

# Innovation & Research



Issue No. 85 Also at [www.innovationandresearchfocus.org.uk](http://www.innovationandresearchfocus.org.uk) May 2011

**IN THIS ISSUE**

<b>Assessment Tools</b>	
Sustainability achievement recognised	4
<b>Construction management</b>	
Improving innovation management	2
<b>Dredging</b>	
Dredging and disposal of materials	4
<b>Energy &amp; Carbon</b>	
Organic PVs – clean electricity	2
UK energy efficient buildings success	5
<b>Engineering History</b>	
Budapest Chain Bridge	3
<b>Modelling</b>	
Modelling for surface water flow	7
<b>Renewables</b>	
Organic PVs – clean electricity	2
<b>Research &amp; Innovation</b>	
Coastal Sediment Systems Research	6
Improving innovation management	2
UK energy efficient buildings success	5
IRF distribution change	5
<b>Structural Engineering</b>	
Structural use of ferritic steels	8
<b>Sustainability</b>	
Outstanding achievement recognised	4
<b>Waste Management</b>	
Dredging and disposal of materials	4
<b>Water Environment</b>	
Modelling for surface water flow	7

## Improving construction process efficiency

In the Low Carbon Construction Innovation and Growth Team Report (IGT), Paul Morrell, the Chief Construction Adviser, says that the construction industry faces ‘the biggest change management programme that the industry and the society it serves has faced since Victorian Times’.

The Modern Built Environment Knowledge Transfer Network (MBEKTN) has been working on a Process Efficiency theme to help the industry capitalise on this change. The MBEKTN works as a conduit for the Technology Strategy Board, both gaining industry input for the calls and then promoting them to industry. The theme covers the narrow definition of process in terms of the efficiency of a construction project, but also looks wider to ensure that buildings are effective and meet the design intent, promoting building performance evaluation and examining user behaviour in buildings.



itself forms two of the IGT recommendations.

In a workshop, jointly promoted by UK Contractors Group, Constructing Excellence and CPIC (the Construction Project Information Committee), the MBEKTN investigated some of the developments of BIM, and found that the greatest barrier to uptake was seen to be determining ownership of the model. The likely outcome would be that the client or the whole team jointly would own it. The majority of delegates agreed that ‘it is important that govern-



*Building Information Modelling is seen as a tool able to transform the practices and, potentially the structure of the industry. Photo courtesy of and copyright of 2011 TEKLA Corporation*

The MBEKTN set up the Process Efficiency Task Group at the start of 2010. The Task Group undertook an industry survey and identified three top challenges for the industry:

- integration;
- making the consideration of whole life issues a reality; and
- motivating people to change and to be prepared to innovate.

Process issues are covered in the Technology Strategy Board’s Low Impact Buildings Programme, and aspects of process innovation either are, or will be, subjects for TSB Challenge Funding.

When delivering its report to the Technology Strategy Board on aspects that the Task Group felt would give the best potential for improvement in efficiency, one of the most important issues brought up was the rapid take up of Building Information Modelling (BIM), which

ment mandates BIM’. The audience was less sure about whether it was ‘important that BIM is required in submissions to Building Regulations and other statutory duties’. Most disagreed with the statement ‘there is insufficient evidence that BIM saves money’. When asked ‘who is most likely to make money from BIM’, encouragingly, 49% felt that this would be ‘everyone’, 26% the client, and 17% the tier one contractor.

Industry evaluation on the use of BIM methodologies is advancing rapidly. The MBEKTN will continue to promote discussions about BIM to reduce the uncertainties that surround it, and will be joining with ICE and others to hold another joint conference in the autumn.

*For further information please visit [www.mbektn.co.uk](http://www.mbektn.co.uk), where discussion forums and special interest groups provide a hands-on introduction to its work.*



# Improving innovation management in construction



Innovation, the successful exploitation of an idea, provides an essential means by which construction firms can improve and meet some of the many economic, social and environmental challenges faced in these uncertain times. It is of little surprise that a growing number of firms are seeking ways to manage innovation in a more proactive and conscientious manner. However, progress has been hindered by a lack of research and understanding of innovation in the construction context, and by the absence of practical guidance for those who aspire to improve innovation performance. There is an urgent need to address this and equip construction firms with practical and effective approaches for improved innovation management.

**A** research project that set out to bridge this gap has been conducted on behalf of CICE at Loughborough University and VINCI Construction UK Ltd under the EPSRC Engineering Doctorate (EngD) programme. This collaboration, coupled with the application of an action research methodology, enabled a highly applied approach to the research during the course of the four year project.

The industrial sponsor presented two significant challenges: firstly to assess innovation performance and, secondly, to develop and implement interventions to improve performance. These key objectives suited the cyclic process of diagnosing, planning and taking action, and evaluating the action defined by the adopted research methodology. Two complete cycles were achieved during the four year timeframe and a combination of qualitative and quantitative research methods were applied, including surveys, focus groups, statistical analysis and triangulation.

Based on the findings the sponsor now supports the innovation process by ensuring that people have the required means (e.g. knowledge & ability), motives (e.g. incentives & direction) and

opportunities (e.g. time & resource) to execute each process stage through a continuous management cycle of diagnosing, planning and taking action. This flexible approach reflects the changing needs of innovation and the absence of an 'off-the-shelf' solution.

