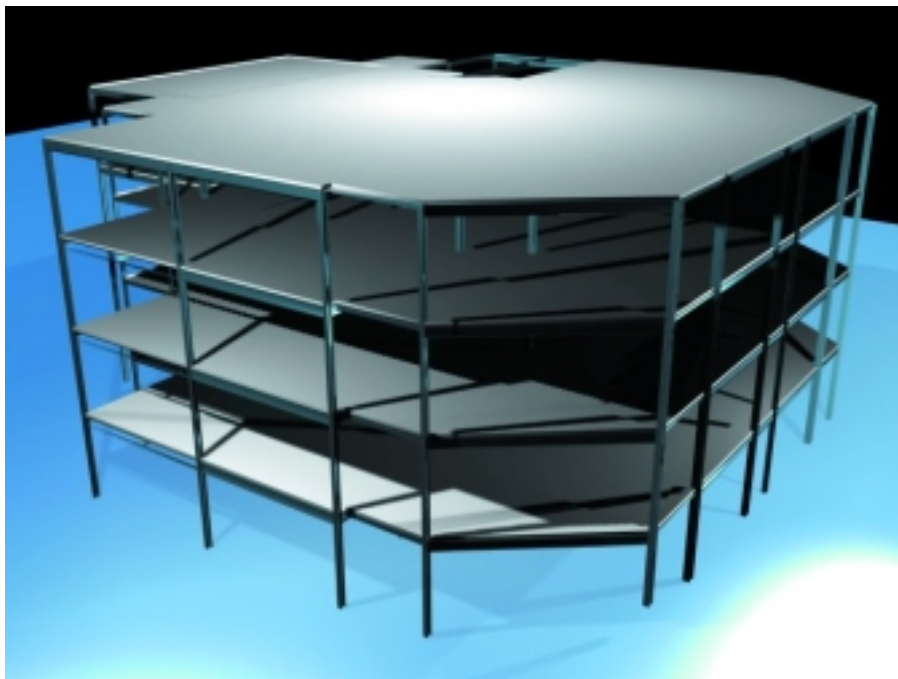
- **Modelling in 3D** – in time, the model will become a central component to true multi-disciplinary team working. This will bring about the sharing of a single building model – how many understand the real implications of working in this way?
- **Design codes** are building evermore on advances in global knowledge. As a result, the designer needs a deeper understanding of more complex behaviour.
- **Design tools** - more and more evidence indicates that engineers are relying on the tools to replace understanding - this is dangerous.

There are some shining examples today of organisations who are looking ahead and recognising the need for both education and training. Are they going to be tomorrow's winners? Who knows? One thing is certain - they are placing themselves very confidently on the starting blocks.

Modelling in 3D

The solution of the future is the Single Building Model - a model in which the design intent of many disciplines is held, a model that communicates between the whole project team.

Many organisations are already beginning to work with some of the key components of what will, over time, become the Single Building Model. They are working with 3D architectural models, 3D structural models and 3D HVAC models. There is a level of communication between these disciplines and their models. There is also a level of communication down the construction chain, for instance, from designer to steelwork contractor. This latter link has worked successfully where the engineer has taken full responsibility for the setting out the model.



Picture 1 – CSC Trng 1.JPG – A 3D Structural Model Created in 3D+

There are a number of organisations successfully leading in this way of working, for example Whitby Bird, Ove Arup and O'Roake-Laing. They tend to be the innovators, the leading 5%, who

will always trial new technology as soon as it becomes available, understand its capabilities and limitations and find ways to make it work for them.

This innovator phase has been going on for at least the last five years. It is now time for the mainstream to start incorporating 3D modelling technology in their everyday working practices.

Typically, in an organisation, the younger staff are those that are IT literate and the older staff are those with real engineering experience and knowledge of the requirements of management and quality.

This has produced a resistance to the adoption of 3D modelling in some organisations and caused problems with the take up in others. The more senior engineers need education to raise their understanding in 3D modelling so that they can put in place the required processes for management and quality. At the same time, younger engineers need to be trained in the use of the design tools now available permitting 3D modelling.

Advancing Design Codes

In the next couple of years, Euro codes will be published in their final form as full EN documents. There will then be a period when parallel use of National codes and Euro codes will be permitted. In about 8-10 years, it is intended that the National codes will be withdrawn and Euro codes will become mandatory.

