

# Innovation & Research



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## Playing to win: managing water in Tanzania

A table-top game and interactive computer model are helping farmers and water planners to share and manage scarce water supplies in the Usangu wetland of Tanzania, in an innovative project co-funded by DFID and the International Water Management Institute (IWMI).

The River Basin Game formed the basis of workshops run by Sokoine University of Agriculture. By taking part in the game, a wooden table-top construction of the river basin, people were encouraged to think about water management and how it impacts on different users in the river basin.

The computer model helps water managers and planners to evaluate the economic and environmental impact of different water management regimes, and their effect on local livelihoods.

Both tools were developed as part of a five-year project called RIPARWIN (Raising Irrigation Productivity And Releasing Water for Intersectoral Needs). The project brought together researchers from the UK's University of East Anglia, Tanzania's Sokoine University and IWMI, who worked with local communities, river basin managers and non-governmental organisations to explore ways to improve water management.

Water management has become a pressing problem in the Usangu River Basin: over the last decade the wetland has shrunk, and the Great Ruaha River – which runs through the region – now dries up completely during the dry season.



(Top) Playing the River Basin Game  
(Above) The Ruaha River during dry season

The scarcity of water has led to conflict among the farmers, cattle-keepers and households who live downstream of the river, and the rice producers who live upstream. The project showed how improved irrigation could help rice producers grow more crop per drop, and so free up water for other users, while canal regulation means that water now reaches downstream users for a longer period during the dry season.

The project also started a dialogue between people living in the river basin who depend on irrigation for their livelihoods, and the River Basin Game was an important tool in this. As a result, Tanzanian policymakers, water managers, and local communities now have a better understanding of the role of irrigation productivity and water management, and of

the importance of saving water while maintaining rice production in the river basin. River basin managers in Africa and Latin America experiencing similar problems are looking at the project to see what they can learn from it.

For further information please contact Bruce Lankford of the University of East Anglia (01603 592897; E-mail: [B.Lankford@uea.ac.uk](mailto:B.Lankford@uea.ac.uk)).

**DFID** Department for International Development

# Control strategies for large-scale structural testing



With the help of an RAEng Global Award, Dr Tony Blakeborough from Oxford University recently spent 3 months working with Prof Mahin at the University of California at Berkeley investigating control strategies for the next generation of large-scale structural testing.

Over the last ten years the Department of Engineering Science at Oxford has become a leading laboratory in the development of structural dynamic testing techniques. Current projects cover the dynamics of guyed masts, hospital floor vibrations and crowd loading of grandstands. However, the core of the work has been the development of real-time substructure testing – a powerful technique that reproduces in the laboratory how a structural component behaves when an earthquake strikes a building.

The method couples a physical specimen to a computer model of the remainder of the structure. The idea originated with Professor Mahin in the 1980s and Oxford has speeded up the process so the test can take place in real time.

In the USA, Berkeley hosts one of the major equipment sites in the Network for Earthquake Engineering Simulation (NEES) program, which is an \$80M investment in earthquake research by the government science agency National Science Foundation. One line of research is to perform simultaneous linked substructure tests in different laboratories across the country. Although on a different geographical scale the problems are the same as in real-time testing in that stable and accurate control depends on a rapid transmission or modelling of the feedback signals.



(Above) Real time hybrid test on a Jarret damper in the Structural Dynamics Laboratory at Oxford  
(Above right) Pseudodynamic test of a 'zipper' frame in the NEES laboratory at University of California at Berkeley



approximate the behaviour of the remote structures so that stable, more robust tests are possible. The models are updated when information from the remote site is received. There are plans to test the algorithms with simultaneous coupled substructure tests at Oxford and Berkeley.

For details on The Academy's Research Support Schemes please contact Mr Rob Barrett, Manager, Research Support (0207 227 0500; E-mail: robert.barrett@raeng.org.uk; website: www.raeng.org.uk/research).

