PRACTICAL APPLICATIONS FOR CONSTRUCTION AND THE BUILT ENVIRONMENT

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IN THIS ISSUE

SPLASH reviews national programmes on water research for developing countries

An important objective of the SPLASH Era-net (European Union Water Initiative European Research Area Network) is to exchange knowledge between different European partner research initiatives and to facilitate collaboration between them. As part of this, SPLASH recently surveyed programmes relating to water research for developing countries, funded or co-funded by the national governments of the 11 SPLASH partner countries. This provided an analysis of thematic and geographic research areas covered, capacity development, funding issues, programme development, dissemination activities, and the potential for joint activities.

Gathering of SPLASH partners

Within the thematic area of water research for development:

- the main sub-themes are 'more crop per drop', 'protecting eco-systems' and 'water and sanitation';
- clear areas of geographic focus are also revealed, with Africa and Asia receiving support from all countries, although there are gaps in coverage within this;
- programme funding is mainly by ministries, primarily to universities in SPLASH partner and beneficiary countries, and research centres and government institutions in developing countries;
- while there are different approaches to developing programmes, most identified research priorities internally, involving Southern organizations in the research design;
- it was found that more than half of programmes surveyed already incorporate some form of collaborative working with other national programmes or international organizations and initiatives.

While the aims, objectives and focus areas vary across the programmes surveyed, there is a good spread of support across the thematic areas, and all partner countries are involved in the Mekong region and in Africa, suggesting that these offer the greatest potential benefits for future collaboration.

Existing programmes show additional common characteristics such as capacity development, dissemination strategies, and clearly, collaboration between programmes and other national or international organizations is already underway.

The survey concluded that there are good opportunities for future joint programmes, without necessitating a significant shift in the existing research culture.

For further information please contact Peter O'Neill, Deputy Head, Central Research Department, Department for International Development (E-mail era-net@dfid.gov.uk).

DFID Department for International Development

Building information modelling

BERR

A report by ERABUILD, concluded in 2007 – *A Review of the development and implementation of IFC compatible BIM* – set out to benchmark internationally the development and implementation of building information modelling (BIM) compatible with the International Foundation Class (IFC).

An Integrated Building Information Model stores all of the building information that will be or is likely to be relevant during the total lifecycle of the building, and provides access to that information for the participating members. The ERABUILD project sponsors felt that the use of BIM and international open standards and neutral technology, which enable information flow and storage of all relevant building information data for the lifecycle of a building, could be an important contribution to the Strategic Research Agenda of the European Construction Industry.

The Report outlined the way to unleash the potential for digital BIM for the industry. Its authors saw this happening through the use of software technology and certification, high quality open international standards, as a drive for increased international collaboration, and examined contractual and process impacts.

The Report suggests policies for funding long-term research and educational programs, and suggests that further improvements should be user-driven, clearly dictated from business needs. However, to be able to effectively share information, three specifications must be in place.

- An exchange format is needed, defining HOW to share the information. IFC (an ISO standard in development) is such a specification.
- A reference library is next, to define WHAT information we are sharing. The developing IFD (International Framework for Dictionaries) Library, an implementation of ISO 12006-3, serves this purpose (see www.ifd-library.com for more details).
- Information requirements are also required, defining WHICH information to share and WHEN. The IDM/MVD (Information Delivery Manual/Model View Definition), also an ISO standard in development, forms that specification.

The report makes a number of technical recommendations including continued incremental improvement of the IFC specification, implementation of IFD in real usage scenarios, preferably in the early phase of the building process, and the development of open technology to allow integrated BIM merging models from various sources,

Process recommendations include improving the software certification process for IFC, development of international BIM Guidelines, further investigation of the impact on BIM of contractual and process issues and BuildingSMART technology in the AEC/FM Industry.

For further information the full BIM report is now available from the Erabuild website http://www.erabuild.net. See also the BuildingSmart website www.iai.org.uk and the IFD library http://www.ifd-library.com/.