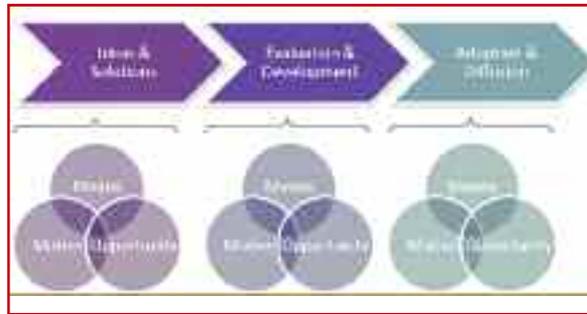
- The research has also provided:
- a novel insight into the significance of and relationships between factors that influence innovation in a construction firm, highlighting the areas to consider when developing a strategy or intervention for improved innovation management.
  - the development and application of a

method for the measurement of innovation in the construction firm, demonstrating a set of suitable indicators for monitoring inputs, outputs and outcomes of innovation;

- the development, implementation and evaluation of two interventions for the improved management of innovation, providing practical guidance for those who seek similar goals; and
- an example of how an action research methodology can be used to systematically diagnose, plan, take action and evaluate interventions for improved innovation performance in a construction firm.

This project has helped to raise awareness and understanding of innovation in construction, including the need to monitor and manage performance and practical ways by which this may be achieved. As a result, the sponsor has benefited from increased performance from its innovation budget, year-on-year improvement in terms of employee satisfaction with innovation support and participation, and a healthier innovation portfolio.

*For further information please contact Nick Shaw at VINCI Construction UK (E-mail: [nicholas.shaw@vinciconstruction.co.uk](mailto:nicholas.shaw@vinciconstruction.co.uk)).*



*The Innovation process stages*

## RENEWABLES & CARBON

# Organic PVs: clean electricity from carbon



Every hour enough energy arrives at the surface of the earth from the sun to meet humanity's energy requirements for a year. The challenge is to harvest even a small proportion of this energy in an economically viable and sustainable way. Recent technological innovations in conjunction with changes in the global energy landscape have dramatically increased demand for photovoltaic (PV) technologies. The unique selling point of PVs is their ability to silently convert sunlight directly into electricity without any moving parts or emissions, making them ideally suited for integration into the fabric of buildings. Whilst today's PV technologies jostle for market share in this burgeoning sector, the next generation are poised to disrupt the party in the near future.

**O**ne such technology is 'organic photovoltaics' – which utilise sub-micron films of organic semiconductors (molecules or polymers) sandwiched between two electrodes.

The low thickness of these devices renders them inherently light weight, low profile and compatible with conformal substrates. They also offer the advantages of low temperature fabrication using low cost deposition methods and are free of heavy metals and other toxic elements.

This class of PV technology also offers the possibility of integration into windows, since they can be tailored to harvest only specific parts of the solar spectrum whilst being transparent to others. The potential for controlling the colour raises the possibility that they might also be used indoors.

The first generation of organic PVs are set to be commercially available within a year with



*A flexible organic photovoltaic device fabricated in the Hatton laboratory.*

operational lifetimes and efficiencies matched to portable consumer electronics. From a theoretical perspective, and what is already known about the stability of organic semiconductors, the ultimate goal of integration into buildings is achievable. With the current pace of developments this may be a reality within a few years.

One critical determinant of both the operational performance and cost of organic PV is the window electrode, which must efficiently couple light into the device and extract current to the external circuit. Dr Ross Hatton (University of Warwick) leads a programme of research focused on understanding the science that underpins the operation of the transparent electrode in organic PVs and the development of new electrodes specifically for this application.

# Learning from the past – Budapest Chain Bridge



The building of the Chain Bridge over the Danube (1840-49) connecting the towns of Buda and Pesth (Budapest since 1873) was one of the major British civil engineering achievements in the first half of the 19th Century. The three main participants were Count Stephan Széchenyi, William Tierney Clark CE FRS and Adam Clark.

The Hungarian reformer, Count Széchenyi, met Tierney Clark (See the ICE Biographical Dictionary entry by Mike Chrimes) in 1832 when he came to England for a systematic search to find the most appropriate bridge design and the best engineer to build it over the ice-bound river.

As soon as the Count saw the Hammersmith Chain Bridge, where Clark worked and resided, he was convinced that he had found both the right design and engineer (by that time Clark was in the process of completing his third chain bridge). From then on Széchenyi and Tierney Clark had a close, even affectionate, association and corresponded with one another. Adam Clark (no relation), employed by Tierney to superintend the building, was a young Scot who remained in Hungary for the duration of the construction. Tierney Clark directed the works through letters and during his annual visits, sometimes in the company of his nephew Bland William Croker.

In his will, Tierney Clark left all of his drawings, papers and books to Croker. After Clark's death in 1852 this material disappeared, assumed destroyed as not a single item has come to light. Fortunately most of the archival material connected with the bridge survived in Budapest archives. A presentation by researcher Sandor Vaci to Lawrence Hurst and Mike Chrimes of the

ICE demonstrated that this important part of British civil engineering history was abroad and proposed that it should be digitised and catalogued to make it available for study anywhere else in the world. Subsequently ICE entered into a contract with the Budapest History Museum to lead the archiving project there.