For further information on this work please contact Dr Tony Blakeborough at Oxford University (01865 283422; E-mail: tony.blakeborough@eng.ox.ac.uk).

Whilst in Berkeley, Dr Blakeborough worked in Prof Mahin's group developing control strategies that use local models to

## BUILDINGS

# Avoiding cold-bridging in non-traditional buildings

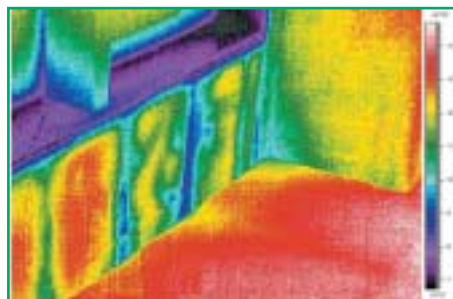


Modern lightweight building envelopes rely on high performance insulation to achieve the required U-values and reduce the risk of condensation formation. Coldbridging is caused by local narrowing of the insulation or by metallic components such as fixings and brackets penetrating or bypassing the insulation. Both surface condensation and interstitial condensation may be caused by poor detailing of modern facades.

Coldbridging can be avoided by good detailing and is not usually a problem within a zone of cladding designed as a system. Problems commonly occur at interfaces between different components or different forms of construction. Built-up walls are often bespoke designed and dependent upon good detailing on a project-by-project basis.

The Centre for Window and Cladding Technology has produced guidance on detailing to avoid coldbridging. The CWCT has worked with industry to identify common causes of coldbridging and establish alternative details that are also robust in terms of buildability, structural integrity, weather sealing and so on.

Non-traditional building envelopes used on commercial and public buildings are highly bespoke. Even if proprietary cladding systems are used, the interfaces with adjacent cladding, the primary structure and penetra-



Coldbridging due to framing members and inconsistent insulation (courtesy of Sandberg)

tions caused by building services or fixings for signage are different on every building. For this reason, the development of standard details is not practical. The CWCT guidance categorises the different types of interface and cladding and describes the principles to

be followed along with typical examples.

A combination of thermal imaging and, two- and three-dimensional thermal simulation, has been used to illustrate the potential coldbridges and the improvements that can be made. The guidance looks at curtain walling, insulated panel systems, rainscreen walls and slope glazing and roofs.

The guidance is presented on a searchable CD-ROM along with CWCT technical notes TN33 *Breather membranes and vapour control layers in walls and facades* and TN45 *Thermography and facades*. An executive summary is available at <http://www.cwct.co.uk/coldbridging>.

The research was jointly funded by the CWCT and the DTI under the Partners in Innovation Programme.

For further information please contact Ms Zhihong Liao at CWCT (01225 386541; website [www.cwct.co.uk](http://www.cwct.co.uk)).

# A client's guide to zero defects



The late identification and rectification of defects acts as a dampener on many otherwise successful projects. Things are not finished properly, or they do not work as hoped (or at all), or completely unexpected events occur. Sometimes the problems are resolved to some degree but recur and cause more problems.

These scenarios apply from the most humble jobs up to prestige developments. They lead to disappointment, arguments, disruption, additional costs, energy, time and reputation – and sometimes to litigation.

'Zero defects' is perhaps the holy grail of the Latham/Egan agenda – often reported but rarely sighted. Are defects a fact of life? Are we in the UK worse than other countries? Are some jobs worse than others? – And if so, what are the identifiers of success? What can we do about defects?

CIRIA has proposed a project targeting this one issue, involving all parts of the supply chain including:

- clients;
- clients' agents – who get deeply involved in defects and their elimination;
- constructors – who manage the whole process of defect identification and resolution;



A MORI survey of over 10,000 people who bought a new home between January 1999 and March 2000 found that 81% reported housing defects and snags with their home.

- designers – who are frequently also involved in many of the issues;

- specialist contractors – who are called back to remedy the defects; and
- facilities managers – who are affected by defects, and are often the ones to report them.