ERABUILD is a strategic network for national Research & Development Programmes from Austria, Denmark, Finland, France, Germany, the Netherlands, Sweden, United Kingdom, Switzerland and Norway, and started in 2004. The aim has been to influence the European Research Area (ERA) on sustainable development in the construction and operation of buildings by preparing frameworks for trans-national R&D co-operation and learning networks, identifying best practices in programme management. A successor programme, ERA-COBUILD, has been approved by the European Commission and will commence in Summer 2008.

BUILDING SMART is an initiative by the International Alliance for Interoperability, which offers an industry-wide forum for the industry and government to work through due process to identify, test, review, recommend and implement smart ways to deliver quality buildings and services to the facility owner.

STRUCTURES & MATERIALS

New approach to early-age thermal cracking

ice

The ICE is supporting a study into an new approach to dealing with early-age thermal cracking in concrete, following an update of the CIRIA Publication *Early-age thermal crack control in concrete*, which was updated and published as CIRIA Publication C660 in February 2007.

A principal reason for the update was to align the design with the requirements of Eurocodes, in particular EN1992-3, which will replace BS8007 for design of liquid retaining structures. The technical work was undertaken by Dr Phil Bamforth under contract to CIRIA. He was supported by an expert Steering Group and Dr Steve Denton of Parsons Brinkerhoff provided specific expertise in the Eurocodes.

The revised guidance suggested that the Eurocode advice was un-conservative in some circumstances and proposed measures to reduce the risk accordingly. Following the publication of CIRIA C660, the author observed that some of the basic assumptions behind the cracking model of BS8007 (and which has been adopted by EN1992-3) may be incorrect, particularly in the way in which restraint is assumed to affect crack widths in members subject to continuous edge restraint.

Early-age thermal cracking in a wall on a stiff foundation

A new concept was proposed and it is this which is the subject of the current study supported primarily by the ICE, with additional support from the Highways Agency and the Concrete Centre.

The project, being undertaken by Dr Phil Bamforth and Parsons Brinkerhoff, is aimed at developing a model (primarily) for early-age thermal cracking that reflects more reliably the cracking mechanism and in particular the role of the boundary conditions (restraint) in the distribution and size of cracks within a member.

The model will be tested against field observations, published data and using FE analysis. A basis for a new design approach will be developed, aimed at being applicable for controlling cracking under any conditions of restrained contraction.

For further information please contact Dr Phil Bamforth (E-mail: phil.bamforth@btopenworld.com).

Wind and sea forecasts for coastal waters

HR Wallingford

Marine engineering operations vary from maintenance of sea defences through to the construction of new offshore wind-farms. There is a need to know precisely about wind and sea conditions so that personnel are not exposed to dangerous conditions and so that the expensive engineering facilities, such as cranes and jack-up vessels used for piling, are deployed optimally. This is particularly important during marginal sea conditions and amongst shallow banks and strong currents.

Wind/sea forecasts helped schedule piling operations by the jack-up vessel MV Resolution off the Lincolnshire coast (photo courtesy Centrica).

HR Wallingford has combined its skills and modelling capabilities with those of the Met Office to develop a forecasting service that provides site-specific and accurate real-timer predictions of wind and sea conditions. This service has been used by LNG tanker terminals, Network Rail and the Royal Navy. With the construction of the Lynn and Inner Dowsing offshore wind farms off the Lincolnshire coast, the service has been extended to include the UK renewable energy industry.

The new wind farms – to be installed and run by Centrica – should be fully operational by the end of 2008. Their output will meet almost 50% of Lincolnshire's annual domestic demand. The offshore construction operations – driving of monopiles, cable-laying, and installation of turbine towers, nacelles and blades – are restricted by specific safe operating conditions. The service has provided the construction team with site forecasts of the prevailing winds and waves and has thereby helped to maximise operational efficiency as well as to minimise risks.

Accurate predicting depends on representing the effects of the series of shallow banks to the north and west of the site that provide shelter (particularly at low tide) from the severe wave climate of the North Sea, and the influence of local winds.

