

Innovation & Research



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Designing high performance social housing

Since the introduction of the Code for Sustainable Homes in 2006, the housing sector has made good progress in developing solutions to meet the Code's tough thermal performance requirements. A key continuing challenge is applying these lessons in mainstream construction, particularly the social housing sector.

With this objective in mind, the Concrete Centre has been working with A2Dominion, a Registered Social Landlord (RSL), and a housing contractor. Collectively, the team has produced a design for Code Level 5 social housing, based on an existing standard housing type. The overriding challenge presented by the exercise was to provide a highly energy efficient design without impacting on the core requirements of social housing, which include:

- affordability;
- low maintenance requirement;
- simplicity (easy to operate);
- use of systems with a proven track record;
- robust and durable solutions.

The result is a relatively conventional, very-well-insulated masonry and concrete house that uses mainstream construction techniques and materials. The 85 square metre design is suitable for mid- and end-terrace plots, and could form part of the RSL's national programme of construction.

In meeting the design challenge, the decision was taken to incorporate proven technologies as much as possible, leading to the choice of a conventional high performance condensing boiler for heating/hot water, and photovoltaic (PV) panels which satisfy the entire renewable energy requirement. Whilst relatively expensive, PV has the advantage of needing minimal maintenance and user interaction from the occupants, helping to ensure good whole-life performance.

For the building fabric, robustness and cost

were particularly important factors, leading to a decision to specify heavyweight materials. Conventional cavity wall construction was used since it was not found to present any particular thermal performance limitations at Code level 5, notwithstanding the need for a larger cavity to accommodate the increased insulation.

Air leakage was specified at the very low rate of 2m³/m²/hr, which is an achievable target for modern masonry construction. To help maintain this level of performance over the life of the building, a wet-plaster finish was specified. This provides a durable air barrier and tough surface finish that also helps to maximise the thermal mass of the structure for improved year-round thermal performance.

A detailed overview of the design, and of the lessons learned from working up the specification, are contained in a document entitled *Achieving Code Level Five in Concrete and Masonry*, which can be freely downloaded at www.concretecentre.com. A conference is also being planned where this project and other initiatives in the field of social housing will be presented.

For further information please contact Tom De Saulles at The Concrete Centre (01276 608714; E-mail: info@concretecentre.com).



The Concrete Centre
THE CONCRETE SOCIETY ASSOCIATION



mpa
essential materials
sustainable solutions



(above) End terrace example of the Code level 5 design.
(right) Site view of a social housing development based on the Code level 5 design.



Dynamic flood risk modelling

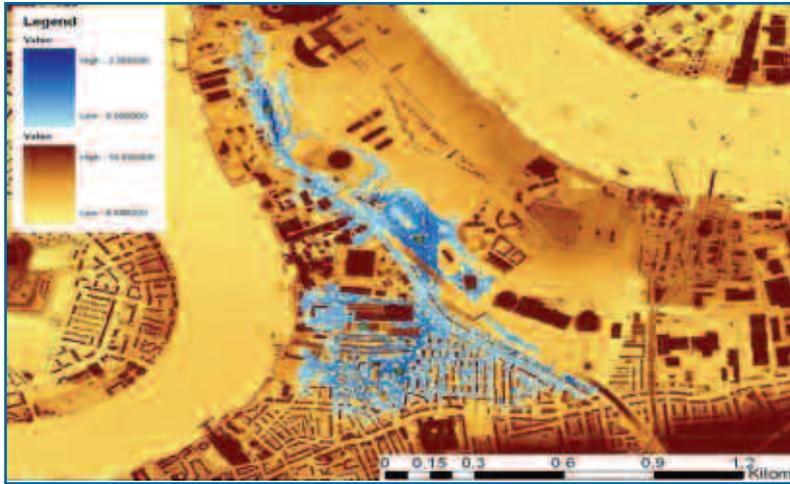


Flood risk management is an important consideration for government. One flood event can potentially cause millions of pounds worth of damage in addition to much human misery. However, with so many rivers, catchments, coastlines and weather events, it is not possible to provide protection for every location against all possible floods.

In the UK, the management of flood risk has been aided using quantified risk analysis as the cornerstone. The methods that have been developed (called RASP – Risk Assessment of Flood and Coastal Defence for Strategic Planning) deal with the numerous, extensive and diverse ‘systems’ of flood defences that comprise embankments, walls and moveable structures.

The impacts on risk from climate change, new developments, maintenance of defences and repair interventions can be identified using RASP methods. RASP methods have wide capability and can even calculate the benefits of flood proofing and flood resilience measures. RASP analyses can be conducted over a range of spatial and temporal scales and for a range of purposes such as long-term strategic planning and short-term asset management. Such has been the success of these methods that the Environment Agency has commissioned HR Wallingford and partners to update the Modelling Decision Support Framework (MDSF2), and to provide the basics for the system analysis within their Performance-based Asset Management Systems for Flood Defence (PAMS).

HR Wallingford has recently improved the spatial coherence of how flooding is represented in this modelling system, and has created a more realistic dynamic representation of how flood water on flood plains interacts with



TRISKS analyses river-channel/flood-plain dynamics, also how breaches grow once the defence is overtopped/fails.



presented in this modelling system, and has created a more realistic dynamic representation of how flood water on flood plains interacts with

the fast flood flow in the main river channel.

In locations where defences may have a weak spot, the new TRISKS (Temporally-resolved Flood Risk Simulator) incorporates interaction between river channel and floodplain, and has the capability to describe how a breach in the defences grows. This is based on the use of the software InfoWorks-RS linked to HR-BREACH.

Fragility curves continue to describe the performance of flood defences, and damage relationships are used to convert flood depth velocities into impacts. These developments offer significant opportunities for improving the evidence upon which to base decisions.

They include estimation of realistic loss of life and improved flood forecasting, flood warning and emergency management activities.

Other advances comprise explicit representation of the downstream impacts of flood defence and channel maintenance works, as well as the explicit representation of ‘active’ assets such as pumping stations, barriers and gates.

For further information about flood system risk analysis, contact Ben Gouldby, Principal Scientist, Floods Group, HR Wallingford (01491 822273; E-mail: b.gouldby@hrwallingford.co.uk).

ENVIRONMENT & CARBON

Why Carbon Capture and Storage?



The importance that the Government, the UK Climate Change Commission and the Inter-governmental Panel on Climate Change (IPCC) have placed on Carbon Capture and Storage (CCS) makes it appear as a silver bullet. The UK has committed to an 80% reduction on carbon against 1990 levels by 2050. This has already been broken down into carbon budgets in five year intervals. For the UK to hit these targets it relies on CCS working. Carbon Capture and Storage (CCS) will be the subject of a new ICE Report, published this autumn.

