PRACTICAL APPLICATIONS FOR CONSTRUCTION AND THE BUILT ENVIRONMENT

Innovation & Research FOCUS

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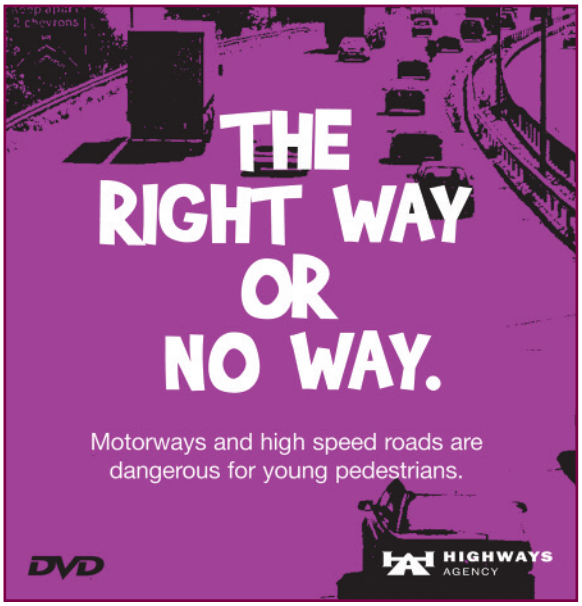
IN THIS ISSUE

The Right Way or No Way: safety improvements for child pedestrians

The Highways Agency is implementing a new educational resource aimed at young pedestrians playing on our road network. From information gained through a report written by the National Intelligence Unit (NIU) within the HA, it was established that over 3000 children a year have been on our network when they shouldn't be. The Agency is convinced there are many more unreported cases too, any one of which could lead to a serious injury or fatality.

The first approach the Agency took was to discuss the issues with various focus groups. These comprised youngsters representing a variety of youth environment establishments (Youth Offending Teams; schools; karate clubs etc.) to better understand their motivations. Close attention was paid to the language that the youngsters were using so that when it came to the actual creation of a tool, the script would be reflective of those it was intending to represent. The Agency then set about producing the package.



Cover of the DVD

A package of solutions was decided upon so that going forward youth leaders and teachers will be able to use whichever tool is suitable for their group of youngsters.

A 20-minute DVD was produced using child actors doing the dangerous activities youngsters are often involved in (playing chicken, crossing where they shouldn't, damaging fences) as revealed by the NIU report. Prior to production, the script for the piece was tested by road safety officers and school teachers for suitability, to make sure that the DVD would be able to be used effectively. A child's voiceover talks viewers through the scenarios with T4-style presenters cutting in to discuss the issues. A central theme within the different chapters of the DVD is the importance of awareness: the need for children to pay close attention to the dangers surrounding them on the roads, as well as the risks involved in taking ill-advised chances.

The film is cutting edge and very snappy in its approach. The Agency broadened the content of the film to include messages that affect everyone. Therefore, rather than focus solely on motorway safety, the Agency incorporated scenarios that were relevant to other areas as well, for example a scenario concerning the need to use appropriate crossings is applicable to both motorways and local roads. The film has been designed for use in classrooms or with youth groups, as youngsters learn more in this environment.

The Highways Agency are also providing guidance notes for teachers and youth leaders, with ideas of how to further use the theme and we are offering a drama script to help with development of the ideas through schools. There is also a parents' factsheet to encourage them to discuss the issues at home.

The Agency has tested the package at various schools with excellent results and feedback so far. All materials are now available on www.highways.gov.uk/youngpedestrians.

HIGHWAYS AGENCY

For further information please contact Julie Smith, Coordinator, Driver Information Programme (Email: julie.smith@highways.gsi.gov.uk).

Aiming for high-energy-efficiency fabric for construction of sustainable homes

BIS

The Technology Strategy Board is supporting a £6.4 million programme to build twelve world-class, energy-efficient houses, without using renewable energy technologies.

The project – AIMC4 – will see the Technology Strategy Board partner a major consortium of three leading developers (Stewart Milne Group, Crest Nicholson Plc and Barratt Developments Plc), H+H UK Ltd, BRE and Oxford Brookes University. The AIMC4 project will take a 'fabric-first' approach to the construction of the new homes, with the aim of achieving a 44% reduction in carbon emissions. Only specific building materials, components and systems that will increase the energy efficiency of the houses throughout their lifespan will be used. This holistic, design-based solution has not been attempted before and marks a significant step forward in the journey towards cost-effective, zero-carbon homes.

The test homes will be constructed in three conventional developments and lived in by ordinary families, with their performance monitored over several years to ensure that they continue to achieve reduced emission levels. The £6.4 million project, in which the Technology Strategy Board will invest £3.2 million, will see three different construction types evaluated – one timber, one masonry and a third, hybrid, option – each capable of longer-term volume delivery.

