

Post-Graduate Training Course

'Understanding Structural Behaviour'

**Organised for the
Institution of Structural Engineers, 2006**

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Preamble

Until these public courses started in 2006, the course was run in-house for many of the leading firms of structural engineers; Arup, Buro Happold, Atkins others in the UK and all the major firms in Denmark.

The first public course was held in London in February and the success of that course has led to a further five courses including those in July and September.

To date in 2006, 80 delegates have attended the course, the majority being recently qualified graduates preparing for chartered membership of a professional organisation.

What is the purpose of the course?

The structural engineering design office has seen a complete change in a very short period of time, from a process dominated by hand calculations and drawings only 20 years ago to the modern office with a computer on each desk and the adoption of three-dimension modelling for the exchange of data files.

These techniques provide design opportunities for exciting and radically new styles of construction, but they raise an important issue at the same time; how are the skills of structural modelling, hard won by designers before computers existed, to be transferred to the new generation of young engineers in training?

Structural Modelling

Whereas the focus of the structural designer 20 years ago was to find a mathematical model for analysis and design, the computer has replaced those numerical skills to allow the structural engineer to focus on the modelling process; from the real structure to the computer model.

The skills required for that process are not easily defined; a complex mix of experience, structural theory and most of all, an understanding of structural behaviour.

Young engineers must be convinced that they need that understanding, independent of the computer, to allow them to judge the validity of the stages of structural modelling and the

ultimate safety of the design to be built and that starts with an understanding of structural behaviour.

Results from the Course

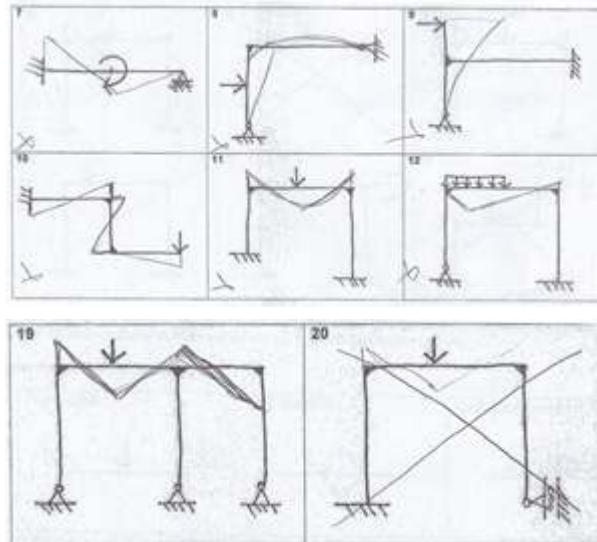
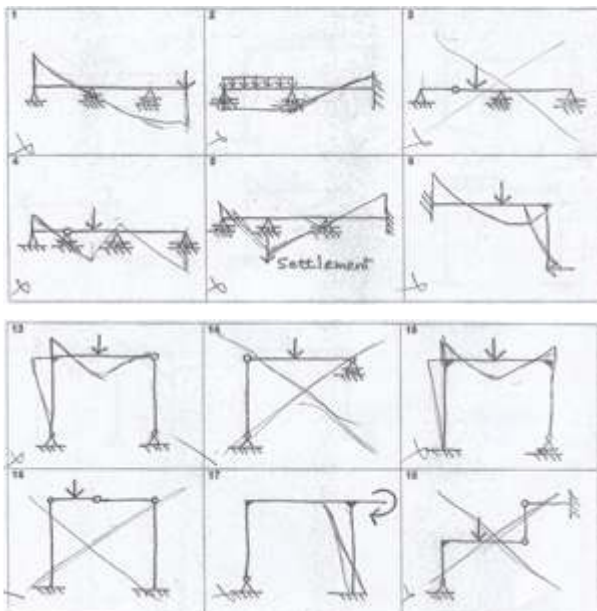
At the start of the course, each delegate is given a diagnostic test of their structural understanding.

This deceptively difficult test has been used for over 30 years, since the course was first developed for the Arup Partnership and requires the bending moment for a range of two-dimensional frames.

