

Innovation & Research



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RASP – improving flood risk assessment

To improve the performance of UK flood defences and to reduce flood risk, DEFRA and the Environment Agency have recognised the need to consider systems of defences rather than single defences in isolation. Risk managers, responsible for assessing and managing flood risk in a town (or a coast) protected by several different defences, need to consider how the flood defence system functions as a whole.



The RASP (Risk Assessment of Flood and Coastal Defence for Strategic Planning) project has developed and demonstrated methods for dealing with systems of flood defences that apply, for instance, to large flood-plain areas. These may depend on numerous, extensive and/or diverse defence systems such as embankments, walls and moveable structures. With moves towards more integrated flood risk management, the approach enables risk managers to develop balanced, integrated risk management strategies.

HR Wallingford led the development of the RASP project. At its heart is a hierarchical risk-based analysis framework for floods, now being used to underpin decision support tools being developed by the Environment Agency. The principal benefit of the RASP approach is that it helps users to understand the real risk – taking account of defences – and the contribution of each asset to controlling risk. This improves the targeting of investment to reduce flood risk. The work was funded

by Defra and the Environment Agency.

The RASP methodology gives national-scale quantified estimates of flood risk on a 1km grid. It estimates the probability of failure of systems of flood defences for a given defence loading under high, intermediate and detailed levels of assessment. For instance, flood-risk maps produced using it will provide more-detailed information about properties at risk, and average flood depths in different areas.

The illustration, a ‘risks to people’ map, enables ‘people risk’ to be quantified, management actions to be better targeted and the risk to life and limb to be reduced.

A second figure on the IRF website demonstrates that tiered methods developed under the RASP project are now underpinning decision-making at policy, strategic and local levels.

For further information please contact Paul Sayers at HR Wallingford (01491 822344; E-mail p.sayers@hrwallingford.co.uk).



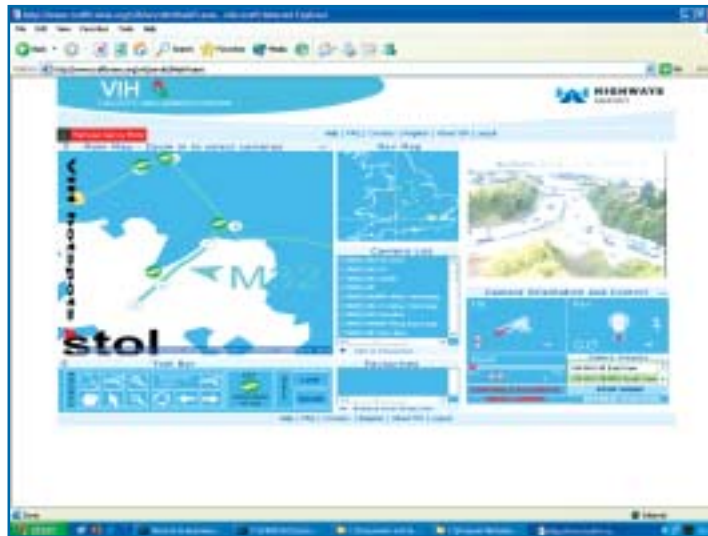
Real-time traffic images: on the Edge

The Highways Agency is bringing traffic information into the 21st century with research aiming to make real-time CCTV images from its network easily and affordably available to all. Initially the technology will be used by the Highways Agency and its contractors, but eventually the information will be available to the public too.

The Highways Agency's new Traffic Officer service was launched last year in the West Midlands. Traffic Officers will soon be seen across the rest of the motorway network and on some trunk roads. The National Traffic Control Centre is now fully functional, and Regional Control Centres are also opening up across the country. Being able to see 'live' what is happening on the network is vital to the success of all these initiatives.

Currently, the Agency is upgrading its telecommunications network (NRTS) and CCTV systems. NRTS will provide communications between the roadside infrastructure and the Regional Control Centres (RCCs). Each RCC then has a Television Base Station that looks after provision of CCTV images within the RCC, and of 'Video Information Highway' (VIH) protocol CCTV images to the outside world.

At present, users outside RCCs, such as managing agents, can only access the images using specialist 'VIH client'-compatible software and a leased landline. The problem is



Approved users can control CCTV cameras through the Edge Client, even while out on the network.

that this system is costly to install and maintain, and is only available in static locations.

Enter the 'Edge Client'. This solution is so called because it sits on the edge of the NRTS VIH network. Essentially, the Edge Client provides a web-based solution for the dissem-

ination of real-time streamed network CCTV.

