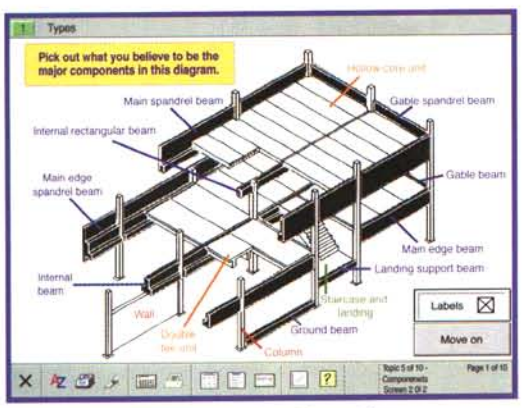
Moulding Young Minds and Changing Attitudes

Fee competition and demands to create structures faster are increasing pressures on young structural engineers. Many do not specify reinforced concrete because they are unaware of the material's potential. John Osborne explains why the reinforced concrete frame lobby believes that new software can help recent graduates and more experienced engineers.



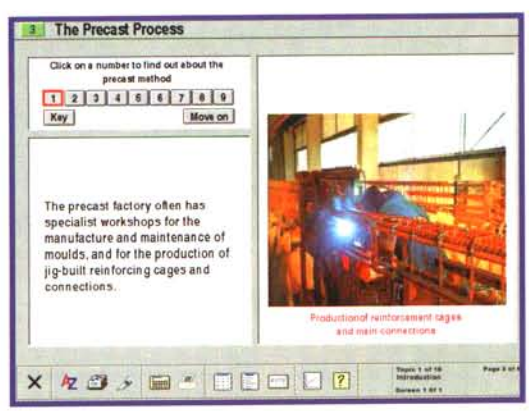
CALcrete is interactive and should provide much needed CPD.

Introduction

In autumn 1999, the Reinforced Concrete Council (RCC) launched two major software suites. Both aim to speed up the concrete design process. The first consists of several programs which commit reinforced concrete design to computer spreadsheet files. These are available on a CD-ROM. The second suite is called CALcrete (Computer Aided Learning in Concrete).

According to Martin Southcott, Project Director, RCC, spreadsheets have particular benefits for the design of concrete structures. In addition to increasing design efficiency, they produce more accurate cost information, provide uniform design documentation and can be a medium for learning and data exchange. Combining design output quantities with current cost rates allows rapid cost optimisation of concrete structures. Such optimisation techniques have the potential to save clients up to 10% of frame costs.

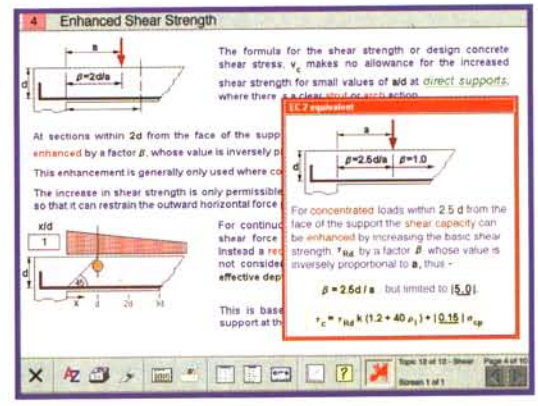
The 26 spreadsheets developed by the RCC are expected to aid the design of reinforced concrete to BS 8110 and include simple element design, flat slab design, simple retaining wall design and sub-frame analysis. An accompanying user guide will give commentary and show worked examples of contemporary design. Some spreadsheets have also been developed to EC2 (ENV 1992) to help ease the transition to Eurocodes.



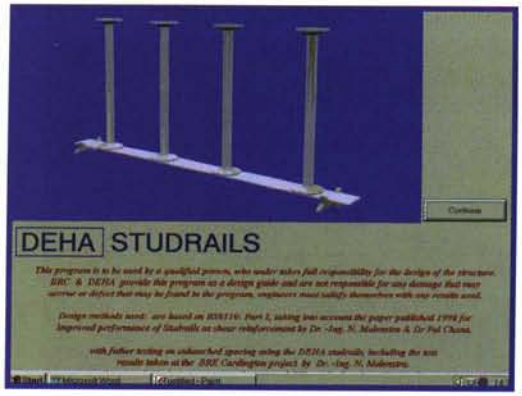
In order to spread the word, the RCC has been presenting the spreadsheets as part of BRC's Reinforcement Innovations '99 roadshow at various venues throughout the United Kingdom. The RCC and BRC, a fabricator and supplier of steel reinforcement and construction products, claim that these have generated much interest.