The proposal is centred upon the wants of clients but will fully involve the other stakeholders. It seeks to identify categories of defects, and for each, develop strategies for minimizing the occurrence of defects; identifying and resolving defects during construction rather than after hand-over; and putting in place teams and contracts that minimize the problems.

Further definition of the proposal will follow a workshop of interested parties including potential funders and research contractors.

For further information please contact Alan Gilbertson at CIRIA (020 7549 3300; E-mail: [alan.gilbertson@ciria.org](mailto:alan.gilbertson@ciria.org)).

## HIGHWAYS

# Highways Agency acquires new high-speed deflectograph to improve asset management



The Highways Agency (HA) has recently taken delivery of a new High-Speed Deflectograph (HSD) from the Danish supplier Greenwood Engineering, at a cost of almost £1 million. At present, approximately 25% of the network (around 4,500 lane-kilometres) is surveyed annually using conventional Deflectograph equipment, which represents many, many cones! The new vehicle will improve productivity, but also reduce the associated traffic congestion.

The HSD is an advanced system for the measurement and collection of structural pavement condition data, mounted on an articulated vehicle chassis. However, unlike the conventional Deflectograph, which operates at low speed and therefore requires the implementation of traffic management measures, the HSD is designed to operate at up to 80 kph.

The HSD measures the deflection response of the road pavement under a pre-determined axle load (usually 10 tonnes), classifying pavement strength, and highlighting locations with structural weaknesses. The primary sensors for deflection measurement are Doppler laser sensors, which measure the instantaneous deflection velocity of the pavement surface. A reference Doppler sensor is employed to remove unwanted contributions in the measurement. A major advantage of the Doppler laser system is that deflection velocity is measured continuously, and in a non-contact fashion.

The first prototype HSD was built by

Greenwood for the Danish Road Institute (DRI). At this stage, the device is mainly a research tool, and the HA will now investigate its capability and best method of operation, in conjunction with TRL (who will operate the equipment), the manufacturer and DRI. It is anticipated that this will lead to the development of techniques for routine use of the HSD on the network.

Acquisition of the HSD is the latest step in the Agency's strategy to undertake all its road surface and structural condition surveys at traffic speed, to contribute to its wider objectives of reducing congestion, improving safety, and optimising the management of its assets. Other systems currently operating on the network include SCRIM, for measuring

road surface skid resistance, and TRACS (Traffic Speed Condition Survey), which measures longitudinal and transverse profile, road geometry, macro-texture and real-time crack detection at speeds of up to 115 kph, referencing the location of data using GPS.

TRACS, SCRIM, Deflectograph and other data are all fed into HAPMS – the Highways Agency Pavement Management System. HAPMS is then used to analyse the data to identify problem areas on the network, and optimise future road maintenance programmes, on a whole-life-cost basis.

Research continues into the development of high-speed systems for the measurement of the condition and effectiveness of road markings and road studs.



High speed deflectograph (courtesy of Highways Agency)

For further information please contact Ramesh Sinhal, at the Highways Agency (01234 796527; E-mail: [ramesh.sinhal@highways.gsi.gov.uk](mailto:ramesh.sinhal@highways.gsi.gov.uk)).

# Using reclaimed components and recycled materials dti

Buro Happold is currently undertaking two complementary projects funded under the DTI Partners in Innovation Programme. One is to design and construct a building made, as far as possible, from reclaimed components and goods, but not including recycled materials such as recycled plastics. The other is compiling for designers a guide to this challenge.

**The re-use project or 'The Reclaimed Vicarage'.** There is no real substitute to doing something as an approach to really understanding what the issues are in a topic. So the re-used building project is in the thick of 'learning by doing' on a vicarage in Birmingham.

The aim is to investigate a range of opportunities for the re-use of mainstream building materials, and to test these in the building project. There is already widespread re-use of some building materials, but these are usually low value but high bulk (crushed concrete) or high value small volume (architectural features). What is lacking is routine re-use of serviceable items such as windows, tiles, pipes and wires.