To access the Edge Client all that is needed is a standard web browser and ADSL broadband linkup, meaning that once installed, the user cost is much lower than the current system. Images can also be made available through suitable portable devices such as PDAs and mobile phones.

Another advantage of the Edge Client is that it allows approved users to have remote pan, tilt and zoom camera control, very useful for Traffic Officers or contractors' staff out on the network who need to communicate with the RCC.

An initial research project developed the Edge Client to pilot stage. The pilot users are now providing the team with useful feedback that will be taken into account when the technology is

rolled out to the RCCs.

For further information please contact Mark Davies, Highways Agency (0117 372 8183; E-mail: mark.davies@highways.gsi.gov.uk).

SAFETY

Understanding cranes for safety gains

With around 1,000 tower cranes being used at any one time in the UK, it is important that all personnel involved in specifying, procuring, planning, erecting and operating them, as well as those on site around them, understand the major hazards to the safe use and stability of tower cranes. Tower crane collapse presents a risk not only to site personnel but also to members of the public, potentially leading to fatalities.

Whilst the collapse of tower cranes is rare, accidents and near misses do occur. These generally result from events, either singly or in combination, that have not been anticipated, such as events or actions that cause unexpected loads or from errors during erection, use or dismantling. Failure in any part of the crane or load carrying systems is likely to cause serious accidents – which generally involve both the crane operators and other site personnel or the general public.

CIRIA's new guidance *Tower crane stability* aims to bring together important practical and design issues that impact on health and safety, and to present current understanding of best practice based on the experience of a wide cross-section of the industry.

The guidance is aimed at those involved in the design, planning, communication and management of tower cranes,



Tower cranes are in common use in construction

who need to understand the issues and be educated in the safe use of tower cranes – planners, architects, permanent works engineers and site supervisors. The report includes specific guidance for designers of temporary works involving tower cranes, the understanding of wind effects, other loading and support considerations, and factors of safety and design of foundations. The report also highlights some key situations in which a specialist should be consulted.

Tower crane stability will be available from early 2006 – visit www.ciria.org/rp707.htm. For information about the range of site guides available from CIRIA, visit www.ciriabooks.com.

For further information about this project please contact CIRIA (020 7549 3300; fax: 020 7253 0523; E-mail: enquiries@ciria.org).

Planning for resource sustainable communities: waste management infrastructure



Supported by the ICE R&D fund and launched in March 2005, Planning for Resource Sustainable Communities: Waste Management Infrastructure, is a Code of Practice that helps planners and policy-makers to support the delivery of waste plans and targets. The Code provides a framework requiring developers to consider various aspects of waste management infrastructure in community designs. As a society we are accustomed to the fact that utilities such as water, electricity and sewage are a statutory requirement for new or refurbished buildings. The purpose of the Code is to develop a culture where opportunities for waste management infrastructure are considered.

The Code can work on a voluntary basis, but will be more effective when it works through the planning system. As such the Code can be built into different levels of guidance, including Spatial Planning and Supplementary Planning Documents, which then provides a firm basis for implementation. The figure indicates potential intervention points.

The Code has been developed with the view that waste management infrastructure should be considered through a checklist of 10 Sustainable Design Principles. These cover the management of demolition, refurbishment and construction waste, as well as the infrastructure that should be considered to manage commercial, household and industrial waste. The Code makes



Designing waste management facilities into new development

reference to a wealth of good practice, including the ICE Demolition Protocol, which is being successfully implemented in the London Borough of Brent. A resource efficiency tool for both demolition and new build, the Protocol is incorporated within the Borough's Supplementary Planning Guidance, allowing conditions to be set on planning approvals detailing the Project Team's responsibilities.

Code documents can be downloaded from: http://www.ice.org.uk/knowledge/specialist_waste.asp.

For further information please contact Andrew Crudgington at the ICE (020 7665 2219; fax: 020 7799 1325; E-mail: andrew.crudgington@ice.org.uk).

WASTE

Innovation and research in waste management

Professor Sue Grimes is the first woman to be appointed to a Research Chair sponsored by the Royal Academy of Engineering. The Chair in Waste Management at Imperial College is co-sponsored by the SITA Environmental Trust and is held at Imperial College. With the creation of the post, Imperial aims to become a centre for excellence in waste management and research. This will be carried out through a network of waste stakeholders including industry, government, local authorities and academic institutions worldwide.



The drivers for innovation in waste management thinking and the need for novel approaches to research on waste have never been greater. Because of targets set for recovery and recycling, the legislative requirement for reduction in landfill disposal and the increasing primary, treatment-specific and waste stream-specific EU regulations, there is an urgent need for innovative research to find solutions to the problems faced by both the waste producing and waste treatment industries. The Imperial approach will be based on the application of the fundamental principles of science, technology, engineering and management to real problems.