The AIMC4 consortium will construct the homes to achieve Code Level 4 (Energy) of the Code for Sustainable Homes and will target the following headline deliverables:

- a widely applicable Code for Sustainable Homes Level 4 (Energy) range of design solutions that are not reliant on renewable technologies;
- a new industry innovation process map to facilitate the accelerated development of materials, components and systems including the manner in which they are incorporated into the build process;
- a significantly improved, and in some areas newly created, UK supply chain capable of delivering a selection of innovative products to support the AIMC4 'fabric first' approach to Code Level 4 (Energy);
- a variety of build systems, capable of volume delivery within the UK market (timber, masonry and possibly a hybrid option);
- twelve innovative homes, with 'as built' and 'as lived in' monitored performance, to begin the process of creating a database to inform mainstream volume production;
- reduced construction costs to achieve viable Code Level 4 (Energy) homes that are easy to use and market, and that are based on a fabric solution, on a volume scale, through process change and new product technology.

Stewart Milne Group demonstration Sigma Home, on the BRE Innovation Park, achieving 100 per cent reduction in carbon dioxide emissions from heating and lighting.

The project is responding to the target set by the Government to reduce carbon emissions from homes by 2016. AIMC4 is a challenging research project, bringing together the UK's premium developers and suppliers to pave the way for the delivery of sustainable homes. This will yield a variety of building systems, each capable of volume build, reducing carbon emissions and driving delivery of the Government targets while creating desirable and sustainable communities.

The Technology Strategy Board's Low Impact Buildings Innovation Platform was established in May 2008 with the aim of increasing innovation in the building industry to meet these challenges. The Innovation Platform invests jointly with industry and other funders in projects to bring innovative solutions, and to overcome barriers to the wider use of existing solutions. The Innovation Platform's budget has been increased from £30m to £47m over the initial three years (2008-2011) to address the challenge of both new and existing buildings.

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).

Innovate to Survive Conference

ice
Institution of Civil Engineers

In June 2010 leading members of the civil engineering, building and built environment community will come together to discuss key issues facing the industry.

The Institution of Civil Engineers' flagship event of the year is designed to highlight how innovation in civil engineering design and construction can underpin the challenges of a low carbon future. Aimed at attracting up to 350 senior decision-makers from across the globe, this event will be your opportunity to engage in the debate.

Alongside the event, EPSRC are sponsoring a poster competition for students (ranging from HND to PhD) to put forward their innovative solutions in key areas such as Transport, Energy, the Built Environment and Water and Food Security. The student deemed to have produced the most innovative idea will win a trip for two to Copenhagen, and winners of all categories will be able to attend the event for free and meet the President. Abstracts of up to 1000 words are welcome. For further details, or to register for the event, please visit ice-innovatetosurvive.com or contact Jessica Weaver on 020 7665 2114.

Numerical modelling of living things in water for marine and estuary engineering projects

HR Wallingford

Although reliable hydrodynamic models exist of water and sediment movement, there is a need for combining these with new ecological modelling techniques in order to deal with predicting the impact of change on the populations of living things.

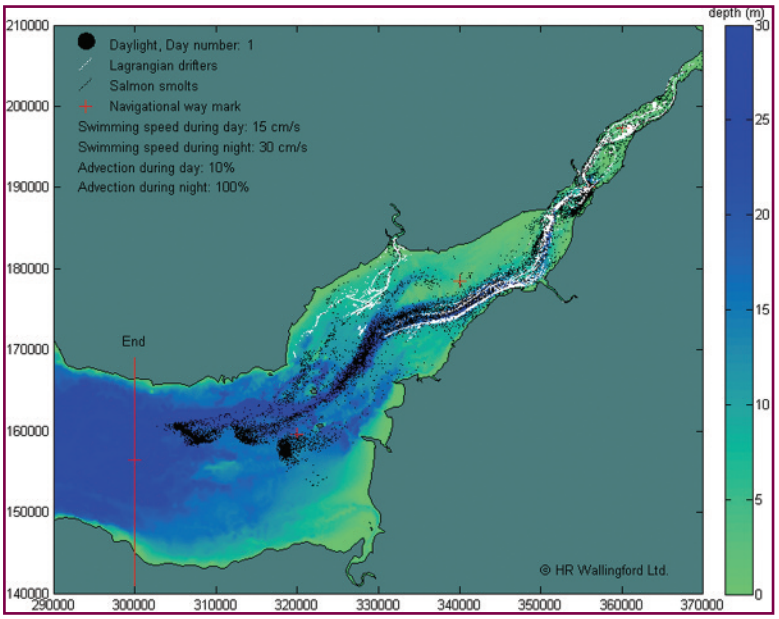
A key consideration is the influence of currents (both marine and estuarial) on aquatic lives. Most aquatic life starts off as spores, eggs, or larvae, and these exist entirely at the mercy of water currents. This is true not only for animals such as large fish that eventually grow powerful enough to overcome any natural current but also for animals that become sedentary and settle in one place, such as many marine worms, shellfish and crabs.