The project will have a searchable catalogue organised around nine different headings for archive references, subjects, dates, originators, recipients, sent to and from, and sizes of drawings. The manuscript material will be restored in some cases (outside the funding) and scanned or photographed at high resolution in colour. This will make it possible to study any item in detail and obviate handling the originals in the future.

There are three main depositories of this material in Budapest.

The Budapest History Museum keeps the Adam Clark archive. This includes: Tierney's letters to Adam over a ten-year period; Adam's letters to his parents, which often mention his work on the bridge; miscellaneous correspondence and documents (including a Passport to Adam issued by Palmerston); Adam's workbooks; and drafts of some of his letters to Tierney, 174 items in all.

The Hungarian Academy of Science's archive has the Széchenyi-Tierney Clark correspondence (59 items). These are Tierney's letters to the Count and copies of Széchenyi's to Clark, bearing in mind that those he sent have been lost in Hammersmith.

The Hungarian National Archive is the depository of the drawings and some letters and reports related to the building of the bridge. The most important drawings, particularly those with Tierney Clark's signature, have been selected out of over three hundred.

Besides the Budapest archival material, eight letters, written during his annual journeys by Tierney Clark to the secretary of the Water Company, will also be included as being of special interest (these are kept at the London Metropolitan Archives).

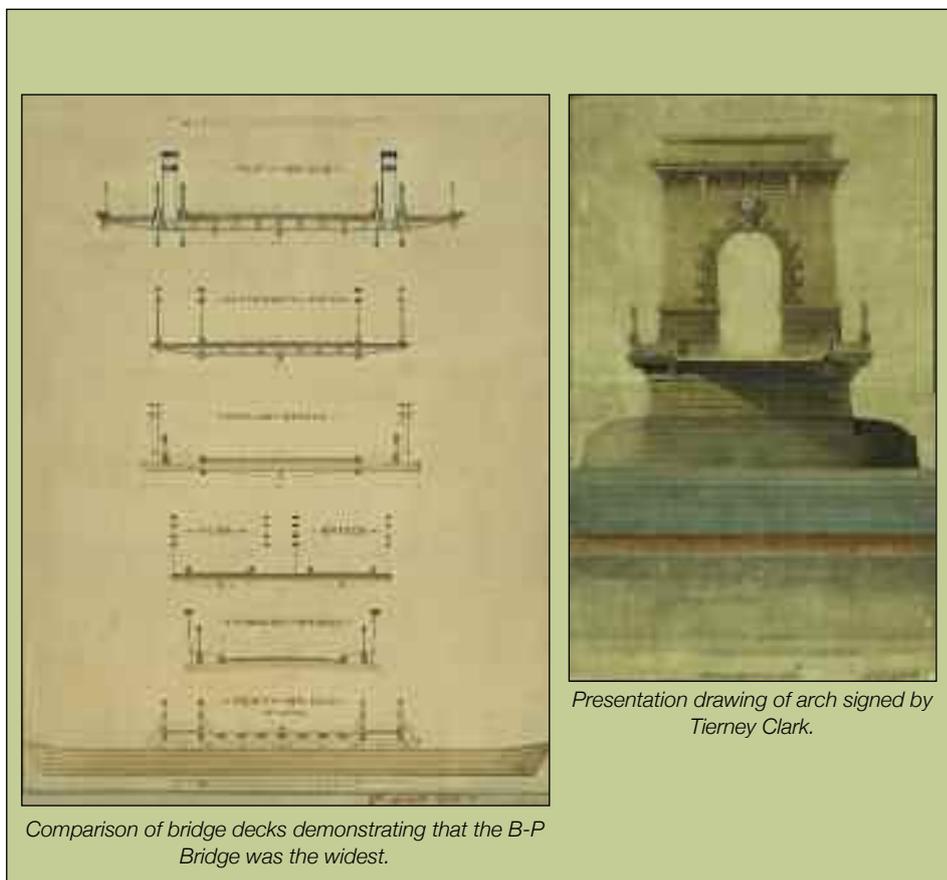
The completion of the Archiving Project is expected at the end of 2011. The entire material will be available on DVDs and later put on the internet. A condition of the funding was the submission of a paper for the Proceedings by the curator, Roland Perényi of the Budapest History Museum.

*For further information please contact: Mike Chrimes, Director, Engineering Policy & Innovation, ICE (020 7665 2250. E-mail [mike.chrimes@ice.org.uk](mailto:mike.chrimes@ice.org.uk)).*

The complexity of organic semiconductors combined with the small thickness of the photoactive layers requires that the electrodes are engineered on the scale of 1 billionth of a metre (i.e. 1 nm). In a recent report in the scientific journal ACS Nano, researchers in the Hatton Group have shown that decorating the surface of the window electrode with gold particles only 11 nm in diameter is an effective means of improving the efficiency of current extraction. Gold film electrodes perforated with micron-sized apertures have also been developed, in which the high cost of gold is mitigated by the low thickness used: < 9 nm. Details of the latter will be published in *Advanced Functional Materials*: Volume 21, Issue 9, May 10, 2011, Pages: 1709-1716.

Dr Hatton is a member of the EPSRC Supergen Excitonic Solar Cell Consortium, is supported by a RAEng/EPSC research fellowship, and has benefitted from support from the Advantage West Midlands/European Regional Development Fund (AWM/ERDF) Science City Research Alliance AM2.