The underlying concept of Sue Grimes' research is to use wastes, many of which are disposed of to landfill, as a source of commercially useful materials. Wastes are often difficult to use because they are either complicated mixtures or composites. To recover valuable resources from such sources, a number of factors have to be optimised including the fundamental science, a workable recovery methodology that can be engineered, and recyclables that are fit for purpose and economically viable for a particular

market opportunity. Sue will work with the industry stakeholders, both nationally and internationally, to seek to achieve effective resource management for, and resource recovery from, end-of-life materials.

Some examples of innovative research already developed by Professor Grimes' group,

in projects funded by EPSRC through the DTI/Link and other government sponsored programmes, are:

- removal of flame retardants and other additives from plastics to aid total recycling;
- use of microwave technology in material recovery processes from waste;
- development of novel concentrator cell technology to achieve the simultaneous recovery of metals from and the destruction of organic contaminants in effluents containing metals and organic components; and
- development of a closed-loop methodology for the recovery of aluminium as added-value chemicals from smelter residues.



(Top) Professor Sue Grimes. (Above) City-generated Waste – an Artist's Impression

For further information on the Academy's Research Support schemes please contact

Mr Rob Barrett, The Royal Academy of Engineering (0207 227 0500; E-mail: robert.barrett@raeng.org.uk; Website: www.raeng.org.uk/research).

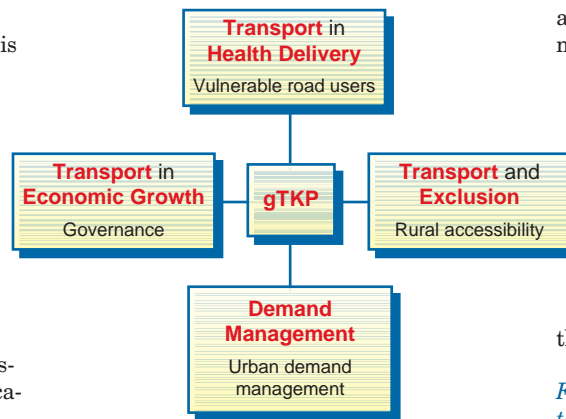


The future of transport in developing and transition countries and its dependence on innovative knowledge management

Efficient and safe transport is fundamental to the lives of people throughout the world. Transport is a key infrastructure component; it is estimated that the asset value of the road network in Africa alone is more than US \$500bn with an annual maintenance requirement of over \$12bn. If improved knowledge and understanding results in even a small improvement in performance, significant benefits can be accomplished. However, developments in transport knowledge remain largely inaccessible to those who will take up and apply the knowledge in developing and transition countries.

The global Transport Knowledge Partnership (gTKP) aims to bridge this gap by making relevant knowledge easier to find and by encouraging greater participation from these countries in the management and application of this knowledge. The initial focus of the gTKP is on roads and road transport, particularly in Asia and sub-Saharan Africa. Participation is open to anyone with an interest in transport; however the core users are practitioners in transition and developing countries.

At micro level, an effective transport system enables access to services such as education and healthcare, provides trading links, and furthers social development. At a macro level an efficient transport system is seen as



Breadth and Depth Themes of the global Transport Knowledge Partnership

an essential pre-condition for a country's economic development.

The gTKP aims to provide a vehicle for the transfer of knowledge to those who require it rather than providing a repository of knowledge. The gTKP's core is an electronic portal, which will provide links to available knowledge, best practice and individuals and organisations with expertise. It will progressively develop in line with users' needs.

The knowledge will initially be structured around the breadth and in depth themes as shown in the figure.

For further information please contact the gTKP Core Management Team (0207 804 2004; E-mail info@gtkp.com, website: www.gtkp.com).

WATER ENGINEERING & IT

CFD modelling of water engineering problems



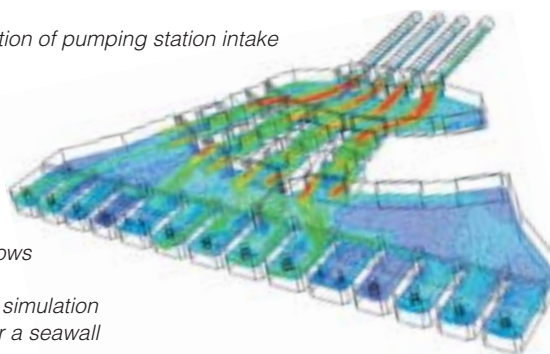
Although numerical modelling will never replace the use of physical modelling to develop solutions for complex hydraulic situations, the CFD approach (Computational Fluid Dynamics) has advanced sufficiently for it to be able to carry out many of the simulations required in water engineering problems.