The service comprises twice daily model runs that provide five-day forecasts on a secure website. Warnings are also directly given on any exceedance of predicted conditions over the defined safe operating thresholds. Actual measurements are provided on the web site alongside the forecasts – for ongoing confirmation of accuracy. Feedback from the construction team on the forecasting service has been positive – to date the system has proved its worth through the ongoing safe and efficient construction programme.

An illustration of predicted wave severity field for Lincolnshire Wind-farm sites is attached to the web version of this article and a pdf of the longer article is available there for downloading.

For further information please contact Nigel Tozer, Principal Scientist, HR Wallingford, (01491 835381; E-mail n.tozer@hrwallingford.co.uk).

Innovation technology for integration of health-care infrastructure planning, design, construction

CICE

This HaCIRIC research project at Loughborough University aims to apply advances in construction innovation technology (IT) in modelling, simulation and visualisation to develop an integrated approach to the planning, design, construction and operation of healthcare infrastructure.

The UK National Health Service (NHS) is currently undergoing transformation, with the Darzi review identifying access to GPs, hygiene and innovation as priorities. Innovative healing environments very much depend upon the design and construction of healthcare facilities that contribute to the quality of care and recovery process, whilst promoting therapeutic goals and enhancing operational efficiency.

Figure 1: *Advances in 3D CAD & 3D BIM were applied by Architects from Anshen + Allen for the creation, effective collaboration and integration of the mechanical, structural, electrical and plumbing systems for the Mills-Peninsula Medical Centre in California, USA. The ArchiCAD™ 3D BIM model was also used in collaboration with NavisWorks™ for pre-construction clash detection simulation tests.* (Image source: Graphisoft; Anshen + Allen).

Two further illustrations are attached to the web version of this article and a pdf of the longer article is available there for downloading.

Previous research has linked quality of care, patient health and wellbeing with the physical characteristics of the healthcare environment (Douglas and Douglas, 2004 and 2005). However, relationships between environmental stimulus and response are complex and not fully understood (Canter and Canter, 1979). An integrated approach is needed but this requires collaboration with various stakeholders, including those who might not be able to visualise solutions being present.

Current research has identified a need for evidence-based design strategies for patient-centred healthcare infrastructure and this can be provided by the application of innovation technology that benefits from advances in CAD, BIM, Parametric Modelling and Simulation, Visualisation, VR, AR and Virtual Prototyping.

Through a combination of state-of-the-art reviews, identification and study of good current practice, and modelling and simulation, this project will investigate a range of techniques, solutions, and strategies. It will also explore relationships and conceptual linkages between the physical environment, innovation and healing environments. It has as some of its objectives:

- the determination of UK and international application of innovation technology to healthcare infrastructure planning, design and construction;
- the development of a Healthcare Infrastructure Digital Mock Up Facility (HIDMUF); and
- the development of an integrated approach to the planning, design and construction of healthcare infrastructure.

For further information please contact at Loughborough University Professor Andrew Price (01509 222627; 01509 222604; E-mail a.d.f.price@lboro.ac.uk), or Emeka E. Osaji (01509 223641; E-mail e.e.osaji@lboro.ac.uk), or visit http://www.haciric.org/.

Highways Agency and VOSA join up for WASP – the Weight and Safety Partnership

Spotting overweight lorries on the road network had always been a bit of a problem – until the Highways Agency and the Vehicle & Operator Services Agency (VOSA) pooled their technology.

Weighing up the problem

VOSA has long sought a more-effective means of targeting non-compliant vehicles, especially HGVs, and it is an issue that the Highways Agency has wanted to deal with too. So when the subject came up at a joint workshop attended by the two organisations, Jamie Hassall, Network Operational Policy Team Leader in the Highways Agency, realised there was a simple solution.