*For further information please contact Dr Ross Hatton, Department of Chemistry, University of Warwick, CV4 7AL (E-mail: [ross.hatton@warwick.ac.uk](mailto:ross.hatton@warwick.ac.uk)).*



Comparison of bridge decks demonstrating that the B-P Bridge was the widest.

Presentation drawing of arch signed by Tierney Clark.

# Dredging and disposal of dredged materials



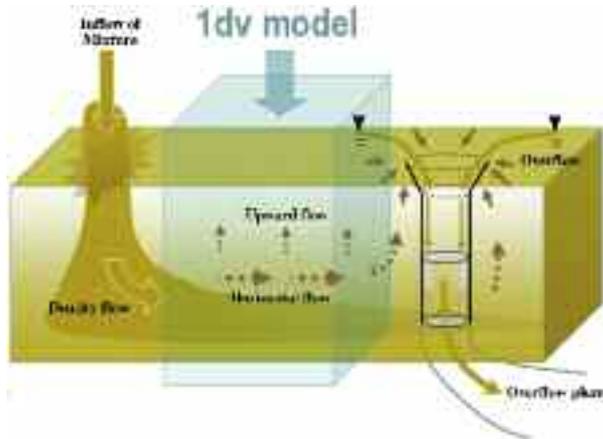
Dredging is carried out for a wide range of purposes including capital dredging (to obtain construction materials such as aggregates), relocating offshore sediments (to create reclaimed areas), maintaining shipping channels, creating trenches (for pipelines), and maintaining drainage channels. Depending on the depth of waters and the dredging rates that are required, different types of dredgers and dredging equipment are utilised by the specialist companies involved.

**C**ommon to all dredging operations over recent years has been growing concern about adverse environmental impacts. The dispersion of sediment from the dredging operation, as well as the disposal of dredged materials, can have many adverse environmental repercussions. These include changes in seabed level, light reduction and even smothering of marine flora and fauna, and adverse effects on ecosystem diversity through profound changes to sediment and nutrient levels.

In order to plan and manage dredging operations a range of software systems are used to simulate all aspects of the operations. A key part of the modelling process is to simulate the drift and spread of dredging plumes of sediment arising from dredging. The accurate measurement of dredging plumes is technically challenging and HR Wallingford has engaged with the Dutch and UK dredging industries for many years in the measurement and improvement of plume models.

HR Wallingford maintains extensive knowledge about such hydraulic and environmental aspects of dredging. A recently completed study has provided accurate simulation of how sediment behaves once it has been pumped into the dredger's central hopper. Along with the dredged material the hopper receives an inflow of copious amounts of seawater.

The new model simulates the sediment transport in the hopper as the incoming flow



Top: Representation of flow characteristics inside the hopper tank of a dredger.  
Above: Modern dredger, of trailing suction hopper type (Photo: HR Wallingford).

gradually makes its way to the hopper overflow. During this process the larger sediment particles drop to the floor, while the excess water that flows out inevitably contains high

concentrations of finer sediments.

The discharged sediment forms a plume in the surrounding waters, but the field evidence is that most of the sediment released from the hopper descends to the bed depositing locally to the dredger. The direction of movement of the remaining plume left in the water column depends on the nature of the local currents. An accurate prediction of the nature and rate of discharge of the material exiting the hopper has a strong bearing on the accuracy of the predicted fate of sediments in the overflow plume.

The new hopper model solves the horizontal and vertical current velocity and sediment concentration through the water depth using a 1dv model. As part of the EcoShape Project the model has been validated against detailed field data from dredging for a range of locations, dredgers and sediment types and has been found to reproduce accurately the measurements of overflow and hopper loading.

This development is part of a larger collaboration (with the EcoShape Project) to develop reliable predictive tools for assessing the effects of plumes from trailer suction hopper dredgers.

*For further information please contact Dr J Spearman, Principal Scientist, Coasts and Estuaries Group, HR Wallingford (01491 82246; E-mail: [j.spearman@hrwallingford.co.uk](mailto:j.spearman@hrwallingford.co.uk)).*

# Outstanding achievement in civil engineering and sustainability recognised



Improving sustainability performance in civil engineering remains a key industry and government objective. CEEQUAL – the assessment and awards scheme for improving sustainability in civil engineering, landscaping and the public realm – has further extended its coverage with its first Outstanding Achievement Awards presented in March.

**T**he awards recognised project teams who had demonstrated 'pinnacle best practice performance' in any of the twelve sections of their CEEQUAL Assessment. From 34 shortlisted applications, a diverse group of projects were chosen by the judges for their demonstration of genuine excellence. Further details of the projects and organisations receiving awards are at [www.ceequal.co.uk/outstanding\\_achievements.htm](http://www.ceequal.co.uk/outstanding_achievements.htm).

Examples of the high performance that gained the awards include:

- working very closely with neighbours on house-to-house vibration monitoring, and an altered design to avoid driven piles;
- extensive collaborative work between engineers and environmentalists;



The new deep foul sewer pumping station at the Olympic Park.

- very high standard of care for the water environment, including upstream as well as downstream monitoring;
- excellent recognition of ancient and indus-

trial heritage on site, the integration of features and their learning legacy website;

- all-round excellent waste management practice, in particular for the innovative uses found for the tunnel arisings;
- sensitive design for the setting, careful use of trees – and their retention – and for creating not a car park but a Park for Cars;
- comprehensive invasive weed control strategy, for 'not throwing chemicals around' and for setting the standard for how others should deal with ecology and biodiversity issues on projects.