Analysis of real problems of how structures interact with fluids has been assisted by HR Wallingford's application of the CFX-5 package (developed and licensed by ANSYS) over the last five years. This numerical modelling capability can be used to solve an array of fluid flow problems – steady-state, transient, laminar and turbulent.

HR Wallingford has successfully used CFD for pipe flow problems – specifically the modelling of flow through water intake pumping stations – see diagram (i).

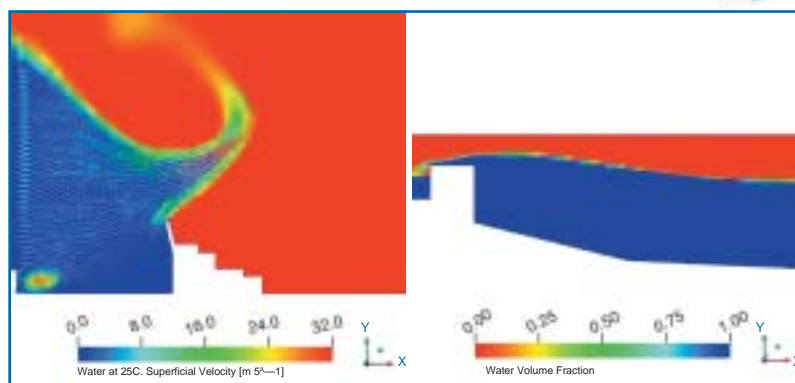
CFD has also successfully been used by HR Wallingford on a wide range of other situations. The CFX-5 model enables the multiphase free surface to be modelled with colour coding showing the relative mixing of water and air – vital in any calculation of forces. Recent examples

i (Right) CFX-5 simulation of pumping station intake



ii (Below left) CFX-5 simulation of violent flows over walls

iii (Below right) CFX-5 simulation of Wave breaking over a seawall



include violent flows over walls and waves breaking over sea walls and use to model flow velocities going into the water intakes of a pumping station, where the analysis was able to compare operational scenarios covering a range of situations with various gates, pumps and inlets functioning – see diagrams.

Whether numerical modelling will ever completely replace physical modelling depends on the complexity of the situation under consideration. However, it is important to recognise that CFD is not just an alternative method; in fact it brings a wide range of sophistication that can be used to enhance physical modelling.

For further information please contact Dr Stephen Richardson at HR Wallingford (01491 822298; s.r.richardson@hrwallingford.co.uk).

Intelligent studs: lighting the way to safer roads

Fog and pollution can make road vision difficult, leading to accidents. The Highways Agency, supported by industry specialists, is piloting new technology to improve visibility for motorists in such conditions.

Fog can be unpredictable and often highly localised, so researchers have developed intelligent road studs (IRS) that could illuminate in response to poor visibility and/or incidents detected ahead. The studs would be installed in the road surface in a similar way to normal road studs. They could be solar powered or wired into existing power supplies.

The current project is aimed at developing a specification and demonstrating suitability for use on the Agency's network where, historically, weather conditions have been a contributory factor to high accident rates. A successful trial will result in this technology being approved for implementation on the network. This would be aimed at improving levels of safety in accordance with the Agency objective of safer roads, and delivering technology that will assist the Agency in meeting its PSA target – *Reduce the number of people killed or seriously injured in Great Britain in road accidents by 40% and the number of children killed or seriously injured by 50%, by 2010 compared with the average for 1994-98, tackling the significantly higher incidence in disadvantaged communities.*

Testing the studs in real-life conditions could have proved tricky, waiting for the right weather conditions to occur. Therefore, the team utilised an inflatable 'fog tunnel' to provide simulated fog. The sectional tunnel, approximately 2 metres wide and 200 metres long, creates fog by pumping water and compressed air through tiny diffusers to create very small airborne water droplets that can reduce visibility down to as little as 5 metres.

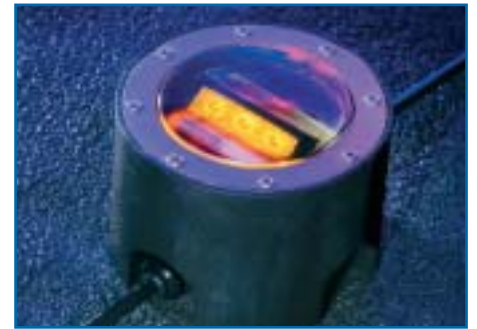
The fog tunnel will also be put to further use in evaluating new imaging technology, which can clarify closed circuit TV images in fog.