The project is to build a 'new' vicarage for King's Heath church, to enable the development of parts of the site for community facilities. The new design has planning permission, the project is in the detailed stages of design and, all being well, work will start on site in late summer and be complete early in 2006.

The main challenge is to link the programmes for building with the careful demolition or dis-assembly of buildings to which the team has access for sourcing materials. This co-ordination is one of the largest challenges. Key targets for re-use are:



*Co-ordination of deconstruction and construction is a key challenge*

- windows and doors;
- spiral staircase;
- timber and tiles;
- elements of plumbing and radiators;
- reclaimed furniture as flooring;
- elements of the electrical system;
- concrete beams as foundations.

There are challenges still to overcome to meet current standards, and the cost-effective removal and re-instatement of elements. This will be reported on as the project develops,

through the Salvo website – [www.salvo.co.uk](http://www.salvo.co.uk).

**The book – 'Building with reclaimed components and materials: a design handbook for re-use and recycling'**

There are many drivers encouraging buildings to be constructed using reclaimed components and goods. The book will introduce the various types of re-use, starting from re-using an entire building for a new purpose at one extreme, either in situ and even moving a building to a new location. There are many examples of use of using reclaimed construction components. Finally there is the possibility of using products, components or building elements that have a recycled content.

The book will be presented in four sections – an introduction to the world of re-use, reclamation and recycling; case studies of buildings that illustrate the practice; guidance on how to ensure re-use and reclamation happens in projects; and guidance for designing each building element with re-use in mind, from foundations to carpets, paint and even tennis courts. The book is due for publication by James and James (London) in late 2005.

*For further information contact Bill Addis or Andrew Cripps at Buro Happold (020 7927 9700; E-Mail [Bill.Addis@BuroHappold.com](mailto:Bill.Addis@BuroHappold.com)).*

## WASTE MANAGEMENT & GROUND ENGINEERING

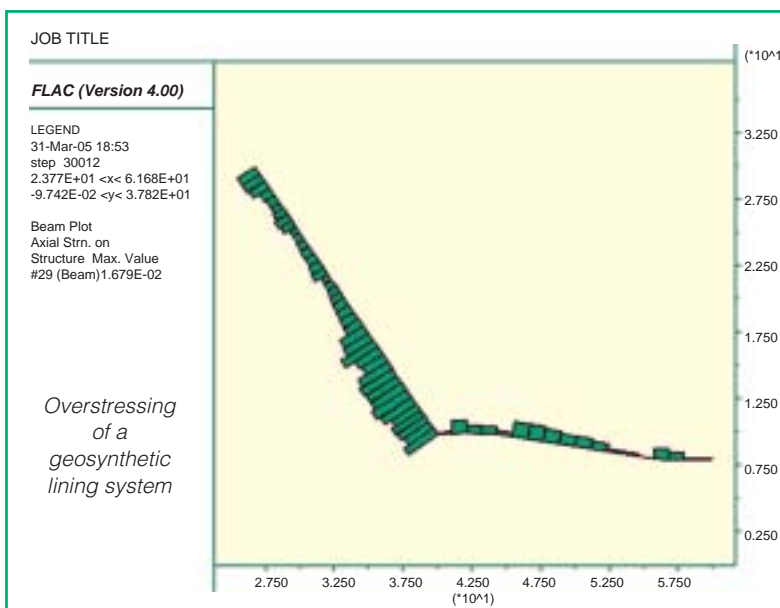
# Innovative landfill lining systems



Golder Associates (UK) Ltd, in conjunction with the Centre for Innovative and Collaborative Engineering (CICE) at Loughborough University, are conducting a research project to develop the analysis and design techniques for landfill barrier systems and, in particular, systems used in steep sided voids such as quarries.