*For more information on CEEQUAL, please email Melanie Manton at [Melanie.Manton@ceequal.com](mailto:Melanie.Manton@ceequal.com).*

# Energy-efficient buildings success

The vision of the Energy Efficient Buildings European Initiative (E2B EI) is to deliver, implement and optimise building and district concepts that have the technical, economic and societal potential to drastically decrease energy consumption.

The first call of the E2B EI has shown significant success for UK organisations as partners, and as key contributors to projects selected for funding by the European Commission. UK companies are participating in a range of projects including examining CO<sub>2</sub> reduction through integrated design and simulation using BIM technologies, wireless HVAC controls, energy hubs, and CHP network technologies.

The HIPIN project is focused on providing insulation having improved performance. The project is coordinated by TWI Ltd in Cambridge (UK) and will start its activities within the second half of 2011. Other UK partners are Arup and Thomas Swan and there are seven more partners from Belgium, Italy, The Netherlands, Sweden and Turkey.

The use of traditional insulating materials requires a substantial thickness to meet code requirements. This can mean that the thickness of insulation leads to noticeable and unwelcome reductions in floor area, or a reduction of the packing density of buildings in urban environments. HIPIN's approach is to develop new nano-based aerogel materials as part of an overall insulating material solution.

Aerogels have thermal conductivity in the range 0.004 - 0.03 W/mK, which compares very favourably to conventional construction materials. However, to date, aerogels have been considered to be too expensive and mechanically fragile to make their widespread use in the construction sector possible.



The E2B Initiative's ambition is that all European buildings will be designed, built or renovated to high energy efficiency standards by 2050.

Targets of the HIPIN project will include:

- Development of aerogels that are much more resilient and robust, to be incorporated into insulation systems without damage. The development of more robust aerogels will also contribute to cost reduction.
- Developing approaches that allow aerogels to be incorporated into a suitable vehicle that can be applied as thick paint layers or even thicker coatings. It is essential that the approaches developed can be used on both new build and retrofit, using techniques that are familiar to today's construction industry.
- Producing a surface on the insulating coating that has a lower than typical emissivity, in order to reduce heat losses and gains through the envelope.

If successful, the project will reduce the heat losses and gains through the building envelope,

achieving reduced energy consumption and increased indoor comfort. Particular care will be taken to ensure that the performance is effective over time and the products developed are easy to maintain.

The E2B EI is managing a €2 billion research and demonstration programme from 2009 until 2019. To date the EC has committed €100 million for the period 2010 to 2013.

The E2B EI will increase the level of research into key technologies and develop a competitive industry in the fields of energy efficient construction processes, products and services.

BIS is keen to ensure that UK companies get their share of the funding opportunities available under the E2B initiative. The Modern Built Environment Knowledge Transfer Network has set up an Access E2B group to:

- help UK increase its capabilities;
- raise awareness of the Energy Efficient Buildings European Initiative in the UK;
- develop working relationships between relevant international, national and regional groups; and
- signpost other existing support services.

For further information contact the MBE KTN's Access E2B Leader, Alison Nichol (01923 664550; E-mail: [alison.nichol@mbekttn.co.uk](mailto:alison.nichol@mbekttn.co.uk)). You can also visit the website of the E2B Association, a not for profit association acting as steering group for the E2B Initiative at [www.e2b-jti.eu/default.php](http://www.e2b-jti.eu/default.php).

## INNOVATION & RESEARCH

# IRF distribution to change, we hope for the better

The Sponsors of *Innovation and Research Focus* have agreed to a significant change to the way IRF is distributed. We hope that it will enhance the usefulness of the Newsletter to those who prefer their technical information to arrive electronically, without reducing the service to those who need or wish to receive it physically.

From the issue after next in the late Autumn, all those of you who presently receive a physical copy of IRF with *New Civil Engineer* and who have registered their email address with the Institution of Civil Engineers will receive their copy of IRF electronically.

You will receive an 'email alert' telling you that a new issue is available, with links to the website so you can view the latest issue there, and a link to enable you to download a pdf copy of IRF. If you receive a physical copy from one of the other sponsors,

they too will be transferring to electronic distribution.

But, if you do not have an email address or a quick internet connection, or would just prefer to receive your IRF as a physical copy, you will still be able to one.

We will seek to identify from sponsors which readers have not registered an email address and gather the addresses together. But the sure-fire way of ensuring, if you wish to, that you continue to receive a physical copy is to email the Editor's PA, Melanie Manton ([irf@venablesconsultancy.co.uk](mailto:irf@venablesconsultancy.co.uk)), or write to

her at the Editor's address on page 8, with your name and address asking to be added to the IRF (physical) mailing list.

We plan to use the resources saved by this change to improve the IRF website and to promote innovation in other ways. We will give more details in August's IRF86, which will be the last issue to be distributed in the current manner.

For further information please contact the Editor, Roger Venables, at the address on page 8.

# Coastal Sediment Systems Research Programme

Sustainable coastline management demands that planning decisions are made with the knowledge of long-term coastal geomorphological changes. An understanding of coastal trends will allow coastal planners to make more informed strategic policy choices. Subsequent short-term capital investments can then be wisely planned. The UK's Coastal Sediment Systems Research Programme addresses these challenges and is the result of an innovative collaboration between the Natural Environment Research Council (NERC), the Environment Agency (EA) and the Department for Environment, Food and Rural Affairs (Defra).