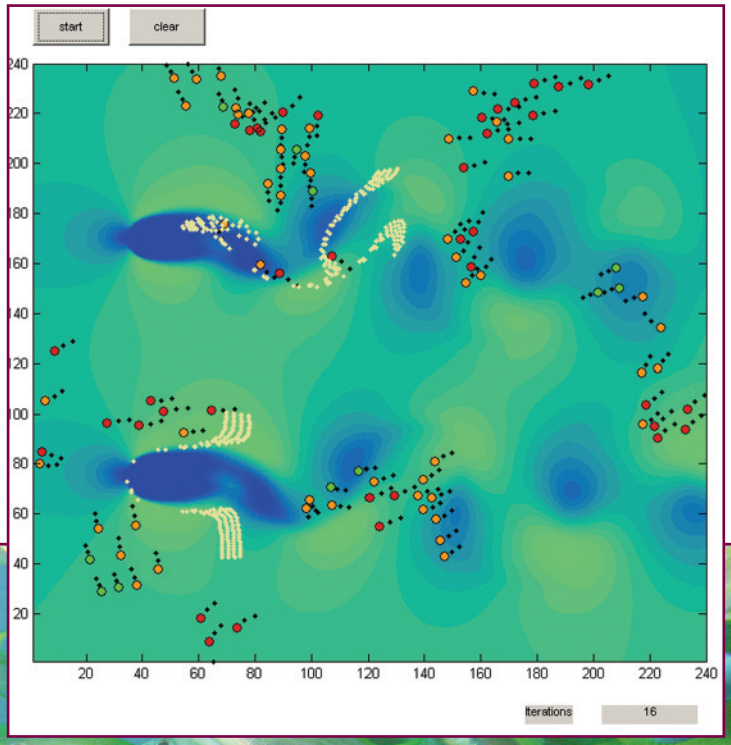
When small marine larvae are able to swim energetically – such as a couple of metres in a few hours – this can impact dispersion in a tidal estuary by many kilometres if they swim vertically at particular times in the tidal cycle. Larger creatures have larger brains, often unknown motivations, and greater swimming capacity. Thus the modelling of larger fish, (typically a few centimetres long) that can swim strongly in any direction but remain heavily influenced by currents, can become extremely challenging.

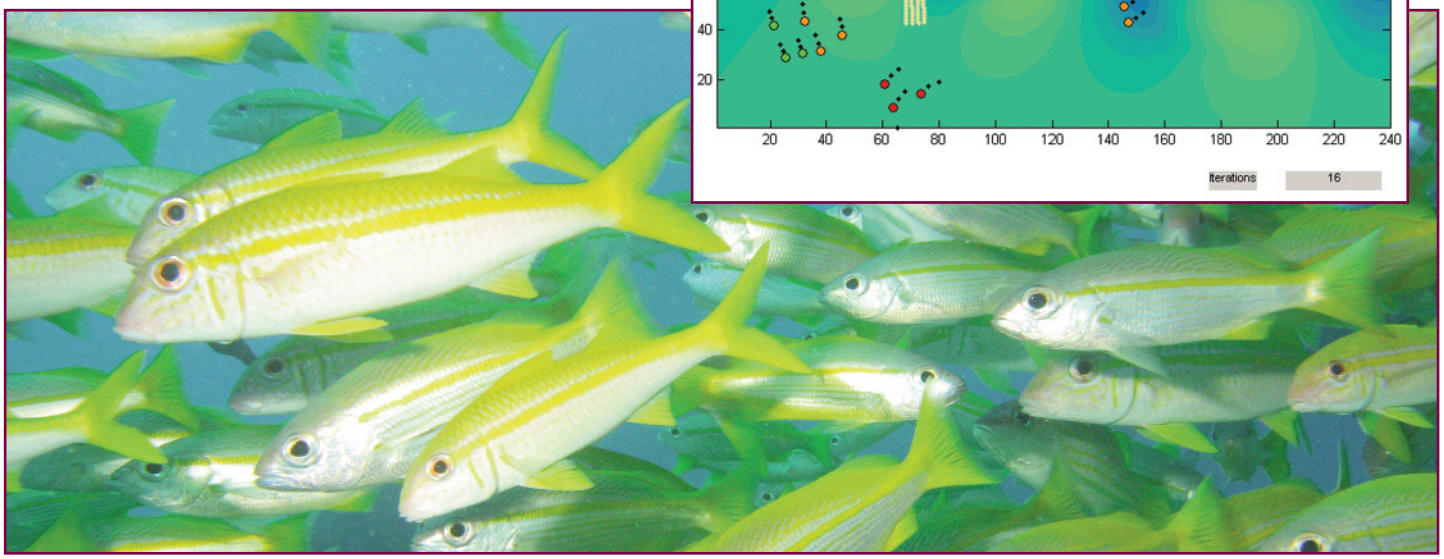
In cases such as low-head hydro power schemes, the impact on physical currents and sediments can be well predicted but there is no precedent for modelling the impact to aquatic life. Nevertheless, where it is possible to reliably predict the intended route (and motivation) for a fish species (over a limited time scale) there is now capability to model the impact. Smolts (juvenile salmon) are a good example where their intended route is known, so that hydrodynamic models of water can be combined with individual-based models of animal movement.

HR Wallingford has recently developed a fish migration model that has been successfully used to provide relative impact to specific species under different barrage scenarios. Additional models have also been developed for larval advection and complex system biological modelling. This is a relatively new but strongly growing area of scientific research and development. The results are encouraging and the complexity of natural systems provides the opportunity to develop methods for handling larger uncertainty than that normally associated with purely physical systems.

For further information about this work, contact Jay Willis, Coasts and Estuaries Group, HR Wallingford (01491 822401; E-mail: j.willis@hrwallingford.co.uk).