If CCS is applied to a carbon-emitting thermal power station, there is the possibility of reducing the carbon dioxide emissions by 80 to 90% compared to a power station without CCS. CCS offers carbon reductions at a cost to generation capacity. The IPCC has indicated that the economic potential of CCS could be between 10% and 55% of the total carbon mitigation effort until the year 2100.

Individual aspects of CCS have been proven, examples existing in Japan, USA and in Europe where CCS or aspects of CCS have taken place. In addition, the use of carbon injection has



(Courtesy of Scottish Centre for Carbon Storage)

been used to enhance oil recovery. Yet no example yet exists of CCS at power station scale.

So, whether it be CCS or another technology, engineers will be central to the delivery of a low-carbon future.

The ICE Report will comprise an Executive Summary and a series of papers by experts on different aspects of CCS and will be available from the ICE website.

For further information please contact Gavin Dick, ICE Senior Policy Executive (020 7665 2221; fax: 020 7799 1325; E-mail: gavin.dick@ice.org.uk).

'High and Dry': Severn Bridge remediation

The first Severn bridge crossing, now carrying the M48, is now over 40 years old. Evidence from other suspension bridges around the world indicated that, at this age, the wires in the main cables should be checked for any signs of corrosion. As a result, the Highways Agency has been undertaking a major assessment and remediation project.

Martin Lynch, technical lead on the project says: 'We realised from this evidence that, for the sake of safety and the longevity of the Bridge, we needed to investigate thoroughly to see if there was a problem.' But that was easier said than done.

'We had to erect working platforms on the main cables high up over the bridge and river, one of them 150 metres up, in a location that is very exposed to rain and high winds,' Martin explains. 'It was extremely difficult.'

With the platforms finally in place, engineers then had to open up the cables (there are 8,000 wires in each) to inspect the 5mm wires making up the cable. They then took away many wire samples for testing.

'We took this process further than has ever been done before in terms of understanding how a small number individual wires start to crack due to corrosion' Martin says. Only a small percentage of wires showed signs of significant corrosion but, clearly, the situation could not be left to get worse.

So, in 2008, a major remediation programme was started. First, the cables were covered with a waterproof membrane to prevent ingress of further water. Then a dehumidification system was installed along the whole length of the bridge main cables with the aim of drying out the cables and slowing down the corrosion process. At the same time, monitoring systems were set up to check that the intervention was working. Martin continues: 'The successful completion of all this work has been down to great team working from all involved.'

'From the initial results, it looks as though we have been successful but we will not know definitely until the end of 2010' Martin says. 'If this intervention has not worked, then we will have to adopt further traffic management measures to reduce the live loads on the bridge, or adopt other engineering measures. But we are fairly confident that we have intervened in time and that our measures will give the bridge a long-term life of useful service aggregates.'

The project is unusual in that, while the team relied on knowledge and techniques that have been developed worldwide, they have pioneered some particularly sophisticated methods of assessing the load capacity of the cables, and Martin and other colleagues associated with the work have published technical papers on the work.

'It is obviously exciting work because you are involved with a landmark structure,' Martin says. 'It is also technically and professionally demanding, because you are breaking new technical ground. You really have to be confident that what you are doing is right, as the risks are very large. It has certainly taken me well and truly away from my desk.'

For further information please contact Martin Lynch, Specialist Bridge Engineer, Highways Agency (E-mail: martin.lynch@highways.gsi.gov.uk).

(Left) One of the gantries in place

(Above) The view west from high up on the bridge

(Inset) The cable-wrapping process



Update from SPLASH!

SPLASH is the EU Water Initiative ERA-Net, a consortium of 16 organisations from 11 European countries active in water research for development. Since starting work in January 2007, SPLASH has made good progress towards each of DfID's four key objectives.

Improve coordination between existing SPLASH partner funded research programmes in order to exploit potential synergies and reduce duplication.

Recently DfID has reported on the completion of the mapping of existing SPLASH partner-funded 'water research for development' programmes. The results of this mapping are available in the online searchable database available at <http://www.splash-era.net/outputs/index.php>.

A review of the completed mapping confirmed that it is not exhaustive. There is a very large number of 'water research for development' projects carried out by different institutions, funded by a variety of donor organisations, and a plethora of internet sites and portals that contain information relating to these projects. In response, SPLASH has developed the online 'water for development - yellow pages', which attempts to bring together this information in a database which can be searched by SPLASH partner country, by thematic area, and by information category. Please visit <http://www.splash-era.net/yell/index.php>.

As a next step, in May 2009 SPLASH successfully piloted a research coordination workshop between ongoing programmes active in Ethiopia. Initially, participants shared information and learnt about their respective programmes, before agreeing joint actions to support future work.

It is planned to convene a further similar workshop in 2010 to support improved coordination between research programmes active in the Niger River basin.

Understand what constitutes good research management practice and ensure that this is known and used.

SPLASH has worked hard to understand what constitutes good research management practice, and has produced guidance materials on the subject. Investigations have revealed that research management is not taught formally to many researchers, and that this is considered a significant gap in the provision of research training. Consequently it has been agreed that SPLASH will develop open source training materials on research management, in order to fill the identified gap, and also disseminate findings from earlier SPLASH work on good research management practice.

Research management is understood to include all of those matters that a research project manager should know in order to effectively manage a research project. Thus the course will not be about research design but about how to effectively manage research.

SPLASH aims to develop the course over the next 6 months and have it ready for piloting early in 2010. The course developers welcome suggestions for course content and mode of delivery. We would particularly like to hear from any individual or organisation that might use the course, and who would be interested to pilot



SPLASH Factsheets are available on line.

it when developed. Your views will assist us in developing a course that fits your needs.

Please contact Frank Odhiambo by email at f.o.odhiambo@lboro.ac.uk.

Improve knowledge sharing between researchers and practitioners to help to speed up the use of research findings, and to ensure that new research is demand-led.

A workshop in October 2008 provided a platform to synthesise eleven lessons learnt across the SPLASH work programme, which would improve the uptake of research results, relating to all stages of the research cycle, from inception to monitoring and evaluation.

Three lessons relate to the dissemination of research results:

- this activity is often still very inadequate;
- existing knowledge could be used more to prevent duplication of research; and
- more needs to be known about how intermediary actors can increase the use of research results.

A set of corresponding recommendations were also developed, aimed specifically at the stakeholder groups of funders, research institutions and research programmes. These recommendations provide guidance on:

- making it a requirement for effective dissemination of research results at programme and project;
- increasing the coordination of existing programmes; and
- recognising the role of and actively supporting intermediary organizations.