**T**his four year collaborative programme of research aims to improve the capability to predict long-term and regional-scale change on the coasts and in estuaries. It is the first outcome of cascading strategies that are starting to set the direction of travel for coastal research in the UK.

In addition to better understanding of coastal trends, climate change introduces a further imperative for making better planning decisions for coastal sediment systems. The Environment Agency's Long-Term Investment Strategy (LTIS) anticipates that investment in flood and coastal erosion risk management will need to double by 2035. Much greater future damage and investment cannot be ruled out, given the uncertainty in climatic processes and future flood and erosion risk projections. Globally these challenges are even larger.

The international coastal research and academic community have worked for a long time to improve understanding of coastal processes and geomorphological change. However, there are few modelling initiatives that are capable of exploring the dynamics between different coastal geomorphological features (such as cliffs, beaches, dunes and estuaries) as part of understanding long-term change and the linkage to flood risk.

The joint Defra/EA research programme has developed the Coastal Research, Development and Dissemination (CoRDDi) framework. This has a pivotal role in providing a link to the higher-level strategies, currently under development as part of the Living with Environmental Change (LWEC) partnership, such as the UK Flooding Strategy.

Within the CoRDDi Framework there is a portfolio of research priorities, including the development of tools and techniques to support better delivery of Flood and Coastal Erosion Risk Management. Priority projects for the next five years have been identified to deliver short-term tools, whereas

longer term efforts are set out for a clear direction of travel beyond that. A key thematic research area identified within the CoRDDi Framework is the need to improve our understanding of whole system behaviour, which includes the geomorphic response of the coast to hydraulic and sedimentary processes.

The collaboration between NERC and the joint Defra/EA Flood and Coastal Erosion Risk Management Research and Development Programme (the Defra/EA joint Programme) is the first outcome from the

CoRDDi framework. The primary aim is to take a significant step forward in improving the understanding of long-term coastal morphological changes.

The focus of this programme will be on the development of a 'systems-based' approach where the interaction between different geomorphological landforms, over relevant time and space scales, are represented through behavioural or reduced-complexity concepts. The programme clearly has international relevance, and international collaboration will be facilitated through a series of planned workshops, including French partners anticipated to be funded by the Agence Nationale de la Recherche (ANR) in 2011.

The first stage in this research saw the Modelling and Risk (MAR) Theme within the Defra/EA Joint Programme commission the Coastal and Estuarine Systems Tools (CoeEST) project in 2010. The CoeEST Study undertook a variety of tasks associated with understanding:

- the role of geomorphological knowledge in coastal decision-making processes; and
- understanding the current status of geomorphological research, systems-based tools and their application.

The CoeEST study concluded that:

- there needs to be a strong role for long-term geomorphological knowledge in coastal planning;
- current tools and approaches have a limited ability to provide quantitative evidence of long-term and large-scale change;
- there are significant challenges for researchers in developing a quantitative systems-based approach;
- there is a significant opportunity for sharing research outcomes and allowing continued development of tools through an open-coded modelling framework.

The CoeEST project team subsequently worked with NERC to define the structure of the



Top: Crantock Beach and Dunes, Cornwall, UK (Halcrow Group Ltd.)  
Above: Black Sea Coast, south of Constanta, Romania. Coastal Structures, eroding beach backed by falling cliffs with cliff top development at risk (Halcrow Group Ltd.)

research programme and an Announcement of Opportunity was recently released by NERC to award the research to a preferred consortium. The four key deliverables from this programme are as follows:

- **Systems Modelling Framework** – enabling an improvement of sediment pathway models across coupled systems over decades to centuries and at regional scales (10 to 100s of km) ;
- **Development of Behavioural Geomorphic Modules** – enabling the development of intermediate-complexity behavioural models of key coastal geomorphological features (0 to 10s of km scale);
- **Application** – exploration of the sensitivities of coasts to changes in sediment supply, climate change and coastal management scenarios; and
- **Pathways to Impact** – providing the groundwork for uptake and application of the research products.

During delivery of the research programme, the Environment Agency will ensure that key outcomes, in the form of improved tools, are integrated into working practice for the benefit of the flood and coastal erosion risk management community.

Building on previous research, the Coastal Sediment Systems Research Programme represents a major step forwards in terms of collaboration and vision within a very challenging research discipline. The international coastal community should benefit not only from improved knowledge of long-term geomorphological changes, but importantly the tools and approaches developed in the programme will be targeted at supporting decisions within coastal planning studies. Studies based in the UK include Shoreline Management Plans, Flood and Coastal Erosion Risk Management Strategies and Coastal Habitat Management Plans. In addition, the desire for an open-coded modelling framework should provide a ‘community modelling’ platform for the management, dissemination and continued development of tools.

At a strategic level this programme will address the UK Coastal Flooding and Coastal Erosion Challenge in the NERC Natural Hazards Strategy theme report, and will also directly contribute to future revisions of the Environment Agency’s Long-Term Investment Strategy. The programme will also contribute to the UK Government’s strategic goals with respect to adaptation to, and mitigation of, climate change. It is also anticipated that this programme will make a significant contribution to the Living With Environmental Change programme.