"We realised that between us we already had all the resources we needed to identify overweight HGVs," explains Jamie. VOSA keeps a database of all vehicles in the country, and how much weight each is legally permitted to carry. The identifier for the vehicle is the registration number – which can be read with an Automatic Number Plate Recognition (ANPR) camera system. And at various points across the country, the Department for Transport has already placed weigh-in-motion sensors, simply to help monitor traffic flow and the weight of goods vehicles.

"The innovation was to link these together for the first time in the UK," says Jamie. Project WASP (Weight and Safety Partnership) was born.

(Top) *VOSA prepare to intercept a targeted overweight lorry*
(Above) *WASP real-time screen information, including vehicle identification and individual axle weights.*

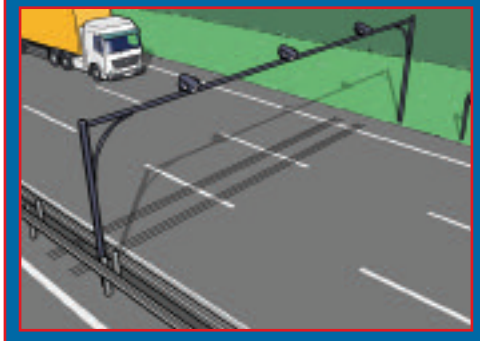
The sting

The operation sounds deceptively simple. Weigh-in-motion sensors (WIMS) in the road are used to weigh suspect vehicles. They operate entirely unobtrusively, measuring weight at normal road speeds, though a little less-accurately than weighbridges. At the same point, ANPR cameras record the number plate. These two pieces of information are matched up with the VOSA databases and if a vehicle is overweight, an alert appears on a computer terminal. A VOSA roadside team is contacted which then intercepts the targeted lorry and leads it to a nearby calibrated weighbridge for the precise actual weight to be ascertained. The actual weight is then fed back into the system, continually monitoring and helping to gauge the accuracy of the WIMS.

"Though ANPR and WIMS were already in use in our pilot area, they were not in the same location," says Jamie. "The sensors had to move 20 metres or so down the carriageway – and we had to make sure the sensors and cameras were close to a weighbridge so VOSA could do the main assessment quickly."

- One seriously overweight lorry can cause as much wear and tear on the road surface as 80,000 cars.
- For every 100 vehicles that were stopped on the basis of human judgment, prior to WASP, only around 12 would actually be overweight.
- In its two-year pilot, Project WASP has led to the prohibition of over 90% of overweight vehicles.

Project WASP: The basics



Step 1
Sensors in the road weigh the vehicle as it travels at normal road speed, while cameras record the number plate and a side view of the vehicle.

Step 2
The information is matched up with the vehicle's technical record and other VOSA databases and if the vehicle is overweight on gross, train or incorrectly loaded per axle, an alert appears on a computer, and an operator instructs VOSA colleagues who are waiting at the roadside to intercept the lorry.

Step 3
The VOSA intercept team then escorts the targeted lorry to a nearby weighbridge for an official calibrated weight assessment. Trucks that are breaking the law can be prohibited and their drivers and operators can be fined.

The system was piloted in the West Midlands and soon created a buzz among freight operators. "Project WASP was big news from the outset," says Highways Agency Project Manager Alan Rowley. "Due to its high success rate, the rogue haulage operators were quick to learn that something was happening."

"But it was the accuracy that was more important," says Alan. "The computer system meant VOSA was able to identify overweight vehicles far more easily – there was a 700% increase in its targeting effectiveness."

VOSA Senior Network Development Engineer, Malcolm Jones explained, "Currently at our site in the West Midlands, when the WIMS are used to identify and target overweight vehicles, over 90% are issued with prohibitions. These vehicles are then removed from the road until such time as their weight is reduced to within the legal limits."

Fine tuning

Important calibrations were made to the system once it was set up. For example, although the ANPR camera could identify the vehicle's number plate, for the teams on the ground, another camera took a side view of the vehicle which showed details such as make, type, a haulier's name, lorry colour and the axle configuration.

