

# Research Focus

Issue No. 40

FEBRUARY 2000

PROMOTING THE APPLICATION OF RESEARCH IN BUILDING AND CIVIL ENGINEERING

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## Improving office productivity: a practical initiative

As around 50% of business is now office-based, the success of much of the UK's economy depends on the output of office workers. 'Knowledge workers' create an increasing proportion of the added value in a developed, modern society. The office environment can have a significant influence on the performance of staff and so make a key contribution to the success of a business. Creating a productive workplace can thus optimise the use of material and human resources and so contribute to the achievement of sustainable development.

A project was launched in April 1997 to create a better understanding, by those responsible for the specification, selection and management of offices, of the interaction between offices and staff productivity. The work has resulted in the publication by Longmans of a guide for facilities and operational managers titled 'Improving Office Productivity'.

The project, funded through the DETR Partners in Innovation Scheme, was steered by a group of commercial sponsors including Royal & Sun

Alliance, Stanhope, Oscar Faber, the Post Office, Interior, ABS Consulting, Thorn Lighting and Troup Bywaters & Anders together with a representative of DETR. The work was led by SBS Business Solutions, with technical input from BRE and Johnson Controls Consulting.

The main programme elements were:

- collation of all accessible published research, leading to a state of the art review;
- a survey of selected companies' experience of features of office buildings and services that enhance productivity;
- analysis of this knowledge base to identify key environmental factors and work activities;
- piloting of the draft guide and supporting software in real working offices.



Royal & SunAlliance's Berkely Square global headquarters where the guide was launched in October 1999.

The guide provides managers with a simple system for assessing their own office, identifying specific priorities and identifying relevant advice on best practice and possible actions. A practical cost/benefit tool is also included to help build an investment case for the actions selected.

Copies of Improving Office Productivity are available from Longmans (01279 623928; www.pearson-ema.com; fax: 01279414130).

For further information on this work and on the new Office Productivity Network PII project, please contact Paul Bartlett at SBS Business Solutions, Waterloo House, Stanwell Green, Thorndon, Suffolk IP23 7JL (tel/fax: 01379 678899);

E-mail: pbbartlett@psilink.co.uk.



## ABOUT RESEARCH FOCUS

## Aims

The principal aim of *Research Focus* is to promote the application of research in building and civil engineering.

Supported by many organisations in the British construction industry, its brief articles on current research are written for practising engineers, architects, surveyors and their clients with the objective of disseminating research news as widely as possible. Its sponsors wish to promote the benefits of research, improve contacts between industry and researchers, encourage investment by industry in research and the use of research in practice, and facilitate collaboration between all the parties involved.

Formally, *Research Focus* is an unrestricted newsletter containing invited factual records or case studies of building or civil engineering research projects. Articles may be reproduced, provided the source is acknowledged.

## Enquiries and Comments

If you wish to know more about a specific project, you should contact the person named at the end of the relevant article. Look on the back page for addresses, telephone and fax numbers of the sponsoring research organisations and professional institutions. General information about their activities may be obtained from them directly.

We welcome your ideas on ways to improve *Research Focus* and so help it to achieve its goals. If you have a suggestion, or an article about an interesting piece of R&D, please send it to the Editor, Roger Venables, at the address below.

## Distribution

If you receive *Research Focus* by direct mail (i.e. not with *Civil Engineering*) and the address it is sent to is incorrect, if you would like additional copies for circulation within your organisation or if you would like to be added to the direct mail list, please contact Lesley Wilson at the Institution of Civil Engineers, 1 Great George Street, London SW1P 3AA (020 7655 2242; fax 020 7799 1325; Email [wilson\\_l@ice.org.uk](mailto:wilson_l@ice.org.uk)).

## Editorial Advisory Board and Editor

Overall editorial policy is set by the Editorial Advisory Board which comprises:

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**Editor:** Eur Ing Roger Venables

**Secretary:** Lesley Wilson (ICE).

Roger Venables, the Editor, is at Venables Consultancy, 12 Cranes Drive, Surbiton, Surrey, KT5 8AL (020 8399 4389; fax 020 8390 9368; E-mail: [rf@venablesconsultancy.co.uk](mailto:rf@venablesconsultancy.co.uk)).