Michael Fuller of Concrete Connections, which is a specialist products division of BRC, said that several new computer packages have been produced to encourage practising engineers and students to look more favourably at concrete construction. "For many years, steel frame contractors have been represented by the British Constructional Steelwork Association and the Steel Construction Institute", commented Mr Fuller. "But in our industry, we are now beginning to form more new bodies like Construct." Construct is an association of the major concrete frame building contractors. Its members include Byrne Bros, John Doyle, O'Rourke and Swifts. Mr Fuller said that Construct was formed in consultation with the RCC with the objective of encouraging more efficient concrete frame building.

A recent roadshow undertaken by BRC in association with the RCC and CARES (the UK Certification Authority for Reinforcing Steels) showed new innovations in reinforced concrete construction. Included in the roadshow was a demonstration of a program for shear reinforcement as well as the RCC's new spreadsheets.



Roadshows and exhibitions are a powerful way of communicating because practical as well as theoretical issues can be discussed in person.



DEHA Studrails on site and on screen.

However, the educational campaign has demonstrated that information technology can be a powerful communications and sales tool.

"This type of package, using spreadsheets, has not been available in the past", explained Dave Smith, a field sales manager who works for BRC Concrete Connections and who has been actively promoting the new CD-ROM. Mr Smith said that the CD-ROM, which has been produced as part of the RCC's project called Spreadsheets for concrete designed to BS 8110 and EC 2 "gives engineers the ability to easily try out various scenarios of design. They can use BRC's program in the programs by other sections to look at problems like punching shear in concrete structures and sandwich panel design."

Gary Nice, a sales engineer, is one of Mr Smith's colleagues. He wrote the program which shows how to design with studrails. Studrail is the name of BRC's system for punching shear which is produced by DEHA Ankersysteme of Germany. According to Mr Smith when the program was launched, engineers "thought it was easy to use and therefore specified the Studrail system. Now that it is included on the CD-ROM, we expect the awareness of the product to grow."

One reason for the success of this project is that it is providing much needed design guidance. Another is that the project's authors have exploited the power of spreadsheets and disseminated them in easily accessible electronic form. The following excerpt from the introduction to the project is on the CD-ROM. It explains the attraction of spreadsheets.

"The spreadsheets are intended to follow normal design practice and cater for the design of low to medium-rise multi-storey concrete framed buildings.

Over a number of years, the Reinforced Concrete Council has developed spreadsheets to produce cost-optimised span/depth charts[1]. It was recognised that the spreadsheets could prove to be a very useful tool for all designers – equally useful to the single practitioner, larger organisations and educational establishments. Thus in 1996, a project was set up to commit reinforced concrete design to computer spreadsheet files. The project was jointly funded by the RCC and the Department of the Environment, Transport and the Regions (DETR) under its Partners in Technology scheme. It was made possible by the support and contributions of time given by individual members of industry. The project was managed by the Reinforced Concrete Council and guided by an 80-strong Advisory Group of interested parties, including consulting engineers and software houses.

Recent project undertaken by Bison Structures.

New programs should encourage more concrete frame construction.

The spreadsheets were to be issued with publications covering their use, complete with model designs and commentary. Two issues were originally envisaged: one to BS 8110: Part 1, 1997, Structural use of concrete[2], and one to Eurocode 2, Design of concrete structures, Part 1[3].

Owing to current uncertainties with the final detailed content of EC 2, the number of spreadsheets to the current ENV has been curtailed. Nonetheless, it has been possible to maintain a comprehensive coverage and present the spreadsheets to EC 2 with those to BS 8110 in this single-volume user guide.

The design of concrete structures has been described as time consuming and costly. Computer programs are used extensively, but designers are often reluctant to rely on 'black box' technology over which they have little knowledge or control. Computer spreadsheets, on the other hand, are user-friendly, completely transparent and very powerful, and are becoming increasingly popular in all aspects of engineering. They have powerful graphical presentation facilities and established links with other software, notably word processors. In structural engineering, they suit concrete design ideally, in that they can carry out a series of mathematical calculations and, as in design, can check whether certain conditions are met. They are an ideal medium to deal with the intricacies of concrete design.