In July 2009 SPLASH worked with development partners to support a training initiative as a knowledge sharing platform between European groundwater researchers and African water practitioners. A follow up will be developed for 2010.

Agree a research agenda and jointly funded activities that can benefit from a trans national approach, that is with more than one European partner working together.

SPLASH conducted a series of consultations to identify research themes that would benefit from a jointly funded approach. SPLASH donors have agreed to fund a research programme which will examine the delivery chain for sanitation services, with a geographic focus in sub-Saharan Africa. The call for proposals is being developed and is expected to be launched in March 2010.

SPLASH donors have also positively responded to a request to support the African Ministers' Council on Water (AMCOW) and African Ministers' Council on Science and Technology (AMCOST) initiative to develop a network of centres of excellence in water science and technology in Africa. Work on this will start in November 2009.

For further information, a series of SPLASH factsheets are available on the SPLASH website www.splash-era.net.

If you would like to be kept informed of future SPLASH developments please ask to subscribe to our quarterly e-newsletter 'Making a SPLASH!' by emailing the programme at Era-net@dfid.gov.uk.

GTI-ModelView: enhancing numerical model outputs in GIS



The complex data formats used in the numerical modelling of water engineering projects can now be directly integrated with Geographical Information Systems (GIS) software thanks to the development of GTI-ModelView by HR Wallingford's Informatics Group.

GIS software provides a rich environment for carrying out the generation and analysis of spatial data, along with data management, map production and simple modelling. The GIS software ArcMap is used widely for such processing but, although it can handle import-export for some data formats, it is not able to handle the complex 4D, multi-parameter data of the advanced numerical modelling software used at HR Wallingford.

GIS provides a professional mapping facility that can be reliably and efficiently used to enhance the quality of modelling reports and output. GTI-ModelView essentially comprises a suite of custom GIS software tools. At its centre is a relational data model that stores numerical model data for any number of files with varying numbers of nodes, elements, timesteps and variables.

The technique enables model results to be analysed in great detail – such as:

- the quantification of differences within or between model runs;

- spatial and temporal analysis, and
- the calculation of new variables based on one or more input variables (eg stream power).

Importantly it allows model results to be compared with measured data (or with any other model data including those with non-coincident model nodes).

Supporting the data model are the GTI-ModelView custom import, load and query tools. The query tools provide the user with some non-standard analysis queries that can be operated on the database to interrogate data from multiple timesteps. These allow the user to explore temporal queries such as 'how many minutes is the water less than 2m deep?' and to present the results as a new layer in the GIS. Existing GIS methods can be used to perform spatial queries, such as 'what is the area in the harbour where waves are greater than 1m high?'

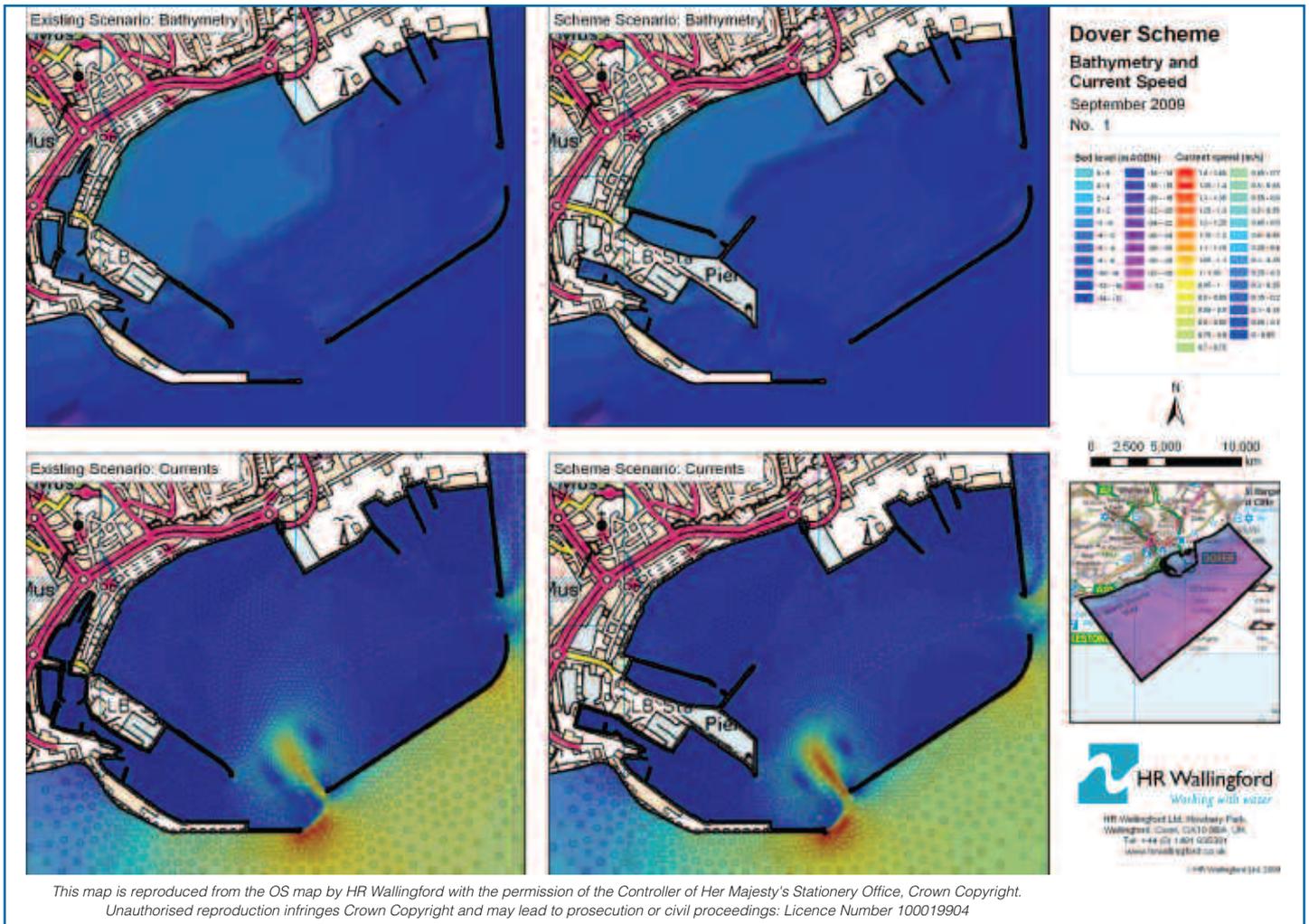
Several queries of this nature can be performed in sequence enabling very detailed

post-processing of numerical modelling results to be undertaken.