Initial results indicate the IRS can substantially improve visibility compared to existing studs. Standard retro-reflective studs ('cat's eyes') illuminate the forward carriageway using vehicle headlamp reflections up to distances of 100 metres. IRS can provide forward illumination at distances approaching 900 metres, bringing obvious safety benefits.

IRS technology is already being used abroad. 'Before and after' statistics show remarkable improvements in safety. The Highways Agency hopes to demonstrate, through careful installation and evaluation, that similar results can be achieved here, where the road studs are planned to be installed at sites identified as accident prone due to their visibility, topography and road layout.

As well as the fog tunnel experiments, the Agency will be studying driver reaction using a driving simulator. The research will result in an evaluation report, which will feed into an on-road trial.

In the longer term, the Agency hopes that IRS will provide additional functionalities. One of these is the capability for the system to identify incidents through sudden changes in speed, and automatically trigger hazard warnings. In



Fog can reduce forward visibility suddenly and dramatically, making driving dangerous

future, the technology could utilise existing capabilities and provide additional safety benefits by advising drivers of the correct stopping distance behind preceding vehicles by using the studs to 'trail' vehicles ahead, particularly useful in conditions of poor visibility.

For further information please contact Jason Burrows, Highways Agency (0117 372 6063; E-mail: jason.burrows@highways.gsi.gov.uk).

MATERIALS & STRUCTURES

Living Steel

Living Steel is a five-year, international programme to stimulate innovation in the design and construction of steel buildings. The initiative was launched in February 2005.



The programme, which has an anticipated budget of €14.25 million, is led by an international consortium of 11 major steel producers, which includes Corus and the two largest steel producers in the World, Arcelor and Mittal Steel. Living Steel is managed by the Brussels-based International Iron and Steel Institute (IISI) on behalf of the programme members.

The goal of the programme is to stimulate growth of up to 10% in the use of steel in construction by 2010. This will be achieved through collaboration and the sharing of knowledge, best practice and innovation around the world. The initial focus is on implementing sustainable housing solutions.

Living Steel will involve a range of new ini-

tiatives including market research, technology benchmarking, knowledge management and an international architectural competition to design and build steel residential buildings.

The inaugural Living Steel international architectural competition was announced at the congress of the International Union of Architects in Istanbul in July. Targeted to stimulate innovative and sustainable housing designs using steel, the winning designs will be built in Poland and India. Winners of the competition, one for each location, will be awarded a prize of €50,000 and a commission for their submissions to be developed for construction in partnership with Living Steel and local supply chain partners.

SCI is a supporting member of Living Steel and has been actively involved in both the development and implementation of the programme. SCI is currently involved in the development of knowledge management tools for Living Steel and in the organisation and management of the architectural competition and demonstration projects.

For further information about the Living Steel programme and how to express interest in the architectural competition please contact Michael Sansom, the Steel Construction Institute (01344 623345; E-mail: michael.sansom@livingsteel.org; website: www.livingsteel.org).



A 10% increase in steel use in construction is forecast by 2010, much of it in housing.

Displacement augered piles



Increasingly, UK construction developments are on brownfield, often contaminated, sites. Traditional bored-pile foundations can create large volumes of contaminated spoil. Driven displacement piles are usually not suitable because of vibration effects on neighbouring sites. Bored displacement piles can provide an efficient alternative in certain ground conditions.

Emerging augered displacement piling techniques combine the advantages of low spoil production with the convenience of a bored pile. Rock and Alluvium Ltd, with the Centre for Innovative Construction Engineering (CICE) at Loughborough University, are researching the behaviour of the soils during installation of these piles and the potential benefits this has on pile capacity and settlement characteristics.

The performance of a bored displacement pile depends very much on the installation process and the effect that this has upon the soil. By considering the behaviour of the soils during the installation and loading of the pile, it can be shown that improvements are made to the ground. This knowledge allows the piles to be designed more efficiently and to have extra load capacity when compared to bored piles of the same dimensions.

A programme of tests on piles constructed using this technique in a variety of soil conditions is under way. Scale models of the installation process will also provide information on the mechanisms at work. This will enable the process to be refined, to produce the optimum performance and ultimately lead to validation of design parameters based upon the theoretical modelling of the soil behaviour.

The work complements parallel investigations into the continuous flight auger method of pile installation that is also being currently undertaken.