(Top right) *Model output showing distribution dynamics of salmon and other fish in the Severn Estuary*
(Right) *Model output showing influence of current velocity on species location and school fidelity*

Structural information survey

Structural Engineering may be said to be a mature discipline, since the basic ideas have been known for many years. There is therefore a tendency in some quarters to think that research and innovation should not be a high priority. However, from time to time it is prudent to assess which areas within the profession could benefit from additional guidance or by the instigation of fundamental research. As a result, the Institution of Structural Engineers recently undertook a survey in which its members were asked to identify those areas of professional practice in which they had experienced (or anticipate) difficulty in obtaining sufficient information (guidance) to complete their task.

The survey was web based, asked only four main questions, and used a combination of tick boxes, drop down lists, key words and open responses in such a way as to maximise computer sorting of the answers. The four questions in order were:

- Please indicate which material your topic is in reference to. Tick boxes e.g. Steel, Concrete, Masonry etc.
- Please classify the topic by using progressively more specific keywords. Dropdown list.
- In which specific areas, either actual or anticipated, have you experienced difficulty in obtaining:
  – helpful information / guidance?
  – reliable data?
  – appropriate solution tools?
- How did you resolve this?

Structural Information Survey

1. Please indicate which material(s) sector your topic is in reference to:

	Response Percent	Response Count
Steel	50.0%	96
Concrete	48.4%	93
Masonry	19.8%	38
Wood	16.1%	31
Plastic	9.4%	18
Glass	17.2%	33
Composite	22.9%	44
Other (please specify)	17.2%	33
answered question		192
skipped question		1

There were 179 responses to the questionnaire and the answers provided a reasonable overview of the problems being encountered. Topics could be grouped under four headings: Eurocodes; Design for structural vibration; Structural materials; and Sustainability.

Within this grouping, there were many requests regarding topics that are currently receiving, or have recently received, considerable attention. Omitting these left the following topics for attention:

- *Eurocodes* – A manual to accompany Eurocode 9, Aluminium
- *Design for structural vibration* – Tall buildings and light structures, Approximate analysis techniques
- *Structural materials* – New materials for constructional use e.g. Composites, High strength concrete
- *Sustainability* – Building over shallow mine workings and on contaminated land, Lime based mortars

The Research Panel of the Institution have now identified champions to take forward appropriate topics and assess what outcomes would be most appropriate.

For further information please contact Berenice Chan, Technical Officer, Institution of Structural Engineers (020 7201 9125; E-mail: berenice.chan@istructe.org).

Durability of galvanised light steel framing

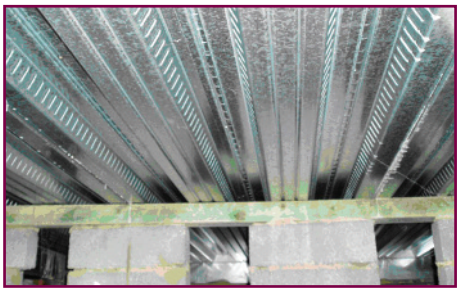
Galvanised light steel has been used successfully in construction for over 20 years in the UK housing sector and offers many advantages both during construction and in service. However, durability of galvanised light steel framing is sometimes considered an issue. SCI has recently completed a project that proves long-term durability of galvanised light steel.

Pre- and post-war steel-frame houses were constructed from painted hot-rolled steel components, were poorly detailed to prevent condensation and moisture penetration, and were not thermally insulated as modern regulations require. Modern light steel framing systems use sections formed from pre-galvanised (zinc-coated) strip steel.

The zinc coating is able to protect the steel much more reliably than paint coatings because it protects the steel in two ways. Firstly, the zinc coating acts as a physical barrier between a potentially corrosive environment and the steel core. Secondly, protection is provided through galvanic or sacrificial protection at cut edges and scratches. Modern light steel framing uses 'warm frame' construction where all the light steel framing is in a warm, dry environment hence the risk of moisture within the building envelope is largely eliminated.

Over the last 15 years, the SCI has been collecting durability data for galvanised light steel *in situ* on various buildings throughout the UK. The SCI has analysed all the collected data and used it to predict the design life of the galvanised coating in different conditions experienced by the steel in different applications. The detailed findings of the research are presented in SCI Publication P262, Second edition. The project was funded by Corus Strip Products UK.

A conservative approach to predicting the design life was adopted. The calculation is based on a 95% probability level of 50% of the galvanising being lost and it also assumes that the loss of galvanising is linear for the remaining life of the structure, whereas in practice the loss of galvanising reduces overtime for constant environmental conditions.



Galvanised steel decking forming the underside of a ground floor slab after 10 years

All the values are for Z275 galvanising which has a total weight of zinc coating of 275 g/m^2. A summary of the design life predictions are:

- no risk of water ingress or condensation – 250 years;
- low risk of condensation – 200 years;
- low risk of water ingress and some risk of condensation – 100 years;
- low risk of water ingress and higher risk of condensation – 50 years.

For further information please contact Mr Andrew Way at the Steel Construction Institute (01344 636525; E-mail: a.way@steel-sci.com).

Incident Management Investment Decision Model

HIGHWAYS AGENCY

The Highways Agency Network Services Incident Management Policy Team have been working on a prototype model designed to analyse the effects that proposed research projects would have on reducing the timeline for different types of incidents. The model has the additional benefit of being able to link its outputs to average vehicle delay savings. Ultimately, the model should be capable of calculating the anticipated benefit to road users for each improvement project, against a baseline derived from 'real' data obtained from Regional Control Centres and Service Providers (and eventually the Emergency Services). This will help to ensure that limited funds are targeted in areas that yield the greatest returns, whether this results in changes to procedures, better Incident Support Units or responder equipment.