The GIS provides a basic set of overlays of information derived from sources such as GoogleEarth. The model outputs can be superimposed exactly into the image. GTI-ModelView allows the model information to be refined and queried. It also enables points of interest to be viewed in detail. This can all be done without running the original numerical model system again.

The figure shows results from an investigation of different harbour layouts, but the approach is generic and can be applied across all aspects of water and environmental engineering studies.

For further information about GTI-ModelView and GIS applications, please contact Mike Panzeri, Principal Informatics Scientist, HR Wallingford (01491 822398; E-mail: m.panzeri@hrwallingford.co.uk).



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Innovation process in the construction sector



A recent report by John Findlay, on behalf of the Centre for Innovative and Collaborative Engineering (CICE) at Loughborough University, has sought to compile the views and attitudes of a peer group of senior executives from organisations within the construction sector on both innovation and associated research and development. While the report concentrates on the consensus of views, where appropriate it also provides key dissenting remarks. It is hoped that the report will provide a better understanding of construction executive thinking for those either wishing to become more innovative or wanting to influence innovation in the sector.

The research sought to understand better the philosophy and processes that influence companies' approach and decision-making when considering innovation. One purpose of the work was to secure insights into the interactions that commercial organisations had with academia, attitudes to research and collaborative working and to seek some general views about the business environment as it relates to the pursuit of innovation.

The study found that the two most important stakeholders for construction organisations in considering innovation were first their clients and then their staff. Senior people draw a distinction between innovation and improvement, and the majority do consider issues that transcend individual projects, with strategic innovation having become a topic of senior board discussion.

For a sector that is labelled as being low in research intensity, the links to academia were found to be quite strong in the sample, with more than half having done research with academia, and with a high proportion of those who did doing so regularly.

More than half volunteered that they were working hard on implementing well-functioning knowledge management systems, and half used communities of practice or their equivalent to assist in knowledge interchange. All regard it as an important subject, as is becoming a 'learning organisation'.

Considering the mechanisms for initiating innovations, less than half the responding organisations used a formal business case when looking at prospective innovation developments, and about a fifth were prepared to admit to judging on the basis that 'it seems the right thing to do'. Half wanted to provide a degree of flexibility and to limit the barriers to the flow of ideas by approaching proposals on a case-by-case basis.

Some 60% of interviewees believe that the industry itself has recently developed a more-attractive business environment in which to pursue innovation.

Key Recommendations

The report makes a number of recommendations of which two are the key ones.

- **The sector should put together a network of senior executives to act as a focus for pre-competitive collaborative work.**

The report recommends that this should be a hands-on group linked to the National Platform. The agenda would take its cue from the topics raised in the National Platform Scoping Studies. It should also set some collective challenges that will get its people to contemplate radical change to

transform the way the sector tackles the sustainability agenda.

To be able to progress this initiative, the representatives' organisations will need to provide sufficient funds to allow the network to flourish and a commitment to be able to meet the funding requirements of the eventual collaborative projects.

- **Informed clients of the industry (and that usually means repeat clients) could help themselves to secure better value if they provided leadership and support towards innovation.**

If better supported, the sector would become more responsive and understanding of their clients' needs. It is up to the members of the sector to invest and promote innovation but we are all leader watchers and the big clients of the sector can assist in setting the agenda and nurturing commitment.

This is not to suggest that the sector should defer responsibility to such clients but to ask that a dialogue be started to address how the business environment can be altered to mutual benefit. The sector leaders need to decide how much of any dialogue and action is a collective or individual effort and it is suggested that the network suggested above would form the ideal convocation for the formation of an action plan.

A further recommendation concerns attitudes to highly trained people. Although many interviewees valued highly trained people, and were aware or had engaged people such as EngD graduates, a disturbing minority would either not want, or know how to use, such graduates.

The report concludes that the sector is selling itself short if it does not seek to use the brightest graduates to shape its future. The sector has many challenges for creative and science trained people so leading the innovation challenge should be an obvious career option for such people.

The report also concludes that academia needs to reach out, particularly to the organisations it already has relationships with, to build platforms on which to help organisations put bright people to good use. Collectively, in conjunction with other appropriate players, academia should be evangelising this theme for its own self esteem and for ensuring that funding and teaching organisations work in harmony with it.

The Management Board of CICE intends to explore and initiate actions on the report recommendations.

The report can be downloaded from www.lboro.ac.uk/kice/research.html by clicking on the 'Report on Innovation' button. Further information on research at CICE is available from Centre Director Dino Bouchlaghem (01509 228 549; Fax: 01509 223 982; Email: cice@lboro.ac.uk).

RESEARCH & DEVELOPMENT

ICE's R&D Enabling Fund seeks further new proposals



If you missed the article in IRF78 about the Institution of Civil Engineers' Research and Development Enabling Fund and its call for applications for support, you may find it helpful to know that there are no specific deadlines for submission – their process is continuous. However, the Committee normally meets in November and May, so in the immediate future it would be helpful if you get any applications to the ICE by the end of February 2010 for consideration in May.

The purpose of the Fund is primarily to enable research projects to get underway, rather than to fund research projects in their entirety. Individuals and organisations may apply for an R&D grant (up to £25,000). Each application is passed to two independent external assessors, who are experts in their field, after which, a board of Trustees meet to make the final decision at their bi-annual meeting.

Submissions generally fall into five categories: historical projects; highly technical or niche projects; projects that help further inform, understand or scope the industry; guidance and best practice work; and enabling research projects that are opportunistic or provide added value.

To receive a set of guidelines and application form, contact Alison Brown (0207 665 2231; E-mail alison.brown@ice.org.uk).

Lightweight embankment: a sustainable approach

The A421 Improvements Scheme in Bedford is being carried out by Balfour Beatty and Scott Wilson, under an Early Contractor Involvement contract with the Highways Agency. Near the village of Brogborough, the route crosses between two former clay borrow pits, one now a landfill site and the other partly infilled and flooded to form a recreational lake. From a study of historical aerial photography, ground investigation and topography, it is inferred that the infill to one of the pits comprises soft clay waste from the other pit, which was probably placed via a pipe or conveyor. The fill was soft enough to form three large fan deposits up to twenty metres thick.

Embankments up to seven metres high are required to carry the new dual carriageway and a realigned local road over the area of soft clay. Staged construction would be required to construct such embankments using conventional earth fill and resulting settlements would exceed 1 metre with severe differential movements expected at the edges of the former pits.

A pile-supported load-transfer platform was therefore adopted for the main carriageway and a lightweight embankment for the side road. PFA (Pulverised Fuel Ash) could not be used as lightweight fill because it was too dense for short-term stability.

A preliminary design was developed using 'Maxit' (expanded clay aggregate (300 to 800kg/m³) as lightweight fill. Deep wick drains and a six-month surcharge with 3 metres of conventional fill are required to reduce the risk of long term settlements.