For further information on either project please contact David Baxter, Research Engineer at CICE (020 8255 2088; E-mail d.j.baxter@lboro.ac.uk).



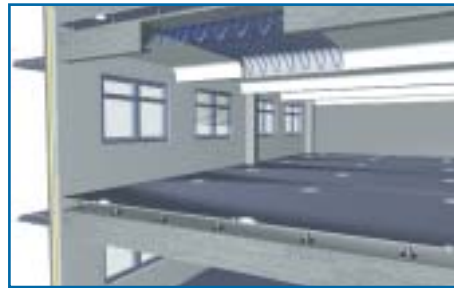
Piling at urban, brownfield sites can produce large amounts of spoil, which is sometimes contaminated. Displacement augered piles avoid this and can offer economies in design through improvement of the soil

BUILDINGS & ENERGY

Low-energy cooling and heating



Over the last two decades the UK has experienced significant growth in the demand for mechanically air-conditioned offices, typically incorporating variable air volume or fan coil systems. However, in response to rising energy prices and the need for improved sustainability, passively cooled offices are on the increase, often combining natural ventilation with a high thermal mass. For buildings with a modest cooling load of up to 35 W/m² this approach works well, but for higher loads system choice is largely limited to conventional air-conditioning solutions.



Cutaway of a Thermocast unit showing the embedded polybutylene pipe work

However, a new system called Thermocast challenges this limitation by providing an effective combination of passive and active cooling through structural conditioning of the building fabric. It has been developed by Tarmac Precast in conjunction with Structural Conditioning Ltd. Thermocast comprises precast, concrete floor units containing unseen pipe-work through which temperature controlled water is pumped to provide year-round heating and cooling.

The underside of the unit is left exposed, allowing the high thermal mass of the concrete to absorb excess heat and stabilise the internal temperature. At the same time, temperature-controlled water piped through the units further enhances the system's capacity for cooling, making it suitable for buildings with loads of up to 80W/m². A relatively high water temperature of around 13°C enables the use of numerous free cooling options for the supply, including groundwater extraction.

The Thermocast system is suitable for a range of building types, and can offer environmental and financial benefits for the building operator, and can provide tangible advantages during the construction phase, including: a fast build programme; off-site manufacture and testing; reduced secondary mechanical & electrical fix; and improved health and safety.

For further information please contact Daniel Westgate at Tarmac Precast (01778 381 000; E-mail daniel.westgate@tarmac.co.uk).



MATERIALS & STANDARDS

Repair standards

BS EN 1504 will give the UK its first comprehensive set of standards for the protection and repair of damage to reinforced concrete. The package includes specifications for key repair materials, including coatings, mortars, bonding agents and injection materials, supporting test methods, a statement of general principles for repair work and a standard for site execution.

The challenge now facing the industry is to adapt to the new Standards as they begin to be used by specifiers. The public procurement directives favour the use of CEN standards by public specifiers.

A recently completed DTI Partners in Innovation project aimed to raise awareness, encourage industry uptake, to provide advice and guidance on the new Standards and to promote best practice in repair works.

The project was led by Hywel Davies, who chairs the BSI and CEN committees, in partnership with the Concrete Repair Association (CRA), Concrete Society, Makers UK and Cranfield University.

A section of the CRA website is dedicated to the new standards, providing all members of the CRA with up-to-date information on the Standards. This guidance has also contributed to the Concrete Society 'Concrete @ your Fingertips' online database of technical advice and a regular newsletter.

To secure access to the documents go to www.concreterepair.org.uk where you need to provide brief details to register for access.

For further information please contact the project leader, Hywel Davies (E-Mail: hywel@gcc.org.uk).



A One-Stop-Shop for structural fire engineering

Structural fire engineering is progressing at a significant pace, bringing together the traditional disciplines of structural engineering and fire engineering. New design methods are continually being developed, based on theoretical and experimental research. Designers and clients are starting to become aware of the benefits of using structural fire engineering, which generally leads to the construction of more economical, robust and innovative buildings.

To reduce the current burden on UK industry in the procurement of efficient and economical construction projects, and to enable the application of the latest technology associated with structural fire engineering, a one-stop-shop website (www.structuralfiresafety.org) has been developed at the University of Manchester. It has been supported by funding through the DTI's Partners in Innovation Scheme. Support is also provided by twelve industrial partners representing the steel, concrete, timber and masonry sectors, as well as representatives from leading design consultancies, approving bodies, the fire brigade and professional institutions.

The website provides practical and impartial advice on all aspects of structural fire engineering, allowing the full benefits of previous research and development to be



The Website gives easy access to practical advice on fire engineering.

utilised in practice. The information currently on the site includes sections on how to design, quick solutions for the non-expert, case studies, material behaviour, references and test data.