The Incident Management Policy Team's Investment Decision Model (IMIDM) simulates incidents by their various phases (from occurrence through to resolution) and the associated 'responder streams' (e.g. Traffic Officer Service only, or Officer and Incident Support Unit (ISU) together etc), as shown schematically in the accompanying figure.

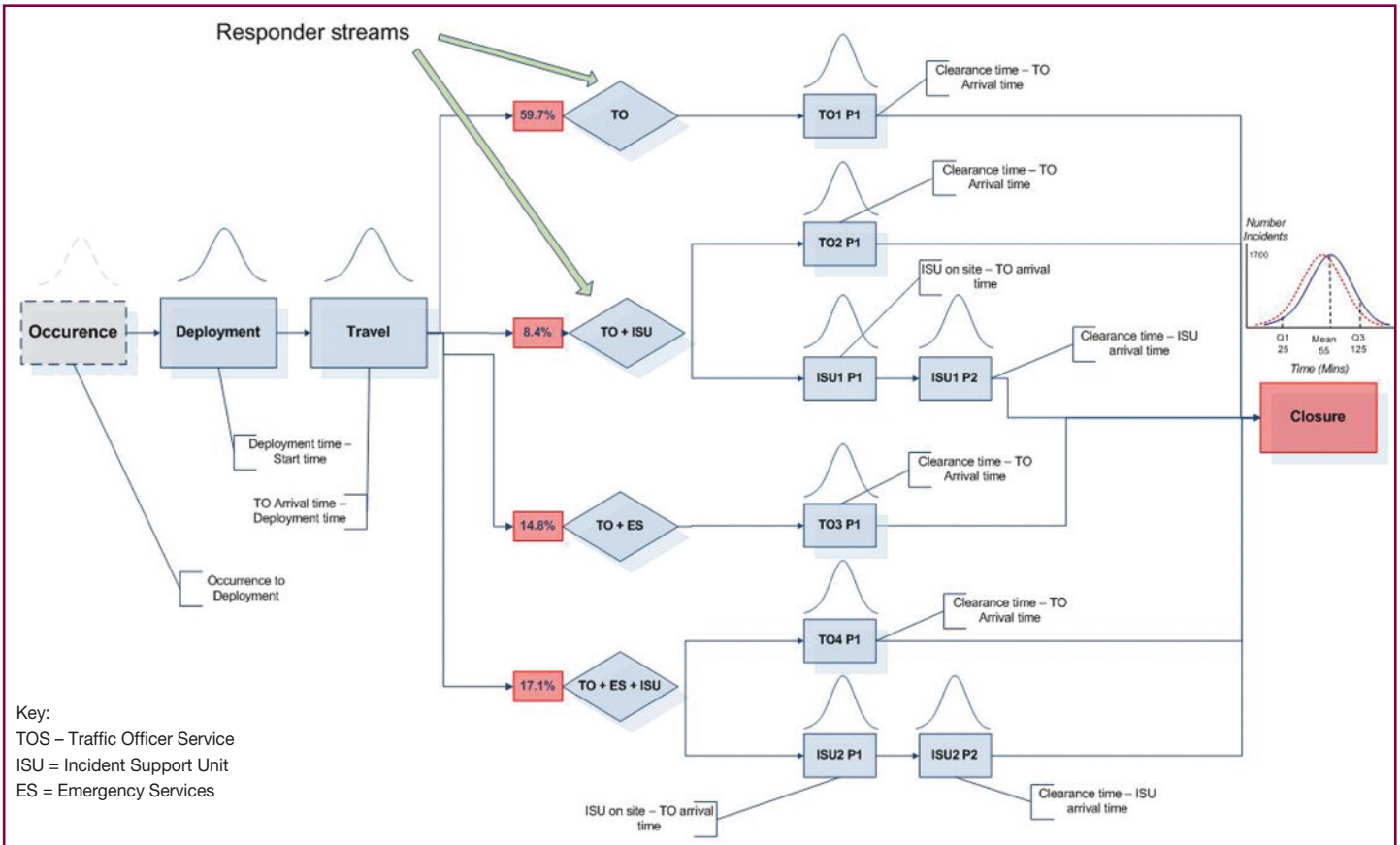
The model currently deals with the most serious congestion-causing incidents, which for the purpose of the model are classed as those resulting in a lane closure. Each of the incident processes has an associated time distribution and these have been obtained from actual incident data. These time distributions cover the range and probability associated with the various phases. The incident data used to construct the prototype model was selected from the Regional Control Centre in the West Midlands between March 2008 and April 2009. Of the 77,000 incident logs analysed, just under 3,200 logs were identified as 'congestion causing', resulting in lane closures.

Having obtained the distributions, the model was constructed. It uses the 'Monte Carlo' technique to simulate total incident durations and, in basic terms, it enables the Agency to understand what the effect of reducing the duration of part of the process will have on the total incident timeframe. This tells us where our efforts should be focused in terms of improvement opportunities through research projects. For example, should we invest in the detection phase or should we improve our capability at the incident scene itself? The model helps to provide the answers and is now being used to target the research programme and inform operational working practices.