In the final design most of the 'Maxit' was replaced by tyre bales, which are of similar long term density to 'Maxit'. Each bale is manufactured by lacing together and compressing about one hundred used vehicle tyres to form a bale measuring 1.5m x 1.5m x 0.85m.

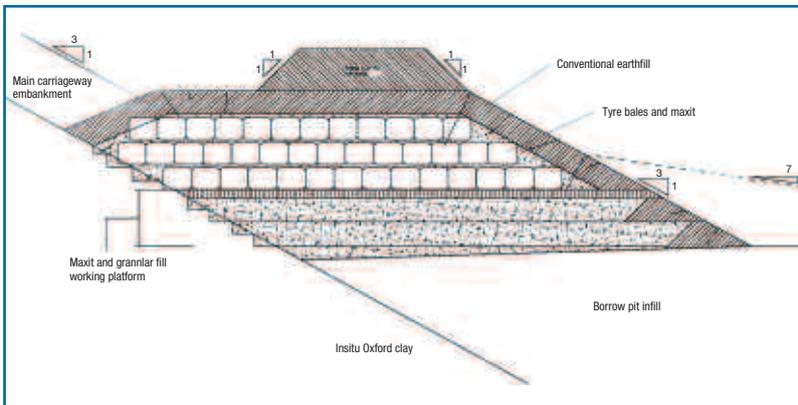
Manufacture of the bales is carried out to the Publicly Available Standard (PAS) No. 108 which does not allow damaged or dirty tyres which may be environmentally detrimental. The embankment will be covered by a minimum of 1 metre of earth fill for aesthetic reasons and to accommodate services in the verges. 'Maxit' is used where tyre bales are not appropriate, for example where the embankment is less than two metres high. 'Maxit' is also used for the working platform for installing the wick drain and for the creation of levelling layers between the layers of tyre bales.

The use of tyre bales offers



significant advantages over other forms of lightweight fill:

- PFA would require staged construction which would have severe programme implications;
- 'Maxit' is imported from Denmark;
- tyre bales are locally sourced and their use reduces the number of tyres that must be incinerated (tyres are no longer permitted in landfill);
- tyre bales offer a substantial cost saving over 'Maxit', they are convenient to store on site and can be placed with standard lifting plant.



This is the first time that multiple layers of tyre bales have been used to form an embankment for a public road in the UK, although some similar structures have been built in the USA. In addition to the sub-grade monitoring being carried out by BBSW, (Balfour Beatty, and Scott Wilson) the Transport Research Laboratory (TRL) is monitoring the temperature and compression of the tyre bale structure itself.



For further information please contact Alex Kidd, Team Leader, Geotechnical Division Highways Agency (01234 796003; E-mail: alex.kidd@highways.gsi.gov.uk); Phil Clifton, Technical Director, Balfour Beatty (E-mail: phil.clifton@bbcel.co.uk); or Ivan Hodgson, Geotechnical Engineer, Scott Wilson (E-mail: ivan.hodgson@scottwilson.com).

(Top) Tyre bales stacked prior to placing.
 (Middle) Cross section with surcharge & stabilising toe bund in place.
 (Bottom) Construction showing tyre bales & 'Maxit' fill.

Piloting construction sector transparency



The Construction Sector Transparency initiative (CoST) is an international, multi-stakeholder programme designed to increase transparency and accountability in the construction sector. It is supported by the UK Department for International Development (DFID) and the World Bank.

The aim of CoST is to enhance the accountability of procuring entities and construction companies for the cost and quality of public sector construction projects. This will be achieved by disclosing to the public 'Material Project Information' at all stages of the construction project cycle, from the initial identification of the project to the final completion.

It is important that the information that is released through CoST is both accurate and available in a form that can easily be understood by stakeholders. To achieve this, the disclosed information will, to the extent necessary, be verified and interpreted by experts (an 'Assurance Team') appointed for this purpose. The role of the Assurance Team is to play an interpretative role in helping to make raw data disclosures more intelligible to a wider range of affected stakeholders.

CoST is currently being piloted in seven countries under the direction of National Multi-Stakeholder Groups (MSG) set up for

the purpose. The seven countries are Ethiopia, Malawi, Philippines, Tanzania, UK, Vietnam and Zambia. In the UK, a three-month public consultation was launched on 11 September to inform public sector clients, industry and public stakeholders, and to seek their views on the UK Pilot.

A monitoring and evaluation consultant has been appointed to monitor progress and assess the effectiveness of CoST during the pilot phase. A baseline study is being run in each pilot country to provide a point of reference against which to assess change over time in some of these indicators (others will only be measured once CoST disclosure starts).

The UK Multi-Stakeholder Group (MSG) has identified four objectives for the UK pilot:

- to provide an enhanced understanding of construction project costs amongst public sector clients, industry and wider society;
- to learn and share lessons on publicly-funded construction project governance.

Piloting CoST on a range of projects will provide data that is more robust and allow stakeholders to assess if and how CoST improves project outcomes.

This pilot is led by the UK CoST MSG, which comprises representatives of the Association for Consultancy and Engineering, the Civil Engineering Contractors Association, the Royal Institution of Chartered Surveyors, Transparency International (UK), the Civic Trust Awards, DFID, the UK Department for Business, Innovation and Skills, and the UK Office of Government Commerce.

For further information please contact Bob McKittrick, Chair of the UK Multi-Stakeholder Group (01246 279586; E-mail bob@lasalle.freeseerve.co.uk).

PORTS & OFFSHORE ENGINEERING

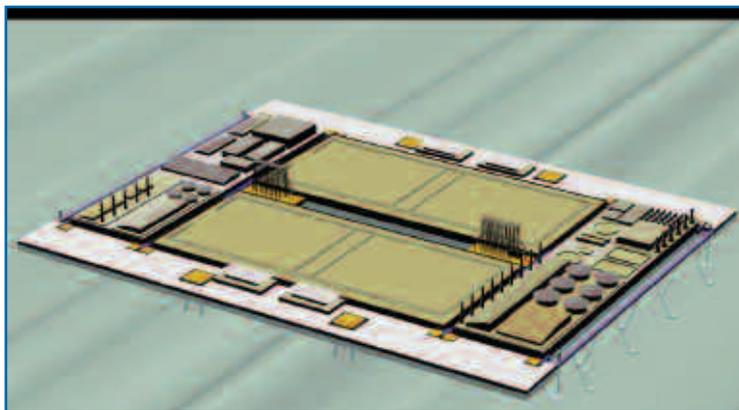
Multipurpose floating offshore bunker supply base – a novel solution to limited port space



A multipurpose floating offshore bunker supply base (MFOBSB) consists of several floating fuel storage modules moored together by a dolphins-rubber fender system with floating berths on the sides. The storage modules are compartmentalized, each compartment being used to store fuel or petrochemical products. The surface of the storage modules and adjacent platforms may be used to house other facilities such as blending machinery, power generation plant, water treatment, control room, incinerator plant, offices, recreational and accommodation facilities for workers. The berths are equipped with fenders and ship mooring units, such as pneumatic fenders and vacuum mooring systems, so as to provide fast, effective, and safe anchorage for ships without the aid of tugboats. Berths also provide space for the flexible hose towers, offices, storage of equipment and generators whilst acting as a buffer against direct ship collision with the fuel storage modules. An example of an MFOBSB which can cater a Suez-max type tanker is shown in the illustration.