Landfill barriers must prevent the flow of potentially harmful fluids and gasses from the landfill into the surrounding environment. These barriers can consist of a series of geosynthetic liners and geological materials. It is now an Environment Agency requirement within the UK that a "geological barrier", usually compacted clay, be included on the base and up the side slopes of the landfill. This provides an increased challenge on a steep sided quarry void.

The stability of a lining system must be assessed to prevent stability failure. In addition to this, small movements must also be assessed, as these affect the integrity of lining



system components and may cause leakage from the site. Numerical modelling has been carried out using the finite difference code, FLAC. This allows for relative movements, strains and stresses in the lining system components to be predicted and designs to be altered accordingly. The figure shows example output data from the numerical modelling. Investigations are also being carried out on the use of innovative materials to aid the stability and reduce deformations within the barrier.

*For further information on this project please contact Gary Fowmes, CICE (01509 228549; E-mail [g.j.fowmes@lboro.ac.uk](mailto:g.j.fowmes@lboro.ac.uk)).*

## TILT-DAM: a new type of flood defence



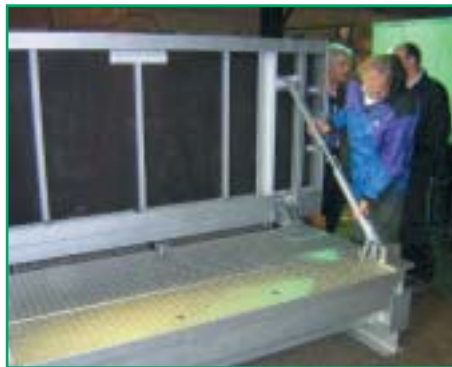
The increasing regularity of flooding in the UK has highlighted the need for improved defence systems to protect householders from the physical and economic consequences of living in areas vulnerable to flooding.

Recognising the need for a simple flood barrier system, James Forrest, a Chartered Civil and Structural Engineer, conceived the idea for the TILT-DAM, a permanent but easily demountable flood barrier system, in November 2003. The mechanism is based on the simple concept of a horizontal path or roadway formed in sections, which can be rotated to a vertical position and used as a temporary flood defence.

Partially funded by an ICE Research and Development Enabling Fund award the manufacturing and testing of a prototype by INTEC Project Management, BRE and HR Wallingford took place between August and December 2004.

Testing revealed that, compared to a current barrier flood protection scheme, the TILT-DAM is much quicker to assemble. In reasonable lighting conditions two individuals raised the TILT-DAM into its 'defence' position in less than three minutes and lowered it to its 'rest' position in approximately two minutes. It was also judged to be significantly easier to deploy in a flood emergency than other competing models.

Significant advantages are also claimed for TILT-DAM being the only demountable flood defence mechanism to have its total



equipment requirements inbuilt within each unit and capable of being operated in all weather and light conditions. The long term in-use costs, based on a 50-year life period, are also claimed to support the commercial viability of the TILT-DAM mechanism. Because a kilometre of defence could be raised in three hours, the invention is expected to be of considerable interest to the Public Sector and the Insurance industry, especially in areas of almost certain risk of major flooding.

The TILT-DAM is an example of innovative thinking within civil engineering tackling the growing infrastructure and environmental challenges that society faces. Harnessing such ideas is important to ensure that we can appropriately protect ourselves in adverse situations.

*For further information please contact John Forrest of Tilt-Dam (01489 890262; E-mail john@tiltdam.co.uk).*

*(Opposite above) Completed TILT-DAM prototype in horizontal position*

*(Below John Forrest locating a prop into position*

## WIND & MARINE ENGINEERING

### Tilting at wind towers – how to minimize the impact of sea-bed scouring



Some of the best locations for wind-farms around the British Isles are in shallow coastal waters where wind is unobstructed by land. However, there is a significant engineering challenge in placing the turbine towers in such environments because, as well as having to withstand storm-force waves and tidal currents, the turbine towers have to remain stable on a sea-bed that may be continuously changing. One of the major challenges faced by designers is how to predict, and obviate, scour of the seabed sediments around caissons used to support wind-turbine towers.