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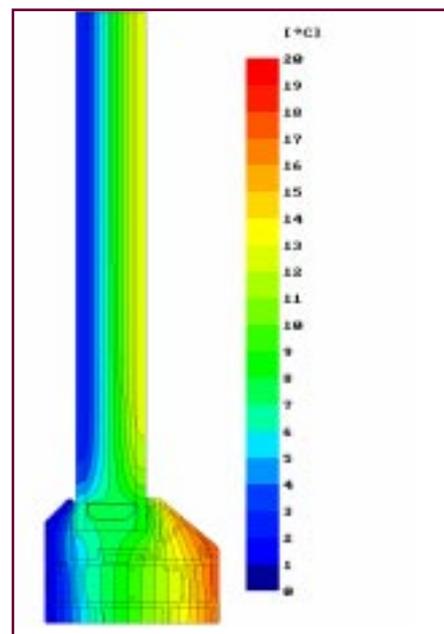
# Heat transfer through windows and façades

As energy usage becomes a more important measure of building performance, there is an increased emphasis on providing reliable methods for predicting heat loss through building components such as windows and walls. Nowadays new standards and software tools are available or under development for the assessment of heat transfer. As part of a DETR-funded project, CWCT has developed a web site (<http://www.cwct.co.uk/thermal>) aimed at introducing the analysis of heat transfer to the window and cladding industry. The site provides a review of world-wide standards, software and assessment schemes, either in use or preparation, for assessing heat transfer through windows.

In Europe, standards are under development for the calculation of window and door heat loss. One of these standards, prEN 10077 Thermal performance of windows, doors and shutters – Calculation of thermal transmittance will provide a method for assessing heat transfer through windows by simplified calculation (Part 1) or numerical calculation (Part 2), using computer software based on finite element analysis or the finite difference method. A scheme showing how to use both parts of the standards and the relationship with other BS and EU standards is given in the web site.

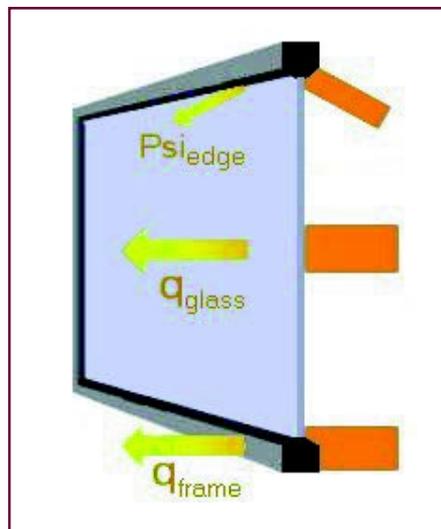
The web site also contains an overview of the international standards related to window heat transfer that are in use (EN, ISO, IEA) or in preparation (CEN). In addition, various national standards currently in use (in the UK, Germany, USA and Canada) are listed.

Software is available for the calculation of two-dimensional steady state heat transfer in windows or wall components. The level of sophistication and hence the number of properties that can be calculated varies. A checklist showing the possibilities and the capacities of three types of software are given. Lists of software for the calculation



2) Temperature distribution of a window frame by a finite element program

1) Heat flow calculation by finite element program



of the thermal transmittance and for the fenestration energy rating have also been given.

The American and Canadian window industries have developed rating schemes for assessing heat transfer through their products, based on combined computer numerical calculation and laboratory measurement. These schemes have been in operation for more than 6 years and similar schemes are being considered for use in other countries. In the UK, a British Fenestration Rating Council has been formed to establish a national rating system for the thermal performance of fenestration products. A list of these procedures and publications has been added to the web site.

The web site will be maintained on regular basis, so should provide a useful continuing source of information for the industry.

For further information please contact Henk De Bleecker, CWCT (01225 826541; fax: 01225 826556; E-mail: [cwct@bath.ac.uk](mailto:cwct@bath.ac.uk)).

## Guidelines for port environmental management

Port operations and development can make substantial direct environmental demands in terms of the land and water space they occupy, and can generate many indirect demands from other associated transport modes such as shipping and rail and/or road access. A project at HR Wallingford to produce guidelines on the environmental management of ports and harbours (see Issue 33) is now complete, and a report, *Guidelines for Port Environmental Management*, is imminent. The work was part-funded by DETR.