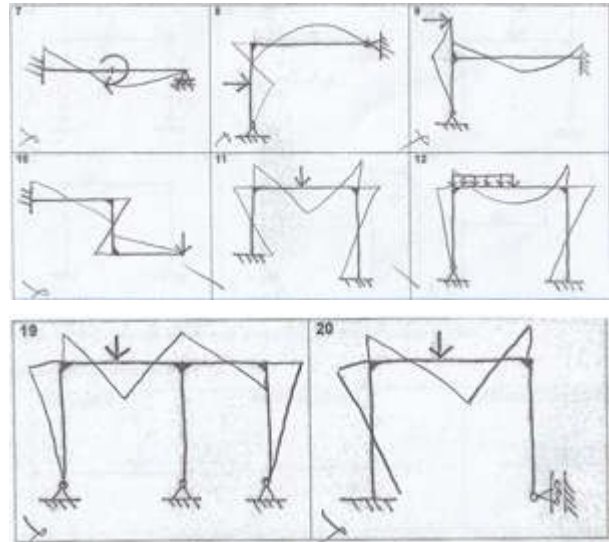
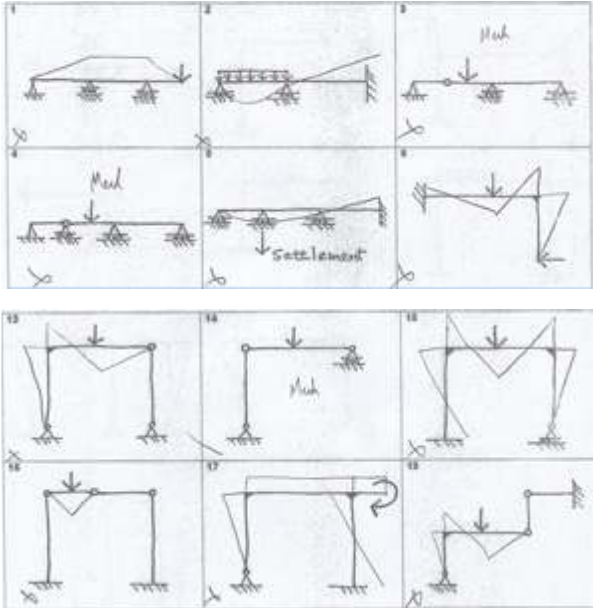
Over that period, the performance of the delegates has worsened to the point where the mean score is less than 20% and a range from 0% to 60%. At a time when major structural failures are regularly reported and many errors in design submissions to the checking authorities are evident, there is a risk that young engineers will use the computer as an **alternative** to understanding the structural behaviour, with potentially serious consequences.

Organisations such as Ramboll in Denmark, with over 4000 staff in offices throughout Scandinavia, now require all newly qualified graduates to attend the 'Understanding Structural Behaviour' course, for example.

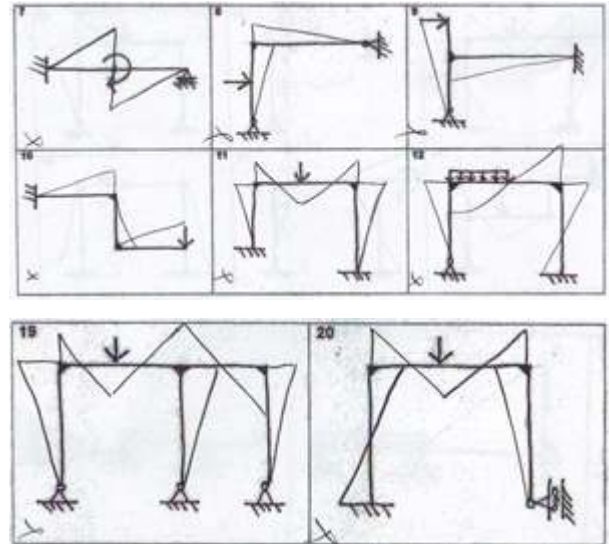
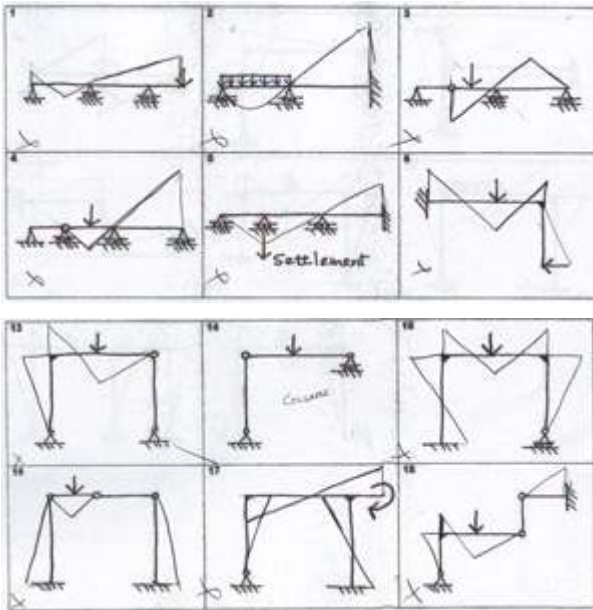
In order to understand the very real confusion which is now generally evident, three results from the test are shown below;



Graduate RAE Grade 5 University
Civil Engineering
2002



**Graduate RAE Grade 5 University
Civil Engineering
2003**



**Graduate/Post-Graduate
Grade 5 University
Civil Engineering
2002**

Review of the Results

These typical examples are included here because the marking could have been unduly harsh. As the results show though, there is a serious deficiency, even to the extent of not being able to solve simple cantilevers like items 6 and 10. Items 11 and 12 are usually correct, despite them being quite complex and it is likely that these are 'examination/textbook' standards which have been drawn from memory.

Objectives of the course

I claim to take the delegates from a point of confusion to a point of clarity in two days and the response questionnaires from them confirm that this is achieved.

An understanding of structural behaviour is like an alphabet and grammar and once learnt, we can then apply it in the two further courses; '*Understanding Structural Design*' and '*Understanding Computer Analysis*'.

Preparation for the Chartered Membership examination of the Institution of Structural Engineers

The combination of the two courses; '*Understanding Structural Behaviour*' and '*Understanding Structural Design*' are an excellent preparation for this examination.

For details of the courses, please see the web site, www.newparadigms.co.uk or contact me.



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