And this is where it is hoped the publication and spreadsheets will help students and inexperienced engineers grasp an understanding of reinforced concrete design. For the experienced engineer, spreadsheets allow the rapid production of clear and accurate design calculations. It is hoped that the spreadsheets will allow younger users to understand concrete design and help them to gain experience by studying their own 'what if' scenarios. The individual user should be able to answer their own questions by chasing through the cells to understand the logic used. Cells within each spreadsheet can be interrogated, formulae checked and values traced.

In producing the spreadsheets, several issues have had to be addressed. Firstly, which spreadsheet package should be used? Excel appeared to hold about 70% of the market amongst structural engineers and was thus adopted. More specifically, Excel '97 was adopted as being de facto the most widely available spreadsheet in the field. To avoid complications, it was decided not to produce corresponding versions using other spreadsheet packages."

A Brighter Future for Reinforced Concrete

Despite major efficiency gains and bold current initiatives, reinforced concrete supply, design and construction must embrace information technology and research and development to unlock further gains, believes Martin Southcott, Project Director of the Reinforced Concrete Council.

A major obstacle for the concrete industry's adoption of advanced technology is the range of incompatible software that has prevented information sharing among the members of the supply chain. To date, many senior managers have been reluctant to champion a technology whose strategic importance they have yet to recognise fully. In contrast, the structural steel industry has just completed a ten-year, £30 million pan-European project to integrate design and fabrication through the use of a common data format encouraging the development of semi-automated design. This is now being used on real jobs and is starting to affect the choice of material through ease of design, software availability and cost savings.

The good news is that much of the hard work has been done to allow others to follow. Sophisticated design programs are available for adaption; their developers are keen to encompass concrete, and help with data exchange is at hand. The International Alliance for Interoperabillty (IAI) is a client/industry-based organisation which aims to encourage the development of a common data exchange framework. This will allow all construction computer programs to share a single database, typically through a 3D-model.

The model will be 'intelligent'. Objects such as floors, walls and beams will be aware that they are objects and not just lines on a drawing and so will have a complete database associated with them, mirroring the real world. This would allow major gains in productivity by all professionals and processes sharing a single database and 'model' for a building or structure, from concept design, to construction, to use and finally demolition. Importantly, the work necessary to describe data transfer involves examining current supply processes in detail, encouraging a fresh look at what is done now and how the process can be improved.

Each construction sector or 'domain' is being encouraged to set up its own detailed model sub-set to ensure real life is emulated and to gain industry commitment. Major clients, aware of the potential benefits of integrating construction processes into their own business processes, are fully supportive of the IAI. They include BAA, Lloyds and London Underground. The client 'domain' aims to develop a generic reference process model that shows the construction project and the pre-project phases from the client viewpoint.

The RCC is encouraging the reinforced concrete industry's participation in a joint-materials group; the civil and structural domain. This domain has found that despite their differences, there are many similarities and opportunities for collaboration between concrete, timber and steel. IAI aims to overcome traditional commercial differences and concentrate on the opportunities for collaboration. This will significantly reduce the duplication of work and efficiently manage the use of technical resources.

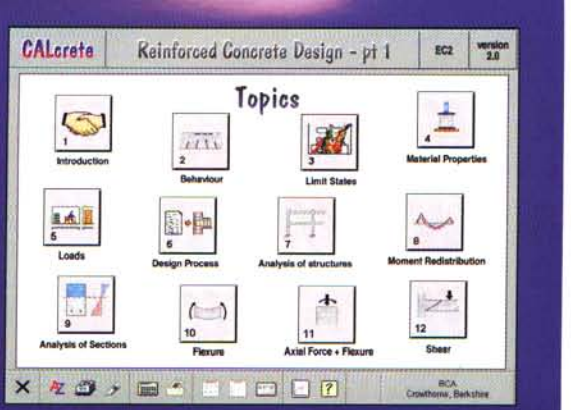
The opportunities for reinforced concrete will be examined at a forthcoming IAI civil/structural domain meeting to be addressed by a speaker from Japan where work on concrete is progressing well. Further speakers will demonstrate what has already been achieved in other sectors and the potential for concrete. The meeting, open to all users of structural materials, will take place at the Institution of Structural Engineers on 30 November 1999 (details from the IAI tel: 0171 636 6951 or the ISE).