Eventually the model will aim to collect command and control data from Emergency Services so that work streams involving those Services can also be analysed. Other incident responders have already expressed a desire to be more involved with this work.

Project Sponsor Paul Hupton said: "We were not satisfied with having a model that purely demonstrates time savings at incidents through improvement projects. We wanted to be able to convert this time into the Average Vehicle Delay metric used by the National Operations Group, so that each project's contribution to the Agency's Public Service Agreement target can be demonstrated. We believe that the prototype model has shown this potential and so work continues on its refinement."

For further information, please contact: Paul Hupton, Project Sponsor Traffic Incident Management Team (paul.hupton@highways.gsi.gov.uk).



Investment Decision Model Weighted by Responder Work Stream

New Government Chief Construction Adviser

BIS

Paul Morrell OBE has been appointed to the new role of Government Chief Construction Adviser. Previously senior partner of construction consultants Davis Langdon, and also former deputy chair of CABE (the Commission for Architecture and the Built Environment), Paul Morrell brings extensive experience across both the public and private sectors to this broad role.

As CCA, Mr Morrell will lead the Construction Innovation and Growth Team. His first task will be to lead the Low Carbon Construction Review, announced by Lord Mandelson on 18 September and due to report its initial findings in spring 2010. This is part of the challenge to bring the industry together to identify how best to deliver the 2022 carbon reduction commitments, to meet the broader challenges of the low carbon future, and to capture the many new opportunities it will bring.

The CCA is an independent role, but will report jointly to BIS and HM Treasury Ministers. The remit of the role includes:

- Chairing the new Construction Collaborative Category Board, which will build on the existing Public Sector Construction Clients Forum, to drive the implementation and further development of best value Government construction procurement.
- Chairing an enhanced sustainable construction strategy delivery board to help ensure policy regarding the industry is effectively co-ordinated.
- Assessing the key barriers to growth in the UK's Low Carbon construction sector to ensure the UK industry is well placed to serve developing needs and markets.
- Working with the industry, through the Strategic Forum for Construction, to deliver the industry improvement agenda, including the Construction Commitments.
- Promoting innovation in the sector, working closely with the Technology Strategy Board and other funding bodies.
- Co-ordinating the Whitehall response to reports featuring construction.

For further information please contact BIS Construction Sector Unit (020 7215 0826; E-mail: terence.boniface@bis.gov.uk).

MATERIALS & ENERGY

Dynamic thermal properties calculator

mpa essential materials sustainable solutions

The Concrete Centre™ PART OF THE MINERAL PRODUCTS ASSOCIATION

The Concrete Centre has launched a free tool for calculating the thermal properties of construction elements, which has been developed by Arup.

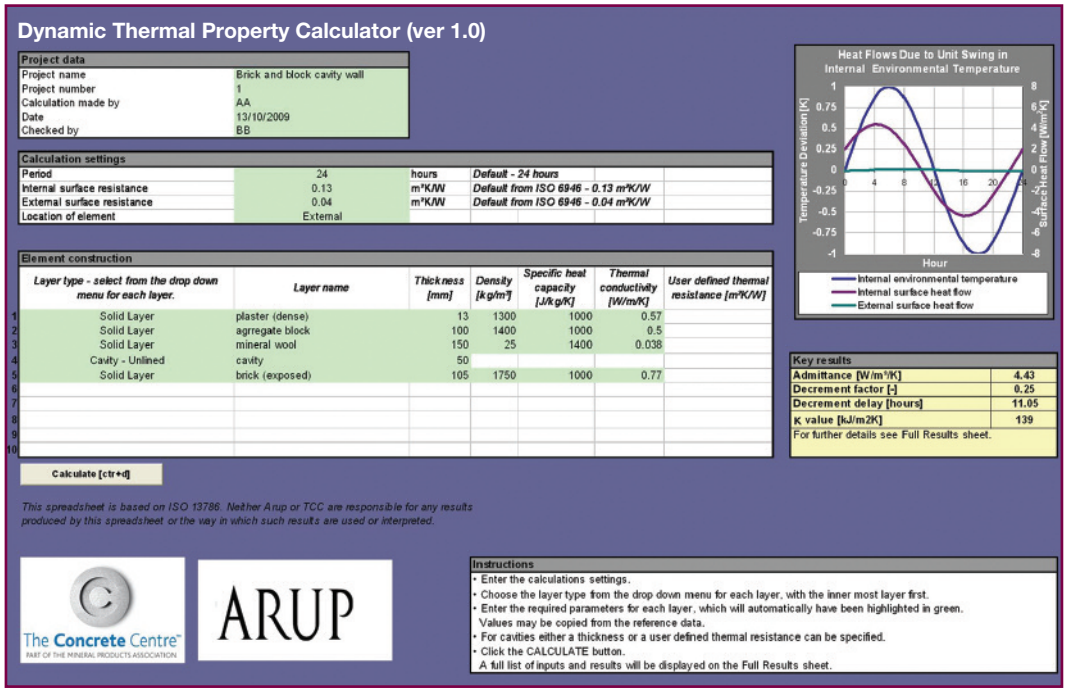
Part L of the Building Regulations, which deals with the conservation of energy, is currently being revised along with the compliance tool for housing known as SAP (Standard Assessment Procedure). The changes to SAP include a more-rigorous treatment of thermal mass in housing and the role it can play in passive design. When used appropriately, thermal mass can improve energy efficiency during the heating season by providing a means of capturing and slowly releasing free heat gains from the sun and internal sources. This cuts the load on the heating system and reduces CO_2 emissions, particularly in well insulated, air-tight homes.