"Because there's a tiny delay between recording the information and identifying the vehicle," Alan says, "the side view camera had to be set up to take the picture 100 milliseconds after the ANPR."

It was these tweaks to the system that characterised what Alan describes as "a real team effort. Everyone was committed and the results speak for themselves."

The West Midlands pilot scheme won numerous awards for both the technology involved and the successful operation of the project. More significantly, VOSA gained Department for Transport funding to roll it out further across the network.

Widening the net

Two other sites are now in operation and during 2008 several more will follow. Highways Agency colleagues in each of our regions will help VOSA manage the rollout.

But there's still plenty of potential to develop the technology, as Richard Taylor, ANPR Policy Manager, explains: "As the WASP national rollout gathers pace, the technology will help reduce unfair competition that overweight lorries can exploit and levels of compliance are expected to increase significantly."

For further information please contact Richard Taylor, Highways Agency, 1st Floor, Woodlands, Manton Lane, Manton Industrial Estate, Bedford, MK41 7LW (0123 479 6232; Fax: 0123 479 6017; E-mail Richard.taylor@highways.gsi.gov.uk).

STRUCTURES, MATERIALS AND FIRE ENGINEERING

Successful fire test on light steel floor

As part of a development programme into the use of light steel framing, The Steel Construction Institute has carried out the first industry sponsored fire test on a light steel floor that achieves 90 minutes fire resistance to the BS EN 1365 fire test. The work was sponsored by Corus Strip and members of the Light Steel Framing Group.

Light steel load-bearing frames are increasingly used in buildings of up to 8 storeys, for which longer periods of fire resistance may be required, The introduction of the new BS EN 1365 fire test regime has required an extensive programme of re-testing, as it is more severe than the former BS 476–20 test, due to the use of plate thermocouples in the BS EN test.

Recent fire tests on load-bearing light steel walls show that 2 × 15 mm fire resistant boards fixed to resilient bars are necessary to achieve 90 minutes fire resistance. For floors, the fire performance is more sensitive to the particular details and boards used because, in fire, there is a tendency for the boards to bow or break away under their own weight, Furthermore, the load ratio acting on the joists is another variable, given that floor joists are generally not loaded to their full capacity when designed for control of deflections and vibrations.

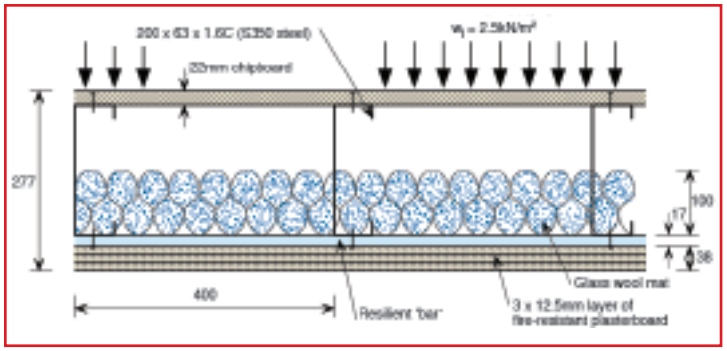
As part of the activities of the Light Steel Framing Group, a fire test to BS EN 1365 was carried out at BRE on 4th March in order to provide generic guidance for the light steel framing industry, The configuration of the light steel floor also satisfies the proposed Robust Standard Detail for acoustic performance in order that the information is widely applicable to practice.

The floor configuration that was tested is shown in the figure. Its span was 4.5m and the imposed load was 250 kg/m2. The calculated load ratio for the floors joists in the tests was 0.3 using S350 steel to BS 5950-8, Using this load ratio, the test results may be extended to other joists sizes, loads and spans.

The fire test supported the applied load for 93 minutes. Importantly, the joist temperature remained at less than 100C for over 80 minutes and so they would be essentially undamaged and re-usable, even after a severe fire. At 90 minutes, the joist temperature reached 280C, at which point the furnace temperature was over 1000C, The mean temperature of the upper surface was less than 60C, which was well within the 140C limit, During the first 80 minutes of the test, the increased deflection of the floor was less than 5 mm, in addition to an initial 9 mm static deflection under load. Even at 90 minutes, the deflection had only reached 30 mm, which was well below the span/30 limit (or 140 mm) to the fire test standard.