**T**he new Guidelines 'do not mandate the actions that port and harbour authorities must take regarding environmental management. They offer suggestions and guidance,' explains Eleni Paipai, project manager at HR. 'We recognise the variety of port and harbour operations and the range of staff with environmental responsibilities. Information is targeted at managers charged with identifying their port's environmental performance and those who need 'hands-on' advice.'

The Guidelines identify key environmental implications of port development and operation, as well as summarising relevant environmental legislation. They highlight the current status of environmental management within UK ports, giving examples of practice here and overseas. General information on the international standard for environmental management systems, ISO 14001, and the EU Eco-Management and Audit Scheme (EMAS) is also provided. Tables and flow charts set out hands-on advice to help minimise environmental impacts.

The new Guidelines complement other initiatives – including Associated British Ports'



*Fal Estuary and Truro Harbour. Truro Harbour Masters Office*

LIFE project on guidance to ports and harbours operating in or near Special Areas of Conservation, and the self-diagnosis methodology of the EC eco-information project – and should be of value to port and harbour managers.

*For further information please contact Mrs Eleni Paipai at HR Wallingford Ltd. (01491 822472; fax: 01491 832233; E-mail: epp@hrwallingford.co.uk).*



## MATERIALS & BUILDINGS

### Polymer composites: a way forward for construction

Advanced polymer composites could give designers and owners of buildings and other structures the adaptability they need to successfully fulfil facilities' design lives.

**T**he construction industry does not place enough emphasis on designing for change in a structure's use during its design life, nor for ease of maintenance and replacement of parts, both issues that were highlighted in the Egan Report.

The life expectancy of most types of building is typically 60 years – and generally 120 years for most bridges. But architectural fashions and uses of buildings change ever more rapidly, and bridge highway loads and traffic capacity can change out of all recognition over a period of 20 years, let alone over the design life.

The construction industry thus needs to produce structures with components that can be readily maintained, replaced, re-arranged, extended and strengthened. Other industries already design their products around these requirements.

Advanced polymer composites, originally designed for aerospace and military applications, have qualities that can also benefit

buildings and engineering structures and may provide a way forward for the industry. They offer architects, designers, structural engineers and building owners many advantages over traditional construction materials. For example, they allow a modular approach with separate rather than integrated functions.

Fibre-reinforced plastics have been used in the construction industry for several decades, mainly for architectural applications. But composites have recently been used successfully for construction applications such as sandwich panels, modular units, structural components, reinforcing bars, and repair and strengthening of structures. This has demonstrated their potential, and their contribution is expected to increase in the future.

*For further information please contact Dr Sue Halliwell at BRE (01923 664860; fax: 01923 664786; E-mail: halliwells@bre.co.uk).*



*Mondial House in London was built around 25 years ago. Its glass reinforced plastics (GRP) cladding has performed well.*

# Fire test on Timber Frame 2000 Building

In a large-scale, 'real' fire test on the Timber Frame 2000 building at BRE Cardington Large Building Test Facility, the building performed well, with neither its structural integrity nor the compartmentation compromised. The test, carried out by BRE and TRADA Chiltern International Fire, was part of the research project on the Timber Frame 2000 (TF2000) building jointly sponsored by the timber frame industry and DETR.



Fire test on the TF2000 building at Cardington

The 6-storey TF2000 building contains 24 flats – four per storey – and is believed to be the tallest timber frame building of its kind in the world. The designated fire test compartment was one of the two-bedroom flats at second floor (third storey) level.

The key objectives of the test were:

- to evaluate the fire resistance of a multi-storey timber frame building subjected to severe natural fire exposure – the particular aspects being assessed being structural integrity (loadbearing capacity) and compartmentation (prevention of fire spread out of the flat where the fire originated);
- to provide data to help develop fire engineering design principles for medium-rise timber frame buildings above 4 storeys.

The test fire was ignited in the living area of the flat and progressed to 'flashover' after approximately 24 minutes. Peak temperatures in the flat reached 1000°C and remained at or around this level until the test was stopped at 64 minutes, having exceeded the planned termination criteria.

Much of monitoring data was collected from the extensive array of instrumentation incorporated in the TF2000 building. A full account of the results will be disseminated once analysis of the data has been completed and interpretations developed.

For further information please contact Dr Vahik Enjily at BRE (01923 664392; fax: 01923 664785; E-mail: enjilyv@bre.co.uk).