Possibly the biggest shock that UK engineers will have in the Euro code is that the use of second-order order analysis is the norm for all building structures, whilst the use of first-order analysis is only by exception. This is the complete reverse of what we do now. It requires a large step in understanding both the theory and the available design tools. Within the next 5 years or so all UK engineers will have to embrace this change.

In a recent series of UK seminars provided by CSC (UK) Ltd, all delegates were asked if they had any practical experience of second-order analysis. Out of a total of 250 attendees, just one

Steelwork contractors buy large pieces of plant in a strategic manner. Due to the massive investment required, they need to minimise the time before a return is made.

When investing large sums in a new piece of equipment, the steelwork contractor recognises there will be a learning curve within the organisation to integrate it fully into working practices. To succeed, he knows that he has to invest heavily in the training of managers and operators. He recognises the need to set up new processes that allow information to arrive at the new equipment, in an appropriate manner. Only in this way can he reap the benefits of his investment.

As a result of this wider perspective to the purchase of machinery, steelwork contractors generally adopt a strategic approach to the purchase of design tools. They are more likely to invest in training, to trial design tools in parallel projects, and to allow for learning curves within project time scales. They recognise that this is essential in order to make the most of the design tool that they have purchased.

The consulting engineer, however, with a slowly growing number of exceptions, still justifies the purchase of design tools “on the back of a job”. The fees for the job justify the purchase. The expectation is that the tool will respond to the, often short, deadlines associated with project work. This is typically done with no formal training.

This approach of adopting a tool with no training and expecting it to perform instantly can be likened to giving of a set of keys for a brand new Ferrari to a 14 year old who has never driven previously. Then asking them to drive 200 miles in the next three hours.



Picture 3 – CSC Trng 3.JPG – Would you place this at risk ?

We need to think strategically and for the medium term when making investments in new tools of any sort. The whole decision to purchase should include a full appreciation of the tool, the necessary training, the learning curve and the setting up of new management and working practices, in order to bring the real benefits in the minimum time scale.

Some examples of good practice

Whitby Bird and Partners, an organisation with a solid reputation for embracing new technology, acknowledged that the use of engineering software design tools had become a daily activity for their design engineers.

As a result, they have now implemented a structured training programme for their engineers. As the provider of some of their design tools, CSC is heavily involved in this programme. Whitby Bird have adapted course syllabus to ensure coverage of the complex structural problems that they regularly solve, and they target the course content to reflect the engineer's experience of the design tool.

Whitby Bird and Partners have taken this one step further, in order to ensure that training is productive; they are implementing a continuous programme of post-course assessment to verify that the training is providing the anticipated benefits. Early indications show that the training is very worthwhile.

Elland Steel Structures Ltd, a medium sized steelwork contractor, has recently completed a "self education" process for each engineer. The advent of the amended BS5950-1:2000 has raised awareness in the industry to assess structures rigorously for sway. This in turn has introduced both second order, P-delta, analysis and the potential for considering buckling analysis. Elland Steel realised the benefit to themselves of fully understanding these techniques.

Elland Steel set about the task by organising in-house training courses run by the SCI and their design tool supplier, CSC. They did this specifically to explore and understand in detail the necessary engineering theory and to optimise the use of their design tools.

In the complex area of second order analysis, buckling analysis and λ_{crit} , Elland Steel recognised one of the key requirements was to spend time benchmarking the new 3D analysis results against those from the traditional 2D approach to structural design.

Conclusion

In the latest SCOSS report, published in June 2001, there was a recognition of the need for personal responsibility and thus the need for personal development. At the core of this is the need for education to give understanding, and training to provide the skill set.

Many areas of working practice are changing dramatically. In order for the industry to meet these challenges, education and training are essential. It is not just about training the operator. A holistic approach to training both management and user is essential. It needs to involve increasing understanding, and raising skill levels.

In many respects, this is a management issue. It is not simply a question of spending money on training courses. It is more about understanding what you can and want to do, identifying the tools for doing it, putting in the management processes and increasing the skills of your people.

A master craftsman uses tools that anyone could use. The essential difference that turns a craftsman into a master is a deep understanding of his trade and thorough training and practice in the use of the tools of the trade.

If education raises awareness, knowledge and understanding, and training increases competence, then these two are the essential components of success.