The information from this test will be used in the update of SCI Publication 129 *Fire Resistance of Cold Formed Steel Members*.

For further information please contact Mark Lawson, SCI Professor of Construction Systems at the University of Surrey, Chair of the Light Steel Framing Group (01344 636525; E-mail: m.lawson@surrey.ac.uk).



(Above *Cross section through the light steel test floor for 90 minutes fire resistance*
(Left) *View of the light steel floor under a load of 250 kg/m² at the end of the 90 minutes fire resistance test at BRE*

Uniting Construction Information (UCI) – a Virtual Enterprise

BERR

It has long been recognised that the construction industry has been confused by the existence of so many IT organisations acting for, and on behalf, of the industry. This confusion has slowed down the effective operation of each individual organisation as well as limiting the development and exploitation of IT within the industry. As a result, many of these organisations have regarded others as competitors, which has prevented them from collaborating effectively. Investigation has shown that the existing construction industry IT entities are on the whole complementary, with a healthy level of overlap between their services. There is a clear opportunity for these organisations to work collaboratively – celebrating their diversity, avoiding wasteful duplication and pursuing common goals for the benefit of the sector.

With the support of BERR, the Department for Business, Enterprise & Regulatory Reform (formerly the DTI), these organisations have agreed to act together to present a coordinated service to industry through collaborative working, partnering government and the academia. The new joint organisation Uniting Construction Information (UCI), will take the form of a virtual organisation that will benefit both the IT organisations and, ultimately, the construction industry as a whole, by facilitating collaboration, and demonstrating trust and commitment. The UCI website launch and a formal launch of the organisation are due soon.

UCI Vision: To improve the performance of the UK construction industry through the better use of Information and Communication Technology.
UCI Mission: To establish an effective network of organisations in construction.
UCI Value: It is based on trust, sharing and collaboration.

There are ten founder members of UCI:
Construct IT for business (CIT) is an industry-led non-profit making collaborative membership-based network.
ICE Information Systems Panel (ISP) acts as a channel to support the industry through knowledge transfer projects and organisations.
IT Construction Forum (ITCF) is a special initiative forum within Constructing

UCI aims to harness the power of IT to transform the industry

Excellence providing a dissemination service for IT Guidance.
IAI Building SMART UK Chapter: Building Smart is the new branding of IAI specialised in using Building Information Modelling (BIM) and IFCs.
Construction Industry Computing Association (CICA) is a division of the National Computing Centre that provides independent guidance and networking.
ICE/ICES Geospatial Engineering Board (GEB) is a professional board of those people working within the built and natural environment involved in the construction and maintenance of, and output from, the Geospatial database.
The **Building Services Research and Information Association** (BSRIA) is a research, consultancy and test organisation that helps companies in the built environment become more efficient and effective.
Construction Opportunities for Mobile IT (COMIT) is a community that specialises in helping its members to realise benefits from the use of mobile information and communicate technologies (ICT).
Construction Industry Trading Electronically (CITE) is a collaborative electronic business initiative for the UK construction industry specialises in developing data exchange specification.
The **Network for Construction Collaboration Technology Providers** (NCCTP) is a network helps to promote the effective use of online technology to support collaborative working on projects and capital developments in UK constructions.

For further information visit the UCI website coming soon at www.UCINet.info or contact Farzad Khosrowshahi (E-mail f.khosrowshahi@salford.ac.uk) or May Bassanino (E-mail M.N.Bassanino @salford.ac.uk), both at the University of Salford.

STRUCTURES AND CODES

Eurocode training resource

SCI

Education and Culture DG
Lifelong Learning Programme

SCI is leading a partially-European-funded project to develop a high-quality online Eurocode training resource for steel design and construction. The project will also review frameworks in partner countries and explore opportunities to standardise professional engineering qualifications and training materials across Europe.