## ENVIRONMENT, MANAGEMENT & MATERIALS

### Defining and improving environmental performance in the concrete industry

Recent UK Government publications and national committees have emphasised the importance of environmental performance, sustainability and the role of the construction industry. This two-year, £118K Partners in Innovation project was initiated in April 1998 to provide the concrete industry, concrete users and policy makers with a means of assessing the environmental performance of concrete and concrete elements, and to help in the selection of the best options.

The project has support from DETR and the Concrete Industry Alliance (CIA). The objectives are:

- to establish a CIA scheme for defining and updating the concrete industry's main environmental impacts, indicating realistic benchmarks, and providing perspectives in relation to other construction and UK sources;
- to produce examples of environmental profiles for common concretes and plain and reinforced concrete elements;
- to publish simple fact sheets to highlight opportunities afforded by concrete for improving environmental performance in construction;
- to apply life-cycle analysis software to the compilation of environmental profiles of concrete and plain and reinforced concrete elements.

Environmental analysis software has been employed for various concrete industry investigations and the project partners have provided much of the environmental inventory data. The following case studies have been addressed.

- Glass-fibre reinforced cement products in which lidded cable ducts and drainage channels have been analysed.
- Recycled concrete as aggregate in new concrete, in which the importance of aggregate shape and quality upon the binder content and environmental performance of the concrete has been examined.
- Formwork, where it was discovered that environmental impacts of concrete were not greatly increased by those from formwork unless section sizes were small.

- Transport, where environmental impacts of transport can significantly increase those of concrete.
- Ground granulated blastfurnace slag (ggbs) and pulverised fuel ash (pfa) which illustrates the environmental benefits of using ggbs and pfa.
- Curing alternatives for concrete blocks, which showed that the environmental effects of three very different curing options were similar.

These case studies will be highlighted in Concrete Industry Alliance fact sheets for wide dissemination. The aim is to encourage implementation in applications where concrete can afford a particular opportunity for environmental improvement and sustainability.

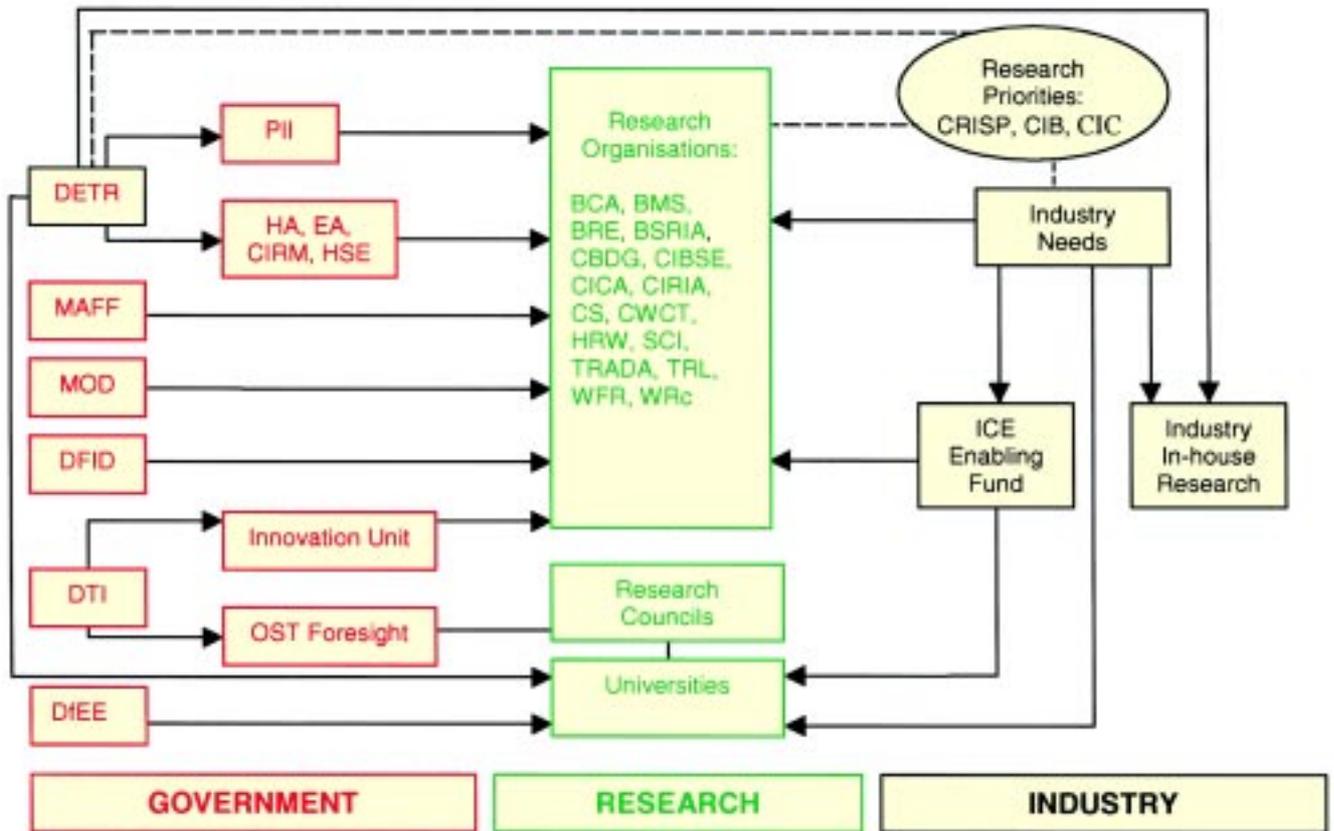
The concrete industry's contribution, along with those of other construction sectors, to national environmental impacts is being assessed. The information will be incorporated in a concrete industry report that also addresses environmental improvement, benchmarks and targets.