HR Wallingford has responded to the lack of understanding about how the sea-bed is scoured by waves (and currents) around different types of foundations used for wind-turbine towers, such as composite monopile caissons. Results from an exhaustive series of hydraulic model tests have provided a numerical analysis of the water-sediment regime around such towers. The modelling was done in a large test basin with waves generated at 90° to the current. The study took into account the structural features of the towers and their foundations, metocean and soils conditions, and the impact of scour occurrence.

Wind-tower foundations were found to be less susceptible to scour in wave-dominated regimes. The shape of the top of the foundation where it is joined to the

base of the tower made a considerable difference (80%) to the speed of scour-hole development. The work adds to the understanding



*Offshore wind turbine (photo: GE Wind Energy)*

needed to assess potential sites for wind-farms in terms of both local scouring and sedimentation patterns. In particular, the study demonstrated that the know-how exists on how to provide effective protection against scouring.

The significance is that any hoped-for expansion of green energy from wind-farms cannot take place unless investors can be reassured about the stability of the system over the duration of the wind-farm's life. The technical understanding to make reliable predictions about scour-hole development and to advise on optimizing wind-tower shape and location is now available.

*For further information please contact Richard Whitehouse at HR Wallingford (01491 822434; E-mail r.whitehouse@hrwallingford.co.uk).*

# Analysis of trunk road accidents

The Highways Agency has recently completed research projects investigating two specific groups of accident on the trunk road and motorway network: those involving goods vehicles, and 'shunt' accidents.

In its Strategic Plan for Safety, the Agency had committed itself to undertake research to evaluate the extent of accidents involving goods vehicles. In addition, the Agency was approached by Kent Police, who were concerned over the frequency of accidents involving left-hand-drive goods vehicles on motorways in their area.

In February 2003, the Agency commissioned URS to undertake this research, which entailed a high-level analysis of accident data for the whole network, followed by a detailed analysis of a smaller data set, and a review of the issues affecting goods vehicles. The high-level analysis revealed that goods vehicles were the first-named vehicle in some 18% of all accidents occurring on the trunk road network between 1997 and 2001. Of these, 472 involved a fatality, and 2380 resulted in a fatal or serious injury, giving a higher severity ratio than for car accidents.

More detailed analysis was then undertaken on selected sections of motorway, all-purpose dual carriageway, and all-purpose single carriageway. The motorway data suggested that 'changing lane to the right' played a part in 30-50% of all goods vehicle accidents, and there appeared to be a tendency for both UK and foreign drivers to have difficulties with blind spots, particularly at merges. On single carriageway roads, a high

proportion of goods vehicle accidents (56%) occurred at junctions, with shunt accidents accounting for 34% of the total.

The study concluded that most accidents involving goods vehicles were associated either with shunts or lane changes. Work on road and vehicle engineering measures may assist in reducing these accidents, but there are limits to what can be achieved, and there is a need to educate and inform drivers of some of the causes of goods vehicle accidents, and how they can be avoided. The Agency is now working in partnership with the Department for Transport and the freight transport industry to achieve this.

The second project, investigating the different types and causes of shunt accidents on the network, was undertaken for the Agency by TRL, between September 2003 and September 2004. Four Agency Areas were selected and local data obtained to identify shunt accidents – this resulted in a sample of 5213 accidents, of which 39% were coded as shunts. A detailed analysis of the data found that, compared to non-shunt accidents, the shunt accidents were more likely to:

- involve more vehicles per accident;
- involve more casualties per accident;
- occur in daylight;
- occur between 1600 and 1900;
- occur on weekdays (especially Fridays);
- involve female drivers.

An investigation into the age and gender of drivers resulted in some interesting findings. It suggested that the 16–25 year (particularly male) and the over 75 year driver age groups were over-represented as the 'shunters', and that the 26–75 year (particularly female) group was over-represented as the 'shunted' drivers.