The idea of an MFOBSB is prompted by anchorage and storage space limitation in ports and harbours, and the potential cost saving for fuel suppliers. For heavily used trading ports with limited sea-front space, anchorage and water-front spaces are precious. With MFOBSB, the anchorage space may be better utilized since ships moored at the floating berth take up less space than those moored by single buoy mooring (which requires a sea space circular area with radius equal to the length of the mooring chain and the ship). The MFOBSB also frees up fuel storage space on land for other developments.

By locating an MFOBSB at an appropri-



Multipurpose floating offshore bunker supply base

ate place, say near the anchorage space, bunker barges need not wait for free jetties at the near-shore fuel depot and the time

travelling to ships is considerably shortened. This results in a faster turnover for bunker suppliers and thus a greater return on investment. The number of bunker barges can also be reduced since some of the ships may call directly at the MFOBSB.

When MFOBSBs are straddled along the edges of navigation sea lanes, refuelling of ships becomes more accessible and ship owners have greater freedom to move their ships around to maximize their productivity.

For further information please contact Professor C.M. Wang at the National University of Singapore (E-mail: cvebcm@nus.edu.sg).

Update on the Driver Information Programme

At the Highways Agency we do as much we can to keep our network of motorways and 'A' roads as safe as possible for all road users. We have already made good progress towards our government-set casualty reduction target through engineering interventions, for example by improving locations with a poor safety record. But one thing we cannot control is human behaviour.

That is why we have developed a series of awareness campaigns that seek to educate people about road safety. These are called 'Driver Information Programmes' (DIPs) and are aimed at various groups of road users with the aim of reducing the incidence of inappropriate driving.

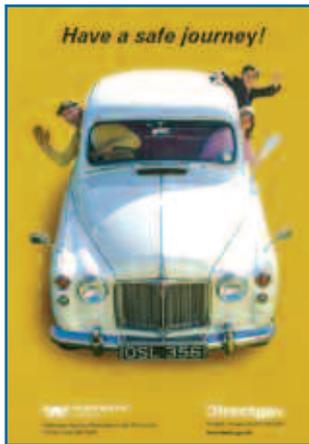
So far we have produced DIPs for all kinds of drivers: motorcyclists; those driving for business; HGV drivers; female drivers; disabled people; and those who tow. We have covered issues such as 'respecting our roadworkers' and 'motorway driving' which include hard shoulders, lane hogging, and tailgating.

During Autumn 2009 we will launch three new DIPs aimed at different issues and groups of people: older drivers, children playing, and deer awareness.

Older drivers: 'Careful! Considerate! Correct!'

This project was triggered by the realisation that we actually have more drivers over 70 killed or seriously injured than we do 16-to-19 year-old drivers. It is a common misconception that it is the other way round.

Research tells us that many older drivers (defined as over 55) have not read the Highway Code since passing their test, and many have done no further training either. Considering the high-speed road network has changed considerably since the first motorway opened in 1958, this exercise hopes to fill the gap and encourage drivers to do some further training or refresher courses, particularly on our road network. The DIP comprises a DVD and booklet, and will be given out to as many older drivers as possible through our strong partnerships in local areas.



(Top) The Highways Agency is continually striving to reduce casualties through engineering improvements
(Above left) Differing driver groups
(Above right) Careful! Considerate! Correct!

Children playing on the network

This DIP came about in the light of a double fatality in the northwest of England. Two young boys were caught on a section of motorway and were tragically killed. There are over 3000 reported incidents a year of children using our network in ways that are not intended – whether that is crossing it, playing chicken on it, or pushing bikes along it – and this number needs to be reduced.

The DIP will comprise a DVD, teachers' guidance notes, a drama script and a leaflet for parents. The DVD is designed to be watched in groups rather than handed out to youngsters directly, as our partners tell us that this is the best way to influence young people.

Deer awareness

There are tens of thousands of collisions between vehicles and deer every year in Britain. Hundreds of people are killed or injured as a result.

We are beginning work on a new DIP that will help to raise awareness among all drivers to become more aware of deer in certain areas of the UK.

With all our DIPs, we work very closely with our partners across industry, government, road user groups and the emergency services to ensure that the messages we put out are consistent and will attract the right people in the right way.

For further information on the DIPs please contact Julie Smith (E-mail: julie.smith@highways.gsi.gov.uk; website: www.highways.gov.uk/DIP).

INNOVATION

IRF seeks additional sponsors

IRF's existing sponsors – see the back page for details – have recently reconfirmed their strong support for the Newsletter but also recognised that there are many other organisations who may also find sponsorship helpful but have never considered becoming involved. So we have embarked on a positive move to attract new sponsors – from government and its agencies, the research community, universities and the private sector, indeed wherever innovation is taking place in and for construction and the built environment. More 12-page issues like this one will follow if we are successful.

IRF is published four times each year – in February, May, August and November – with a circulation of over 55,000. The main intention is to influence the practitioner community rather than the research community, although they are also well represented in the circulation. The by-line *Practical applica-*

tions for construction and the built environment is a deliberate choice, seeking to focus on applications in building, civil & structural engineering and related disciplines such as environment, materials and waste management. Each Sponsor is free to choose their subjects to target IRF readers.

If you or a colleague would like to know more – we have a small information pack available – please write in the first instance by email to the Editor, Roger Venables, at irf@venablesconsultancy.co.uk. We look forward to hearing from you.