Partners in the project were: British Cement Association (leading for CIA), British Precast Concrete Federation, CONSTRUCT, Cementitious Slag Makers Association, UK Quality Ash Association, Quarry Products Association, Reinforced Concrete Council, UK Steel Association, British In-Situ Concrete Paving Association, Glassfibre Reinforced Concrete Association and Building Research Establishment.

For further information please contact Dr Les Parrott, British Cement Association (01344 725713; fax: 01344 727205; E-mail: lparrott@bca.org.uk).



# UK Construction Research Map



LEGEND → indicates research funding route    - - - indicates information and policy links

Where does research for the UK construction industry get done? Where are needs and priorities generated? Where does the money come from? These simple questions lead to complex answers, featuring many cross-connections and acronyms.

The ICE Research and Innovation Committee has tried to distill UK construction research into a framework map that clearly shows the principal paths and landmarks. It is reproduced here as a guide and aid to understanding. The goal of this map is research itself: another map would be needed to describe the routes of its dissemination and application.

The Committee does not pretend to be omniscient or infallible, and hopes that publication of this first 'Research Map' will prompt additions or corrections that progressively increase its value to the whole construction community.

Please address any comments you may have to Dr John Bennett, Technical and Engineering Division, The Institution of Civil Engineers (020 7665 2205; fax: 020 7799 1325; E-mail: bennett\_j@ice.org.uk).



## GLOSSARY

<b>BCA</b>	British Cement Association	<b>DFID</b>	Department for International Development
<b>BMS</b>	British Masonry Society	<b>DTI</b>	Department of Trade & Industry
<b>BRE</b>	Building Research Establishment	<b>EA</b>	Environment Agency
<b>BSRIA</b>	Building Services Research and Information Association	<b>EPSRC</b>	Engineering and Physical Sciences Research Council
<b>CBDG</b>	Concrete Bridge Development Group	<b>ESRC</b>	Economic and Social Research Council
<b>CIB</b>	Construction Industry Board	<b>HA</b>	Highways Agency
<b>CIBSE</b>	Chartered Institution of Building Services Engineers	<b>HRW</b>	Hydraulics Research Wallingford
<b>CICA</b>	Construction Industry Computing Association	<b>HSE</b>	Health and Safety Executive
<b>CIRIA</b>	Construction Industry Research & Information Association	<b>MAFF</b>	Ministry of Agriculture, Fisheries and Food
<b>CIRM</b>	Construction Innovation and Research Management	<b>MOD</b>	Ministry of Defence
<b>CRISP</b>	Construction Research And Innovation Strategy Panel	<b>NERC</b>	Natural Environment Research Council
<b>CS</b>	Concrete Society	<b>OST</b>	Office for Science and Technology
<b>CWCT</b>	Centre for Window and Cladding Technology	<b>SCI</b>	Steel Construction Institute
<b>DETR</b>	Department of the Environment, Transport and the Regions	<b>TRADA</b>	Timber Research and Development Association
<b>DfEE</b>	Department for Education and Employment	<b>TRL</b>	Transport Research Laboratory
		<b>WFR</b>	Warrington Fire Research
		<b>WRc</b>	Water Research Centre

## Secure design

Research has shown that the police's Secured by Design (SBD) scheme in public-sector housing has reduced both the fear and the incidence of crime.