The revisions take better account of this passive heating effect and, to help designers take advantage, the Concrete Centre commissioned Arup to develop a free Excel-based tool for calculating the thermal mass in floors and walls, which can now be downloaded at www.concretecentre.com.

The methodology is based on BS EN ISO 13786, and is fully aligned with SAP, allowing thermal mass values (also know as Kappa values) to be easily calculated and used in SAP software. If required, admittance values are also produced, providing an alternative means of assessing thermal mass.

Another feature of the tool is its ability to calculate decrement. This is a property of thermal mass which describes the way in which the density, heat capacity and thermal conductivity (of a wall for example) can slow the passage of heat from one side to the other (decrement delay), and also attenuate gains as they pass through (decrement factor). Designing for a long decrement delay of around nine hours or more, and a low decrement factor can help reduce overheating problems in summer.

The motivation for producing this tool is the growing need among architects and engineers for more information about the thermal characteristics of construction elements, other than just their U-value. This information helps to inform passive design choices and optimise the energy efficiency of the building form and fabric. Going forward, we are likely to see more attention paid to getting this right as the building fabric will have to work harder to help achieve the challenging requirements of Part L and the approaching zero-carbon target for new buildings. A further driver is the need for climate change adaptation, which will also place greater demands on the performance of construction materials.



The tool calculates the thermal mass and related properties of construction elements such as walls and floors

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

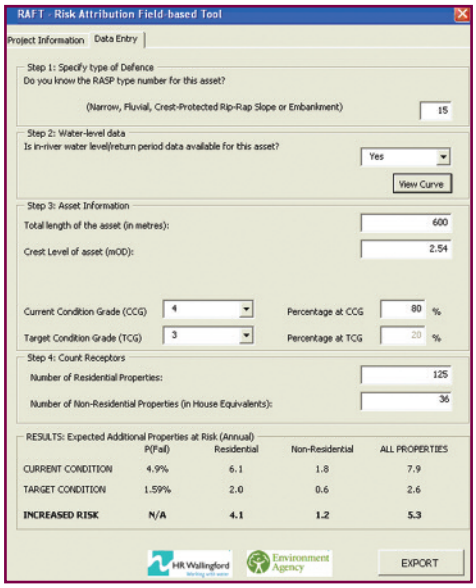
RAFT: a probabilistic tool for attributing flood risk

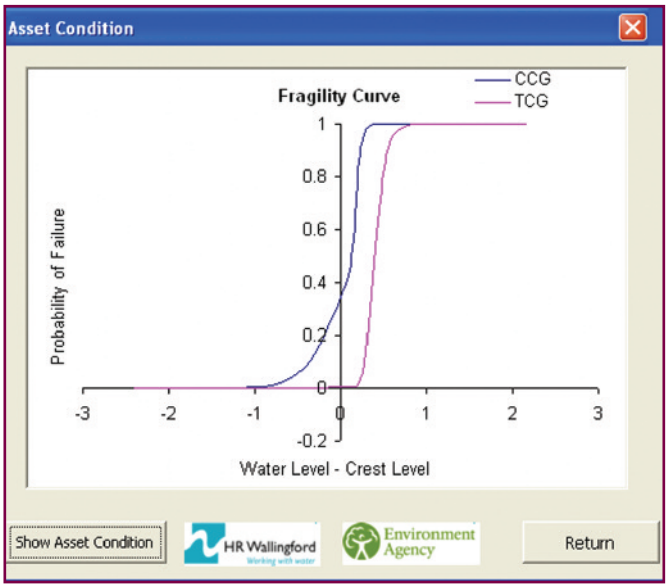
HR Wallingford

Given the complexity of flood defence systems and the inherent uncertainty in predicting how they respond to flood events, probabilistic risk assessment is becoming increasingly common as the tool for the management and design of such systems. However, the 'top-down' nature of the probabilistic assessment traditionally applied to entire systems requires both comprehensive flood defence database information and extensive computer simulation.

In response, RAFT (Risk Attribution Field-based Tool) has recently been produced for the Environment Agency by HR Wallingford. This is a 'bottom-up' model that enables risk to be attributed to individual flood defence assets. The RAFT tool utilises the local knowledge of Agency staff and simple information derived from site investigation (or simple desk-study) to estimate the risk associated with asset condition, without recourse to additional modelling.

The tool is accessed via a GUI (Graphical User Interface) within a Microsoft Excel spreadsheet, and interrogates users for essential local data via a series of carefully designed questions. The answers are used to estimate the number of additional residential and non-residential properties at risk due to diminished asset condition.





(Left) *The RAFT Graphical User Interface.* (Right) *Fragility curves are used to assign how the design performance of a flood defence compares with its estimated actual performance.*

RAFT enables the local knowledge of Environment Agency staff to be captured in a probabilistic analysis for the first time and provides access to powerful RASP techniques (Risk Assessment of Flood and Coastal Defence for Strategic Planning) without demanding a detailed understanding of probabilistic analysis.