Partnered by the Institution of Structural Engineers, SCI is working on the project with the Czech Technical University and the Romanian based Britt Engineering and Association of Engineers. The project will culminate in the delivery of 12 e-training modules ready for autumn 2009.

As part of the project, SCI and its partners are reviewing existing online delivery tools, identifying end-user needs and selecting Eurocode topics and multi-media tools to include in the online training material. In addition to addressing key Eurocode skills needs, the training will complement traditional SCI courses and be designed to encompass CPD requirements.

SCI is working with engineers to explore resource availability and the structure of the learning material. The engineers will also be called upon to test the new training resource and provide feedback for its development.

Ultimately, the project will contribute to a wider initiative for a European qualifications framework to guarantee competence through recognisable and comparable degrees. Currently it is difficult to compare levels of competence across Europe due to lack of comparability and standardisation between engineering degrees and qualifications.

For further information please contact Melissa Barber, SCI (01344 626583; E-mail: m.barber@steel-sci.com).

New approaches for accessing environmental data-bases

In environmental engineering projects where large amounts of data are available and need to be made readily accessible to a range of engineers and scientists, there is a need to improve and streamline data-base management and data delivery. HR Wallingford has moved to implement new systems - mainly in the coastal zone sector, but applicable to all aspects of environmental engineering.

There is increasing recognition of the need to adopt 'open standards' for data exchange so that components of data systems can be built independently, yet can still interoperate with one another. But where the data is primarily concerned with observations of environmental parameters such as waves, currents and sediments, how these standards should be implemented is not yet fully established. Informatics experts at HR Wallingford have started to pull this emerging technology through into the operational systems used in real-life situations.

One of the emerging standards is the Web Feature Server specification from OGC (the Open GeoSpatial Consortium). Historically, this standard evolved for delivering data that would constitute a layer of data on a map, such as a road network. HR Wallingford has recently deployed this technology so that it can be used for delivery of observational or measurement data-sets. The Web Feature Server (WFS) deployment has been used to provide and manage access to marine data of Dubai Municipality; and more recently for NERC's environmental data.

The core of the WFS approach is to provide a consistent interface to an underlying and generally heterogeneous set of data-bases, and which allows different portals to be developed for varied users with different requirements. Although WFS is already in use for traditional map layers, this marine environment application is an early serious use of the system to procure observational and measurement data. The features delivered by the WFS approach cover a range of observation types related to moored instrument deployments and beach surveys.

For further information please contact Keiran Millard, Head of Informatics, HR Wallingford, (01491 832398; k.millard@hrwallingford.co.uk).

(Top left) *Users can easily find beach survey data*
(Left) *Daily conditions are monitored continuously from the top of the Burj al Arab*
(Photo HR Wallingford)

INNOVATION IN RESEARCH

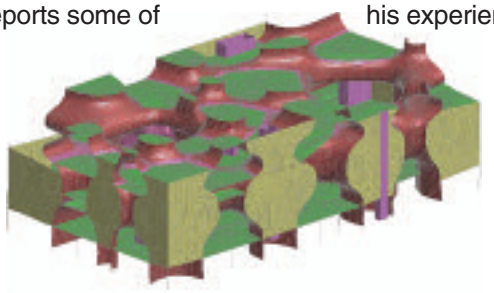
Industrial secondment stimulates new research

Dr Paul Greening of University College London (UCL)'s Department of Civil, Environmental and Geomatic Engineering spent a six month Royal Academy of Engineering-supported Industrial Secondment with Arup's Advanced Research Group. He reports some of his experiences here.

After seven years as a lecturer at UCL I decided the time was right to grasp the nettle and apply for the Royal Academy of Engineering's Industrial Secondment Award. My aim was to update my knowledge of state-of-the-art industrial practices with a view to refocusing my efforts in research and teaching and bringing my research to the forefront of the industry, thus facilitating academia-industry knowledge transfer.