Shunt locations did not appear to be linked to specific geometric features, but were more likely to be associated with high traffic flows, and high volumes of large vehicles. Potential engineering solutions therefore include measures to give advanced warning of queues, lane changes and junctions, the use of overhead gantry signs, and crawler lanes on hills.

If the figures in the study are representative of the network as a whole, then almost 40% of all trunk road accidents are shunt-related, and the overall cost of these accidents to society could be over £2 billion each year (excluding traffic delay costs). Despite the fact that many shunt accidents are of low severity, and scattered across the network, the high frequency of such accidents means that investment to tackle the causes of these accidents can be justified.

Both of these projects contribute to an improved understanding of accident patterns on the trunk road network, and will assist the Agency to achieve its casualty reduction targets.

For further information on both projects go to the Highways Agency's Research website ([www.ha-research.co.uk](http://www.ha-research.co.uk)), and search for 'goods vehicles' and/or 'shunt accidents'.

## IT & DESIGN

# Electronic information for designers



Over three years ago SCI launched its Steelbiz information system. Three years of research and development has resulted in the launch of an updated and improved system to further support the use of steel in construction.

Since the initial launch, use of the system has grown steadily, accompanied by development of SCI's understanding of how designers use such systems. Three distinct user needs analyses have been undertaken, with the aim of improving our understanding of how designers locate and use information.

- In collaboration with the SCI's Co-Construct partners (BSRIA, CIRIA, TRADA and The Concrete Society), some 600 questionnaires and face-to-face interviews were undertaken.
- Two observational workshops were run to simulate designer activity in the use of support information.
- A pan-European workshop was attended by over 200 designers from 21 countries and examined the information deficits and flows in design. About 20 in-house visits were conducted to validate our study findings.

Together with these studies, the use patterns of over three years' operation of the original Steelbiz electronic information system were analysed and the findings used to develop the new information system, SteelbizII. The key elements of the system are:

- a simplified interface;
- powerful state-of-the-art resource discovery using mixed metadata and body content indexing;
- opening of resources with far simpler registration systems for user tracking.

SteelbizII is available at [www.steelbiz.org](http://www.steelbiz.org).

For further information please contact John Moran, Senior Manager IT, The Steel Construction Institute (01344 623345; E-mail [j.moran@steel-sci.com](mailto:j.moran@steel-sci.com)).



Shunt accidents are likely to be associated with high traffic flows

(Photo courtesy of the Highways Agency)

## Studies in fabric-cast concrete



Fabric-cast concrete involves casting concrete in forms made with flexible formwork. This provides the potential to produce forms that are both structurally efficient and architecturally exciting in a relatively inexpensive and practical manner.

The fabric can only carry loads by tension and hence the shape of the element produced depends on the shape and pattern of the fabric, the elasticity of the fabric and the level of pre-tension in the fabric. By careful shaping of the fabric it is possible to produce complex shapes that would otherwise be difficult and expensive to produce using conventional formwork systems.

The slightly porous nature of the fabric allows air and some water to pass in a similar manner to controlled permeability formwork liners. This aids compaction, curing and the surface finish of the concrete, which reflects the texture of the fabric.

Some preliminary studies into the use of fabric-cast concrete have been carried out in the Architecture Workshop at the University of Edinburgh. A number of different elements have been cast, including beams, columns and panels. Beams with variable cross sections and depths that follow the shape of the dominant bending moments have been cast. These beams are efficient in materials, both concrete and formwork, and expressive of their intended structural behaviour. Although a variety of fabrics have been used, woven geotextile fabrics seem to provide a good combination of strength and porosity, and are easily stripped from the hardened concrete.



(Above) Example of fabric formwork for a concrete beam.

(Right) Example of a beam produced using fabric formwork.

As part of the study a workshop was run for students of architecture who were given a free hand and encouraged to experiment with form, surface and materials. The initial studies have shown that there is great potential for economic production of elements that have both structural and architectural qualities. Work is continuing (with engineering students) involving a detailed study of both the construction process and the structural behaviour of variable geometry beams.