The research programme is intended to be delivered between 2011 and 2015, with international collaboration identified early in the programme.

*For further information please contact Tim Wells (wellst@halcrow.com), the Environment Agency Project Manager Owen Tarrant (owen.tarrant@environment-agency.gov.uk) or the NERC Project Officer Jessica Batchelor (jetc@nerc.ac.uk).*

## Numerical modelling for free surface water flow

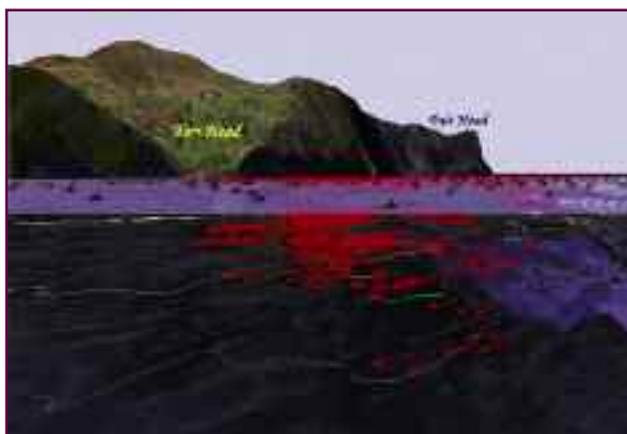
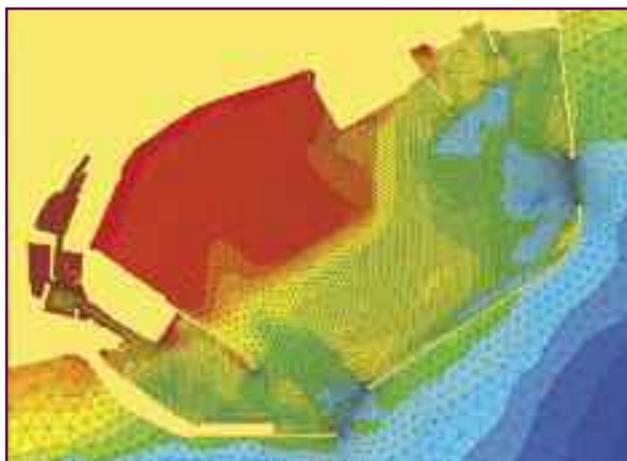
Modelling of structures provides the opportunity to avoid mistakes in design before they are built and, more importantly, enables the designs to be optimised both technically and economically (design choices can also be evaluated). HR Wallingford has for many years provided modelling capability for structures that operate in freshwater and seawater environments, which have progressed from physical models to the highly sophisticated numerical models now widely used.

One of the leading modelling systems for studies of sea and estuary waters is TELEMAC. Conceived over 20 years ago by EDF-LNHE, the TELEMAC system is now under the directorship of a pan-European consortium including HR Wallingford, EDF-LNHE (France), Sogreah (France), BAW (Germany) and CETMEF (France).

HR Wallingford has contributed significant advanced software development to the overall progress of the TELEMAC system. The main elements of the main system comprise:

- **TELEMAC-2D** – a 2D water flow and tracer model principally used for horizontal shallow flows, such as tidal estuaries and large sea expanses; OR
- **TELEMAC-3D** – a 3D water flow and tracer model used for complex flow situations involving differential buoyancy, heat/salinity variation, non-hydrostatic hydrodynamics, and stratified water bodies.
- **SISYPHE** – a general bed evolution model principally used for mud, sand and mixtures, and includes bed consolidation.
- **TOMAWAC** – a 3rd generation wave model used to transform wave conditions and climates from the offshore to the in-shore, including sea-bed refraction, breaking wave stresses, white capping, wind waves, and more.
- **ARTEMIS** – a harbour wave-disturbance model used to study close-up wave conditions in open and enclosed water bodies such as ports, marinas, and harbours.

Recent work has included incorporating state-of-the-art anti-diffusive algorithms for 2D/3D tracer transport. Software run speeds are critical to complex hydraulic applications; TELEMAC, as well as running in simple scalar mode, has been improved over the last 10 years so that it can run in parallel over thousands of processors. This capability has been achieved while maintaining a linearly proportional speed-up.



(Top) Triangular grid used in Telemac-2D  
(Above) Representation of tidal flow vectors in Telemac-3D, work carried out for Thetis Energy Ltd.

Another key feature that has been implemented in TELEMAC is that all engines and modules have been “OpenMI-wrapped” so that they can be incorporated into integrated model compositions. This means that TELEMAC can be set up to include 3rd party software – for instance dynamic coupling of TELEMAC-2D and SWAN has been demonstrated to work.

The TELEMAC system is now open source (www.telemac.system.com) and the source code has been widely downloaded for academic and commercial studies. HR Wallingford carries out training courses and support for system users at all levels, as well as providing a contact point for potential users.

*For further information please contact Sébastien Bourban, Principal Scientist, Hydrodynamics & Metocean Group, HR Wallingford (01491 822351; E-mail: s.bourban@hrwallingford.co.uk).*

# Structural applications of ferritic stainless steels



The Steel Construction Institute (SCI) is managing and co-ordinating a major European study into the structural applications of ferritic stainless steels (SAFSS) with, primarily, the aim of increasing the use of load-bearing ferritic stainless steel in construction by providing practitioners with reliable performance data and design guidance.