The design section covers both prescrip-

tive and performance-based approaches. Available design methods for the performance-based approaches are explained for the three components of structural fire engineering: modelling the fire; determining the heat transfer to the structure; and analysis of structures subjected to high temperatures. The background research supporting the design methods is presented and explained.

The website also provides online professional development courses to educate designers in the use of structural fire design codes, including the new Eurocodes covering steel, concrete, timber and masonry fire design.

For further information contact Professor Colin Bailey, The University of Manchester (0161 200 5795; E-Mail: Colin.Bailey@manchester.ac.uk).

BUILDINGS

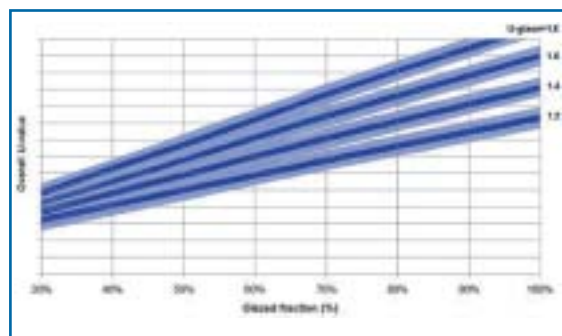
Thermal performance of building envelopes



A guide – *The thermal assessment of window assemblies and non-traditional walls* – has been produced in anticipation of the new part L of the Building Regulations England and Wales. The guide enables readers to differentiate between windows, window assemblies, glazing screens and curtain walling. It then gives clear guidance on how to undertake preliminary design calculations and detailed calculations for verification of the completed building envelope.

The new Part L requires the use of an energy model during preliminary building design to show that adequately low carbon dioxide emissions may be achieved by the completed building. This early energy analysis requires the designer to make assumptions about envelope U-values. It is possible that designers will make assumptions that cannot be realised in the construction. Typical errors are to rely on centre panel U-values quoted by manufacturers and to separate the curtain wall into glazed and opaque areas. The U-value of a curtain wall is determined by the architect's decisions rather than any design by a competent manufacturer.

The U-value of a curtain wall is far more dependent on the area and type of glass used and the spacing of the framing members than on the U-values of either the framing members or any opaque infill panels. Based on detailed analysis of the six most commonly used curtain walling systems used in the UK, the CWCT has calculated typical U-values for framing components. These have been used to



Typical design curve for U-value against type glass type and size

produce design charts showing typical U-values for various areas of glass, glazing U-values and mullion spacing. Further design charts allow for the inclusion of opening lights that will increase the U-value and of opaque panels that will reduce it.

The guide also gives advice on the detailed calculation of U-values. Because of the non-uniformity of the wall with highly insulated panels and less well-insulated

frames, there is a high degree of lateral heat flow within panels. This invalidates the use of centre panel U-values and requires the use of ψ -values to represent edge losses. Pr EN 13947 gives default ψ -values but the analysis by CWCT has shown that lower ψ -values can be attained using deeper thermal breaks and non-metallic pressure caps. Additionally the CWCT work has determined typical ψ -values associated with opening lights installed into curtain wall mullions and transoms. These values are built in to the design charts used for preliminary design and may be calculated precisely for the purposes of verification of the final design.

The thermal assessment of window assemblies and non-traditional walls is published jointly by the Centre for Window and Cladding Technology and the Council for Aluminium in Building.

For further information please contact Mrs Zhihong Liao at CWCT (01225 386541; E-mail cwct@bath.ac.uk).

'Critical Chain' project management *dti*

Not all projects overrun on programme. But often it is dedication rather than a smart approach to project management that is responsible for delivering projects on time. Could project management be made easier? A construction research project funded by the DTI's Partners in Innovation programme, which looked into the application of a new approach to project management called 'Critical Chain', suggests that the answer is a qualified 'Yes'.

The starting point is to challenge the way that uncertainty is dealt with in conventional project management. A project is made up of a series of dependent tasks whose durations are by their nature uncertain. We like to work with task durations that have a high degree of certainty of being completed within the estimated time. However, to achieve this, we must include a time safety buffer for each task. The greater the desired level of certainty the greater the buffer.

This task safety buffer is very often wasted by normal human behaviours such as putting off starting work until the last possible moment, multi-tasking and Parkinson's Law. Tasks thus very rarely finish early despite their in-built safety buffer. In addition, any delay in the completion of an individual task is passed on to the next task, while gains in early task completion are often wasted. Is it therefore surprising that projects have a tendency to finish late?