*For further information please contact Remo Pedreschi, Professor of Architectural Technology, University of Edinburgh (0131 650 2301; E-mail: r.pedreschi@ed.ac.uk).*



## KNOWLEDGE MANAGEMENT

### A knowledge management approach for SMEs



Knowledge-Event Management (KEM) is the first simple, low-cost and practical approach to knowledge management that is suitable for both small and large companies. Although developed for the construction industry, where SMEs employ 62% of the workforce, it is applicable in other industries and for larger companies as it involves learning from day-to-day practice. KEM has been developed and tested in a DTI-funded project in 12 construction companies.

KEM comprises capturing knowledge from events, transforming this into profitable learning, and making this available for others. The approach works with the oral world of the construction industry and develops knowledge with dialogue.

The capturing of events uses an audio diary recorded on a Dictaphone, making it low-cost, simple and not time-consuming. This can be undertaken individually or at project reviews, at valuation meetings, at design meetings, at individual performance reviews or at special workshops.

The knowledge transformation uses Event Debriefing, a form of structured critical inquiry, which can be undertaken between individuals or in groups and the skills for which can be developed as part of normal company operations.

It works with the way people problem-solve in practice. This draws out the wider consequences and contributing issues, which



*Knowledge Management in action – Andy Careless from Pettifer Construction, dictating an event.*

can be costed and which indicate opportunities for making profits in the future, thus giving an impetus to using the technique. The analysed events can then be stored in a

database for later use, re-formed as company procedures, or used in company developmental workshops. The latter, in particular, develop problem-solving skills in groups, which is how the industry operates.

There is a Handbook available, which allows companies to operate Knowledge-Event Management (KEM) themselves and allows the gradual adoption of the approach to be central to a company's development, without any great investment. By working with this simple approach, there are significant benefits to companies in improving their processes and hence profit, to employees in their skill development, and to the industry as a whole in challenging ineffective practice.

*For further information, please contact Prof David Boyd, School of Property and Construction, University of Central England (0121 331 5233; E-Mail david.boyd@uce.ac.uk).*

# TSRsim – new software for generating time series rainfall data for urban drainage design



Until recently it was not possible to set up rainfall time series that reflected local conditions and extreme events. *TSRsim* is a new rainfall generation tool that now enables this to be done, thereby opening up new opportunities for the use of time series rainfall in (i) sustainable urban drainage systems, (ii) combined sewer overflow assessments, (iii) impact of urban runoff on river water quality, (iv) urban flooding, and (v) long-term water resource planning.

**T**SRsim includes present-day and future parameters for several UK locations, based on historical rainfall data and the UKCIP98 Climate Change Hadley model



Extreme event – road drainage unable to cope with intense rainfall (Photo courtesy of R Kellagher).

(medium/high scenario). This allows UK users to include the predicted effects of climate change on their drainage systems and water resources. Because it is calibrated on a site-specific basis, *TSRsim* also has worldwide application – rainfall records from any location can be analysed to generate long-term rainfall series. The software generates a long period of continuous rainfall data (in CSV or RED format) based on available local rainfall records.

The main features of *TSRsim* are: (i) its ability to use local historic records to generate site-specific data, (ii) its parameters are calibrated based on monthly rainfall characteristics, (iii) it can generate up to 200 years of continuous data, (iv) users can disaggregate hourly *TSRsim* rainfall records to 5 minute timesteps, (v) it puts extreme rainfall events in the data it produces, and (vi) it provides rainfall data for the end of the 21<sup>st</sup> century (that can include predicted climate change impacts for several UK locations if desired).

The software tool was derived from work funded by UKWIR and led by HR Wallingford to consider the possible effects of climate change on the hydraulic performance of sewerage systems, and to identify future design implications.

*For further information please contact Mike Briggs at HR Wallingford (01491 822468; E-mail meb@hrwallingford.co.uk).*

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