**F**erritic stainless steel is cheaper and more cost-stable than the more commonly used austenitic stainless steels. This is because it contains less nickel, but it is currently under-used due to a lack of reliable information relating to its structural behaviour.

The new research, which includes material and member testing as well as analytical and numerical studies, aims to provide practitioners with reliable performance data and design guidance in order for ferritic stainless steels to be specified in structures with confidence.

In addition to the structural benefits, the project is also investigating the thermal benefits that may be exploited through the

use of ferritic decking as part of a composite floor system where the soffit is exposed.

For the study the SCI is working with AcerInox (Spain), Aperam (France), Arup (UK), Institute of Metals and Technology (IMT) (Slovenia), Outokumpu Stainless Oy (Finland), Universitat Politecnica de Catalunya (UPC) (Spain) and VTT Technical Research Centre of Finland (Finland). The research is largely sponsored by the European Union Research Fund for Coal and Steel (RFCS) and is expected to take 3 years to complete.

*For further information please contact Dr Katherine Cashell at SCI (01344 636517; E-mail: k.cashell@steel-sci.com).*



Top: Exposure tests on ferritic stainless steel samples to assess durability  
Lower: Ferritic stainless steel decking for use in composite floors.

## SPONSORING ORGANISATIONS

### GOVERNMENT

#### Department for Business, Innovation & Skills

Construction Sector Unit  
Bay UG87, 1 Victoria Street, London SW1H 0ET  
020 7215 0826  
Website: [www.bis.gov.uk](http://www.bis.gov.uk)  
E-mail: [terence.boniface@bis.gsi.gov.uk](mailto:terence.boniface@bis.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](http://www.dfid.gov.uk)  
E-mail: [m-walsh@dfid.gov.uk](mailto:m-walsh@dfid.gov.uk)

#### Highways Agency

5<sup>th</sup> Floor, 123 Buckingham Palace Road,  
London SW1 9HA  
Website: [www.highways.gov.uk](http://www.highways.gov.uk)  
Email [Julie.prince@highways.gsi.gov.uk](mailto:Julie.prince@highways.gsi.gov.uk)

## RESEARCH ORGANISATIONS

### Centre for Innovative and Collaborative Construction Engineering (CICE)

Loughborough University, Loughborough,  
LE11 3TU (01509 228549; fax: 01509 223982)  
Website: [www.cice.org.uk](http://www.cice.org.uk)  
E-mail: [S.G.Yeomans@lboro.ac.uk](mailto:S.G.Yeomans@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](http://www.cwct.co.uk) E-mail: [cwct@bath.co.uk](mailto:cwct@bath.co.uk)

### HR Wallingford Ltd

Wallingford, Oxfordshire, OX10 8BA  
(01491 835381; fax: 01491 832233)  
Website: [www.hrwallingford.co.uk](http://www.hrwallingford.co.uk)  
E-mail: [hinfo@hrwallingford.co.uk](mailto:hinfo@hrwallingford.co.uk)

### The Steel Construction Institute

Silwood Park, Ascot, Berkshire, SL5 7QN  
(01344 636525; fax: 01344 636570)  
Website: [www.steel-sci.org](http://www.steel-sci.org)  
E-mail: [reception@steel-sci.com](mailto: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](http://www.ice.org.uk)  
E-mail: [library@ice.org.uk](mailto:library@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](http://www.istructe.org)  
E-mail: [Berenice.chan@istructe.org](mailto:Berenice.chan@istructe.org)

### Royal Academy of Engineering

3 Carlton House Terrace, London SW1Y 5DG  
(020 7766 0600; fax 020 7930 1549)  
website: [www.raeng.org.uk](http://www.raeng.org.uk)  
E-mail: [angus.baker@raeng.org.uk](mailto:angus.baker@raeng.org.uk)

## INDUSTRY

### Geotechnical Consulting Group

### Mott MacDonald Group Ltd

### Pick Everard

## ABOUT INNOVATION & RESEARCH FOCUS

also on the web at [www.innovationandresearchfocus.org.uk](http://www.innovationandresearchfocus.org.uk)

**Aims** – The aim of *Innovation & Research Focus* is to promote the application of innovation and research in building, civil engineering and the built environment by disseminating new information as widely as possible. Its sponsors wish to promote the benefits of research and innovation, improve contacts between industry and researchers, encourage investment by industry in research and innovation and the use of results in practice, and facilitate collaboration between all the parties

involved. Articles may be reproduced, provided the source is acknowledged.

**Enquiries** – If you wish to know more about a specific project, contact the person or organisation named at the end of the relevant article.

**Mailing List** – If you receive *Innovation & Research Focus* by direct mail (i.e. not with NCE) and your address is incorrect, please e-mail the Editor.

**Editor** – Professor Eur Ing Roger Venables at Venables Consultancy, 12 Cranes Drive, Surbiton, Surrey, KT5 8AL UK (020 3137 2375; fax: 020 8390 9368; E-mail: [irf@venablesconsultancy.co.uk](mailto:irf@venablesconsultancy.co.uk)).

*Innovation & Research Focus* is typeset by PJM Design and published by the Institution of Civil Engineers, Great George Street, London SW1P 3AA, UK. ISSN 0960 5185

© Institution of Civil Engineers, 2011