The RAFT tool has been well received by EA staff at all levels, with Jim Barlow (Head of Asset Management Strategy and Data Systems) saying that "seldom has a simple spreadsheet solicited so much genuine praise".

For further information about RAFT, please contact Gordon Glasgow, and on probabilistic flood defence analysis, contact Ben Gouldby, Principal Scientist, Floods Group, HR Wallingford (01491 822273; E-mail: b.gouldby@hrwallingford.co.uk).

The mobile as transformational technology

The Royal Academy of Engineering

It is clear that the mobile phone has the potential to transform African society, education, commerce, and politics. This is true for reasons that extend beyond its obvious use in facilitating conversation and the flow of information between people.

One of the most powerful aspects of the mobile is that it has become the computing platform for the continent. Mobile phones, even the older ones more commonly found there, are relatively powerful computers, and have inbuilt communications as well as computational powers. Desktop PCs are rare – they are expensive, subject to failure because of dust, temperature and generally harsh conditions, and are less useful for more-prosaic reasons: they require a relatively large amount of electricity to run.

In the bush, this power simply does not exist, whilst in the cities, reliable supplies are becoming a thing of the past. Whilst in Cape Town investigating this work, under a Royal Academy of Engineering Global Research Award, Dr Russell Beale had two or three power cuts that were unplanned, and the power company announced a 'load shedding' regime in which the power was regularly cut off for four hours a day.

There are major differences in creating technologies in the developed and developing world. For example, usually the applications that Dr Beale designs have two cycles of interaction: an internet-based route, and a mobile-based one. The mobile augments the internet one, giving a user access to the system on the move.

In Africa, the internet part is almost always absent, and systems have to be designed for purely mobile use. Other issues have to be factored in. These range from limited literacy, forcing designs that are non-textual in nature, through to respecting social structures. A system is likely to be better-received and trusted if introduced through village elders, rather than directly to users.

Our western notions of structure have to be reconsidered. For example, some cultures have no notion of hierarchy. This means that, for example, a mobile system given to bushmen to classify animals they saw, which originally used categories such as number of legs, size, and colour, was not that successful but worked much better when it was redesigned to remove categories and present everything in a long, long list.

For further information please contact Dr Russell Beale, University of Birmingham (E-mail: R.Beale@cs.bham.ac.uk) or Misty Palmer at The Royal Academy of Engineering (020 7766 0600; E-mail: misty.palmer@raeng.org.uk).

Predicting the fire performance of lightweight timber structures

In the modern sustainability-driven environment, lightweight, heavily insulated timber structures (see Figure 1) are becoming more abundant not only in the residential building sector, but also in commercial new builds such as offices and schools. In such buildings, pre-fabricated products like engineered floor joists, light gauge steel floor and wall cassettes, and structural insulated panels (SIPs) are being adopted as an alternative to the heavier traditional alternatives such as masonry, hot rolled steel, concrete and solid large section timber. Whilst much emphasis is placed on the responsible sourcing of materials, embedded carbon and post-build energy efficiency, little consideration is made regarding the consequences of resulting innovations on fire performance and safety.

Light timber alternative structures such as those formed by SIPs and engineered floor joists are a relatively new concept. However, they are becoming more prevalent in the UK. Like many new technologies, the fire performance of such systems is evaluated via standard fire tests. It is widely accepted that the standard test procedure is not a true reflection of a system's behaviour in a real fire, on a holistic scale, and hence the performance of such systems in real fires is a relative unknown.

Recognising this, BRE Global are undertaking in collaboration with Loughborough University extensive research to establish the performance of lightweight engineered timber structures in realistic fire conditions. Due for completion in 2012, the author's doctorate will address important knowledge gaps in this area through a combination of full-scale, natural fire experiments (see Figure 2) on SIP and engineered floor joist structures and numerical modelling using the TNO DIANA finite element package.

The modelling aspect of this project couples heat transfer and non linear mechanical analyses so that predictions can be made about the likely performance of a lightweight timber structure when exposed to a range of fire scenarios. By coupling the model's development with large-scale fire tests, a robust validated tool for predicting behaviour should be achieved by the end of the research programme.

Substantial progress has been made in the prediction of core temperatures in SIPs exposed to a furnace temperature regime (see Figure 3), which will be extended to natural fire exposure conditions in the near future.

For more information please contact Danny Hopkin (E-mail: HopkinD@BRE.co.uk) or Jamal El-Rimawi (E-mail: J.A.El-rimawi@lboro.ac.uk).

Figure 1 (top) *Example of modern light timber trends*
Figure 2 (above) *Large scale test performed on engineered floor joists*

SPONSORING ORGANISATIONS

GOVERNMENT

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Construction Sector Unit
Bay UG87, 1 Victoria Street, London SW1H 0ET
020 7215 0826
Website: www.bis.gov.uk
E-mail: 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
E-mail: p-roberts@dfid.gov.uk

Highways Agency
5th Floor, 123 Buckingham Palace Road,
London SW1 9HA
Website: www.highways.gov.uk.
Email Julie.prince@highways.gsi.gov.uk.

RESEARCH ORGANISATIONS

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