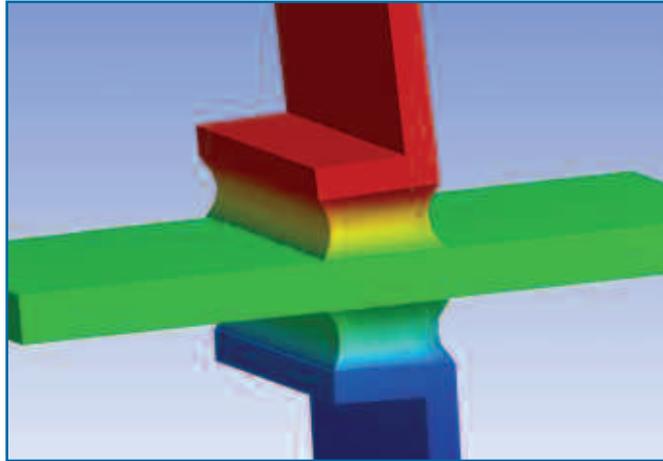
Joining steel to other materials using adhesives



Adhesives offer a range of possibilities for joining different materials together in construction applications, but structural engineers are often reluctant to use them because of a lack of experience and design guidance. In an attempt to overcome some of the perceived technical barriers to the use of adhesives, the SCI is currently engaged in a programme of finite element modelling and physical testing relating to the use of structural adhesives.

The focus of the current project is a glass-adhesive-steel interface of the type that might be encountered in a glazing support system, but the methods used and some of the lessons learned will be applicable to other materials and building elements. The project is part of a wider investigation into steel-glass interfaces and steel-glass composite structures. It is funded by the European Commission through its RFCS programme and by Corus Tubes.

At the heart of the research is the detailed investigation of the localised behaviour of the adhesive joint. To overcome the many complexities inherent in multi-material composite systems, the first step was to consider a simple plane interface between a single pane of toughened glass and a steel angle. Test specimens using three different types of adhesive have been prepared by Cambridge University and are currently being tested in their laboratories. Two types of small-scale test are being undertaken to determine the behaviour



FE model of test specimen undergoing peel test (adhesive layers exaggerated for illustration purposes).

of the joint under shear and peeling action.

In parallel with the physical tests, finite element models of the test specimens have been prepared by SCI. Results from the finite element analysis are being compared with

the results from the physical tests to allow calibration of the models. The outputs from the current phase of analysis will then be applied to the modelling of full-scale glazing support systems and other glass-steel interfaces. The figure shows the finite element predictions of the behaviour of the 'peeling' test specimen (two steel angles with a strip of glass sandwiched in between).

The ultimate goal of the current research project is to produce practical guidance for designers on the use of adhesives in joints between glass and steel, including simplified design rules. However, looking beyond the current project, it is hoped to be able to extend the research in future to include adhesive joints in metal cladding systems and light steel framing applications.

For further information please contact Dr Martin Heywood (01344 636525; E-mail: m.heywood@steel-sci.com; website: <http://www.steel-sci.org>).

FIRE ENGINEERING

Coalmine fire evacuation simulation & modelling

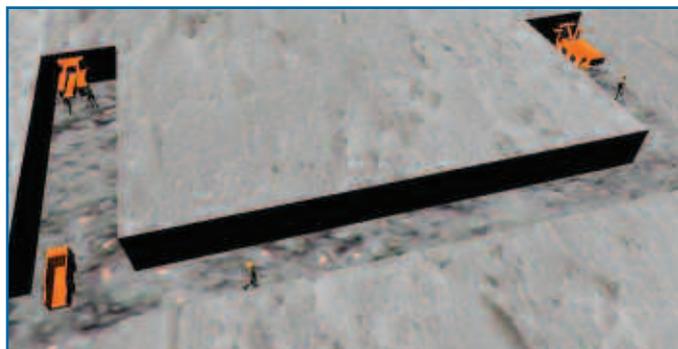


Virtual human crowds have been used in the simulation of building and airplane evacuations but not yet for the simulation of an underground coal mine fire. Dr Jinsheng Kang from Brunel University used a Global Research Award from The Royal Academy of Engineering to develop an evacuation model.

Dr Kang, with Professor Norman Badler and his team at Center for Human Modeling and Simulation, University of Pennsylvania:

- simulated the underground coal mine virtual environment,
- created a fire and smoke propagation model, and
- created a human physiology and behaviour model under the framework of HiDAC + MACES + CAROSA, and realised real-time simulation.

A continuous mining model environment was established, including placement of equipment and machinery. Air flow and smoke propagation in tunnels were simulated according to classic mine ventilation network theory. Fire was simulated based on the burning rate, heating value, CO₂ and CO production rates, and a time-variable blower fan to input gas quantity.



Simulation of a working shift in a coal mine

Oxygen intake was based on activity type and Basic Metabolic Rate (BMR), with oxygen supply determined by location and content, calculated using the smoke propagation model. The CO₂, CO, visibility and toxicity levels were simulated according to location, which also affected physiological and behavioural responses.

Human behaviour was also an important factor and was simulated according to reported literature, and realized in the CAROSA framework as four types of human crowd activities:

- Aleatoric (Stochastic),
- Reactive,
- Opportunistic and
- Scheduled.

All of these factors were integrated into the framework of HiDAC + MACES + CAROSA. Currently, the virtual simulation is running on OGRE (the open source rendering engine).

For further information please contact Dr Jinsheng Kang (01895 266330; E-mail: jinsheng.kang@brunel.ac.uk) or Misty Palmer at The Royal Academy of Engineering (E-mail: misty.palmer@raeng.org.uk).

Development of sustainability-driven tools for improved civil engineering design

In recent years much emphasis had been placed upon meeting the environmental and socio-economic aims of sustainable development, driven by government policy and industry initiatives.

The main emphasis has so far been placed on the building sector, where it is perceived that most benefits can be gained. However, although financial incentives and drivers are perhaps more readily quantifiable in this market, the potential to mitigate the negative and enhance the positive environmental and socio-economic impacts of the associated infrastructure on such developments at a neighbourhood scale – roads, drainage and utilities – may be no less significant, if more difficult to measure. Despite this, even though the assessment questions in the CEEQUAL Scheme Manual are increasingly being used as positive influencers of project teams' efforts in these directions (see www.ceequal.com for details), relatively little attention has been paid to developing targeted tools for the sustainable design of infrastructure.

There is also a strong argument in the lit-

erature for built environment professionals to improve their sustainability literacy. They need to be able to maximise their potential to minimise the adverse impact of new developments on future resources and generations, and to maximize positive impacts, as well as to meet current legislative drivers. While those engaged in the delivery of the built environment cannot be expected to, nor would it be desirable for them to attempt to be experts in the huge range of topics that are covered by the wide term 'sustainability', there is a very clear case for them to have a far greater understanding and familiarity of the new environmental, social and economic issues that they may now encounter.

With this improved literacy should also come increased awareness of the consequences of poor design, the correct time to engage other professions and stakeholders, and the potential

to frame success and/or performance of a project through its ability to minimise its adverse impact on the planet and communities and to maximize the positive impacts and benefits.