So, what is the answer? The safety buffer



Critical Chain Techniques were tested on three Denne Group construction projects

in-built into every estimated task duration is often wasted; the Critical Chain approach is to aggregate a part of each of these individual task safety buffers and place it strategically where it can best protect the project from an overrun. So a strategic 'project' buffer is placed at the end of the longest chain of dependant tasks i.e. the critical chain. This project buffer acts as a shock absorber to take out the impact that delays on individual tasks will have on the agreed completion date.

Through a process known as 'buffer management' the project buffer also, importantly, can be used as a contract management tool to monitor and control the progress of the project. A simple software package provides a traffic light system for visual monitoring. Red indicates the project buffer is being used up faster than the rate of project completion and it is time to take recovery action. Green means individual delays are within the range that is to be expected, so leave the delivery team alone.

The project involved piloting critical chain on three residential construction projects, with construction partner Denne Construction. Greenwich University compared the outcomes of these projects against traditionally managed projects. Project management of the research was by the Centre for Performance Improvement and consultancy was provided by Goldratt UK.

Learning material developed includes a guide to the application of Critical Chain, a one-day introductory workshop and teaching material, plus a paper on the comparative study by Greenwich University, presented at the 2005 CIB Conference in Helsinki.

For further information please contact Nicholas Fowler at the Centre for Performance Improvement (E-mail nfowler@c4pim.org.uk; Website www.c4pim.org.uk).

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Mailing List – If you receive *Innovation & Research Focus* by direct mail (i.e. not with NCE) and your address is incorrect, please contact Kathleen Hollow at the Institution of Civil Engineers: kathleen.hollow@ice.org.uk.

Editor – Professor Eur Ing Roger Venables at Venables Consultancy, 12 Cranes Drive, Surbiton, Surrey, KT5 8AL UK (020 8399 4389; fax: 020 8390 9368; E-mail: irf@venablesconsultancy.co.uk).

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Construction Sector Unit
Department of Trade and Industry
Bay 286, 151 Buckingham Palace Road
London SW1W 9SS
(020 7215 0848 or 0826)
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E-mail: terry.boniface@dti.gsi.gov.uk

Department for International Development

1 Palace St, London SW1E 5HE
(020 7023 7000; fax: 020 7023 0072)
Website: www.dfid.gov.uk
E-mail: enquiry@dfid.gov.uk

Highways Agency

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Email annette.pas@highways.gsi.gov.uk.
Website: www.highways.gov.uk.

RESEARCH ORGANISATIONS

British Cement Association

Riverside House, 4 Meadows Business Park, Station Approach, Blackwater, Camberley, Surrey, GU17 9AB (01276 608700)
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E-mail: tdesaulles@bca.org.uk

Centre for Innovative and Collaborative Engineering (CICE)

Loughborough University, Loughborough, LE11 3TU (01509 228549; fax: 01509 223982)
Website: www.cice.org.uk
E-mail: j.c.brewin@lboro.ac.uk

Centre for Window and Cladding Technology

University of Bath, Claverton Down, Bath, BA2 7AY (01225 386541; fax: 01225 386556)
Website: www.cwct.co.uk
E-mail: cwct@bath.co.uk

CIRIA

Classic House, 174–180 Old Street, London, EC1V 9BP (020 7549 3300; fax: 020 7253 0523)
Website: www.ciria.org. E-mail: enquiries@ciria.org

HR Wallingford Ltd

Wallingford, Oxfordshire, OX10 8BA (01491 835381; fax: 01491 832233)
Website: www.hrwallingford.co.uk
E-mail: hrinfo@hrwallingford.co.uk

The Steel Construction Institute

Silwood Park, Ascot, Berkshire, SL5 7QN (01344 623345; fax: 01344 622944)
Website: www.steel-sci.org
E-mail: reception@steel-sci.com

PROFESSIONAL INSTITUTIONS

Institution of Civil Engineers

1 Great George Street, Westminster, London, SW1P 3AA (020 7222 7722; fax: 020 7222 7500)
Website: www.ice.org.uk
E-mail: enquiries@ice.org.uk

Institution of Structural Engineers

11 Upper Belgrave Street, London SW1X 8BH (020 7235 4535; fax: 020 7235 4294)
Website: www.istructe.org.uk
E-mail: mail@istructe.org.uk

Royal Academy of Engineering

29 Great Peter Street, London SW1P 3LW (020 7227 0500; fax: 020 7233 0054)
website: www.raeng.org.uk
E-mail: robert.barrett@raeng.org.uk

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