This is a key opportunity for all concrete sectors to understand the importance of what is happening and how they must get involved for mutual benefit. If not, the whole industry may be disadvantaged.

Charles Goodchild, the RCC's senior engineer managed the spreadsheets project. He claims that they "cover most of the elements of reinforced concrete structures. This way of displaying information was chosen because of their widespread availability, although engineers are only now beginning to realise the potential of spreadsheets."

According to Mr Goodchild, who is a structural engineer, the project also emphasises that information technology can simplify communication and introduce more uniformity into the design of concrete structures.

"We live in an age of standardisation and rationalisation", pointed out Mr Goodchild. "There has never been a standardised way of designing a concrete beam. For example, there are issues like do you use actual or nominal bar diameters to define 'effective depth'? Hopefully, the spreadsheets will help. In the past, engineers would do calculations by hand. They would take their references from different textbooks and just do what they had done before."



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CALcrete, reinforced concrete design.

According to Mr Goodchild, it might appear that structural engineers only need better guidance when designing more complicated types of elements such as pre or post-tensioned beams.

"At the moment", said "Mr Goodchild "the design of such beams is in the hands of specialists". He believes that may change if more structural engineers could become familiar with pre-stressing and post-tensioning. Mr Goodchild thinks that a CD-ROM which shows the principles of these techniques will help.

"However," said Mr Goodchild, "there is a bigger need for the more usual, non tensioned elements. For instance, designing a flat slab is really quite a daunting task when an engineer has to do it for the first time. Few design examples have been published or been available to guide young engineers. It is quite useful to have a live reference that can be used to do 'what ifs' or produce final calculations."

Mr Goodchild hopes that the CD-ROM will help the concrete industry to get out of the Catch 22 situation which has plagued it for so many years. "People don't have the experience of concrete design. It has become self perpetuating".

It also helps provide much needed continuing professional development. "Currently, nobody has any time for CPD. Besides helping by letting users do their own 'what if' studies, the CD-ROM also helps to increase awareness of the requirements of EC 2."

The reinforced concrete lobby has high hopes for this project. However, it is supplementing it with another major package. CALcrete is the second major piece of software for release in 1999. It is due to be launched in December 1999. This is a suite of 11 modules ranging from materials to design and construction suitable for professional development.

Topics include foundations and retaining walls, reinforced concrete design to BS 8110 and to EC 2, precast and pre-stressed concrete, drawing and detailing, buildability and construction techniques, materials and bridges. CALcrete combines flexible learning with concise presentation using colour, animation, photos, interactive exercises and examples. Modules are available in CD-ROM format and run in Microsoft Windows in a standalone or network environment. CALcrete is a joint venture between the RCC, British Cement Association and Phoenix Systems and the project's authors believe its low cost, high quality and industry relevance will encourage widespread take-up.

The RCC is also using IT to provide more general information about the benefits of designing with reinforced concrete. Its website is currently under construction and is expected to be launched in Spring 2000. Another initiative is the RC-Info disc. The RCC says this CD-ROM provides valuable research, information and educational tool on reinforced concrete design and construction. It contains an interactive library of RCC technical and case study publications, a sophisticated search engine, working and evaluation copies of design software and background information on the RCC, its activities and allied organisations.

RCC-Info was distributed free via the universities to approximately 6500 civil, structural and architectural students during October 1999. It is also available to practising engineers, architects and consultants.

Such initiatives are likely to be welcomed by universities and all those involved in CPD. It will be interesting to assess the effectiveness of these educational campaigns. Many hope it will help promote the message that concrete is the superior structural material.

References

1. GOODCHILD C.H., Economic concrete frame elements, *British Cement Association*, Crowthorne, 1997. 128 pp.
2. BRITISH STANDARDS INSTITUTION. BS 8110: 1997, Structural use of concrete. Part 1. Code of practice for design and construction, *British Standards Institution*, London, 1997.
3. BRITISH STANDARDS INSTITUTION. DD ENV 1992-1-1: 1992. Eurocode 2: Design of concrete structures. Part 1: General rules and rules for buildings. Includes the UK National Application Document. British Standards Institution, London, 1992.

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