In recognition of this situation, Jacobs Engineering and Loughborough University have initiated an Engineering Doctorate (EngD) research project. It is aimed at embedding sustainability within the design process and at providing tools to assist designers and project managers to ensure that sustainability issues have been properly and fully considered.

The first stage of the research work is underway to identify current levels of both staff awareness and past project performance before looking at solutions to address current gaps.

For further information please contact Richard Willetts (0115 921 4247; E-mail r.willetts@lboro.ac.uk).

BUILDINGS & CARBON

Reducing carbon emissions in new buildings

Work by Mott MacDonald on the heating and cooling requirements at Birmingham Magistrates' Court is helping to cut anticipated carbon emissions by 24%.

The design of Birmingham's curvaceous new magistrates' court has taken a significant step towards meeting the UK government's carbon reduction goals – an 80% reduction by 2050 compared to 1990 levels. For new projects, current Building Regulations require a 28% reduction on previous carbon emissions levels. On this project, the client (Her Majesty's Courts Service) demanded a design that betters them by at least 12%. With the current design, it should surpass them by 18% to 24%.

Mott MacDonald and architect Denton Corker Marshall have developed the design to accommodate 24 court rooms, custody cells, magistrates' rooms, offices and a car park. Courts require separate circulation routes for the public, judiciary and defendants in custody.

Architecturally the 13-storey building is attention grabbing, but there are no environmental 'bells and whistles' on view. A highly efficient façade, designed for good daylighting, low leakage and high thermal performance makes a major contribution. But major gains have been made by rethinking building services and challenging assumptions about building use. 'Fans and pumps associated with air conditioning typically consume a quarter of a building's energy. However, if you double the size of ducts, reducing air velocity by half, fans don't have to work so hard – reducing fan energy by 75%,' says Mott MacDonald director Mark Facer. Heating energy will be reduced

by installing heat exchangers to pass thermal energy from the exhaust air stream to incoming fresh air. The bespoke system, 'like very large car radiators in the airstreams', will be close to 70% efficient.

Another gain has involved looking at utilisation rates – the intensity of building use. 'Ventilation and air conditioning systems are usually designed to cope with 100% occupancy,' Mark explains. 'But court rooms are

rarely full, and are never all full at the same time, so you do not need central plant running at full capacity. HMCS provided advice based on real court building utilisation rates.' It was found that the average occupancy of each court was unlikely to exceed 26% of its maximum, although systems must be capable of dealing with maximum occupancy of individual rooms as the need arises.

The building's services have been designed accordingly. 'You need control systems to deliver fresh air to where it is needed,' Mark says. In practice, this is difficult to achieve with a system running at only 26% capacity so the system will have to operate at no less than 45% capacity. This is however much better than the 100% norm.

An additional, significant gain is that primary heating energy is to be sourced from Birmingham's district heating scheme, which utilises good quality combined heat and power, thus further enhancing the building's overall reduced emissions profile. Furthermore, the design can incorporate a connection to chilled water from the same district scheme, should a service come on line.

Construction of the building is currently out to tender, with construction will start in early 2010.

For further information, please contact Hannah Seton, Mott MacDonald Press Office (0208 774 2040; E-mail hannah.seton@mottmac.com).



Birmingham Magistrates Court
copyright Denton Corker Marshall

Making smarter travel choices BIS

The Technology Strategy Board is to invest nearly £5 million in 12 new R&D projects aimed at providing reliable, accurate, and credible information for people to manage their journeys. The total value is £9.6 million. Focusing on accelerating the deployment of Informed Personal Travel (IPT) information, the projects will look at how to provide innovative real-time information that effectively informs about the journey, both in the planning stage and once it is underway should disruption occur.

By adapting existing technology, and developing cutting edge innovation, the projects will help to find the best ways for people to access and use reliable, accurate and credible information to plan their journeys. The following eight development projects are included.



Technology can help plan transport journeys as well as avoid disruption and delay.

eXtraNav – Urban Traffic Management and Control Navigation Unit Interface.

Current satellite navigation units' abilities to re-route during congestion, and hence their impact on driver behaviour, is limited to motorways and trunk roads, not town centres. Equally, local authorities are not able to use satellite navigation as a tool for actively managing traffic, as they have no influence over their route choices. This project overcomes that gap, by unlocking data already held in local authorities' Urban Traffic Management and Control systems.

Seamless Navigation and Positioning (SNAP) is a project to define, design, develop and demonstrate a solution to providing seamless navigation and positioning in all environments. The approach will permit GNSS-enabled devices (Global Navigation Satellite Systems; GPS, Galileo, etc) to operate where they have previously been unable to operate, such as in indoor and underground locations.

SpamJam – Adaptive Travel Alerts using continuous position monitoring. The goal of this project is to make travel alerts both self-configuring and richer, based on automated observation of the actual behaviours of each traveller.

The **Customer Relationships in Shopper Travel Decisions** project will market test a new approach to personalised marketing and loyalty business services for retail travel by bus.

Smartmedia have in recent years allowed multiple organisations to share the same technology platform, but personalised marketing in the bus industry has not yet exploited the benefits of data sharing.

Our Travel – Real-Time Context-Sensitive Travel Information for Communities – is a project aimed at supporting informed personal travel through the provision of user-generated, real-time, multi-modal, context-sensitive travel information. The key innovations in the project are the use of travel information within the context of communities rather than individuals and that we rely on user-generated content as a primary source of travel information.

Empowered Personal Travel Itinerary Monitoring Service (EPTIMS) is aimed at the design, development and demonstration of an 'Empowered Personal Travel' service platform, a personalised, context-aware online 'virtual travel assistant' service for travellers.

FlexiRide is an R&D project that is aimed at delivering enhanced personalised travel information via the integration of car-sharing into multi-modal travel.

Promoting Informed Personal Travel (PIPT) for socially-responsible travellers & thought leading businesses will help develop 'Carbon Diem' (created by Carbon Hero), a software application for mobiles, to encourage individuals to adopt cost- and carbon-efficient.

For further information contact the Technology Strategy Board, North Star House, North Star Avenue, Swindon, SN2 1UE (01793 442700; E-mail: enquiries@tsb.gov.uk) or visit the TSB website at www.innovateuk.org.

SPONSORING ORGANISATIONS

GOVERNMENT

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Construction Sector Unit
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E-mail: p-roberts@dfid.gov.uk

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Centre for Window and Cladding Technology

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The Concrete Centre

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Website: www.concretecentre.com

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The Steel Construction Institute

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Institution of Structural Engineers

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Website: www.istructe.org.uk
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Royal Academy of Engineering

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also on the web at www.innovationandresearchfocus.org.uk

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

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