In practice my period with Arup provided a far richer experience than I had expected as I had the opportunity to get involved in and make an input to a wide range of demanding projects.

A significant amount of my time was spent on suggesting and validating modifications to a sophisticated concrete material model that was incorporated into a finite element code. This resulted in an improved understanding of how in-service loading of concrete structures can change the way they vibrate, as well as a reliable means of predicting the dynamic behaviour of reinforced concrete. This part of the work involved the modelling of a hospital floor and provided explanations for the reasons of the discrepancies between the predicted and recorded structural vibrations. It is my intention to continue this thread of work through both undergraduate and postgraduate research students. The results of this work were submitted for presentation at the World Congress on Earthquake Engineering.



Finite Element Model of an Opera House

I was also involved in using the concrete model for the analysis of an opera house structure with the complex geometry illustrated in the figure.

My work involved the validation of the material model against available empirical data. Since the location of the opera house is seismically active, I was also involved in analysing the effect of an earthquake on the structure and in justifying the optimisation and performance based design technique to the stakeholders. This project resulted in an animation of the structure moving, cracking, yielding in some places – but remaining life-safe – even after an earthquake of a rare intensity.

These headline results indicate only a part of what I gained from the secondment. The secondment, for example, has already spawned several undergraduate research projects and many more will follow. Former colleagues at Arup are also offering their teaching and/or mentoring services to UCL students.

From a personal perspective, the secondment has renewed my enthusiasm for the subjects I teach and improved my credibility as a teacher of future engineers!

For further information on the Industrial Secondment Scheme please contact Dr Imren Markes at The Royal Academy of Engineering (020 7766 0600; E-mail imren.markes@raeng.org.uk).

For further information on this work please contact Dr Paul Greening at UCL (020 7679 2718; E-mail paul.greening@ucl.ac.uk).

Eurocode 2: Assistance with transition

The Concrete Centre

BCA

With the British Standard for the Structural use of concrete (BS 8110) being withdrawn, the Concrete Centre has been working with industry partners to produce a range of tools to assist with the transition to its replacement, Eurocode 2.

The UK construction industry faces a major challenge with the replacement of British design standards by Eurocodes. It is a challenge that could prove expensive. According to a report by the Institution of Structural Engineers, the transition could cost a typical consulting practice £250,000. The report, *National Strategy for Implementation of the Structural Codes: Design*, found that the greatest cost will be a 10% loss of productivity during the first year as staff get used to the new Codes. This alone could cost as much as £128,000.

Economic Benefits

Despite the initial cost, however, economic benefits are expected to be derived from using the new Codes. For concrete design, it is expected that there will be material cost savings of some 5% compared with BS 8110. In addition, Eurocodes are less restrictive than British Standards, with a logical, well-organised layout that avoids repetition. They are also technically advanced and should provide opportunities for UK designers to work in other European countries.

Transition

In the UK, the Concrete Centre is leading the transition to Eurocodes. The main UK National Annex for concrete was published in December 2005. Since that time, the Centre has been working with a number of industry partners to ensure that there is a wide range of resources to assist with the changeover to Eurocode 2.

A website (www.eurocode2.info) provides advice and assistance on the introduction, interpretation and implementation of the new Code. In addition, the Concrete Centre offers courses and has produced a compendium of 'How to' guides covering slabs, beams, columns, foundations, deflections, detailing etc. It has also published '*Concise Eurocode 2*' which summarises the main parts of the Code and provides explanations to all necessary clauses.

A similar guide in two parts has also been published by British Precast (www.britishprecast.org), entitled '*Precast EC2*'. Part One is a design manual that explains the basis of precast concrete design to Eurocode 2, and includes useful design aids in its three appendices. To complement this, Part Two contains a range of worked examples.

For further information please contact Owen Brooker at The Concrete Centre (0845 812 0000; E-mail: info@concretecentre.com).

SPONSORING ORGANISATIONS

GOVERNMENT

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