**S**BD is a police initiative in which officers inspect building designs and recommend actions to prevent crime. If these are implemented, the building project is awarded the SBD logo. There are design criteria for new-build housing, refurbishments and multi-storey housing.

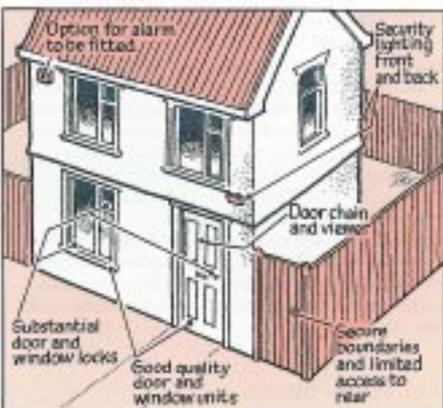
A recent study (by BRE's Risk Assessment Centre with support from DETR, various police forces and the Building Research Housing Group) examined SBD's success in reducing crime and the fear of crime, and in improving residents' quality of life. It focused on property crime and theft of, or from, cars.

Ten different housing estates across the country, representing a range of different social housing types, were selected for investigation. A good proportion of the residents questioned had either lived there before modernisation or knew of the area's reputation. This made it possible to compare the experiences of residents before and after SBD.

Data was obtained from residents' questionnaires and from focus groups of residents, management teams and police. The results show that SBD has successfully reduced the perceived levels of crime and anti-social behaviour, the biggest reduction being burglary and vehicle crime. These findings are supported by residents' actual experience of crime and, where available, police figures. The numbers of residents satisfied with their homes increased.

Improvements to SBD have been recommended, based on residents' concerns. These including the need to concentrate on improving streetlighting, controlling and reducing access through streets, and making streets appear more private. SBD criteria should be developed for social policing, providing facilities for youth, and providing advice on housing management of tenants.

For further information please contact Tim Pascoe at BRE (01923 664418; fax: 01923 664910; E-mail: pascoet@bre.co.uk).



Some of the SBD target-hardening measures

## Developments in modular construction

The Steel Construction Institute's Modular Framing Group is active in preparing design guidance, and in assessing the broader value-benefits of modular or volumetric construction in a wide range of building applications. Two recent SCI activities in this area are Modular Construction using Light Steel Framing: An Architect's Guide, which was published in November 1999, and an ongoing project dealing with the Performance Specification for Modular Construction, which is well underway. Both have been supported by DETR under the Partners in Innovation scheme.



Modules under construction at Terrapin Ltd.

**I**n these activities, the design and construction issues are equally addressed, including interfaces with cladding, services and other components. The broad value-benefits include: speed of installation, reduced waste and disruption on site, and improved quality through off-site manufacture. Against these benefits must be considered any increased 'lead-in' time and costs, especially for small production runs. Economy of scale of production is clearly an important factor. Site logistics can be impressive, with 10 modules a day being installed on typical projects.

In parallel with these activities, the SCI is also investigating the use of modular construction in renovation, for example in roof-top extensions, additional lifts and stairs, and internal bathroom/toilet modules. Suitable demonstration projects are sought in which modular units may be used in the context of building renovation.

For further information please contact Mark Lawson at The Steel Construction Institute (01344 623345; fax: 01344 622944; E-mail: m.lawson@steel-sci.com).



## GROUND ENGINEERING & CONSTRUCTION PROCESS

### Managing geotechnical risk

Independent studies by bodies such as the ICE, TRL and the DETR have all shown that a major cause of delays and cost overruns on construction projects lies in the ground. To tackle these problems, the ICE has, since March 1998, been undertaking a DETR-funded Partners in Innovation research project 'Managing geotechnical risk: improving productivity in UK building and construction'. The work is being undertaken by the University of Southampton Department of Civil Engineering, aided by BRE and overseen by a steering group of clients, developers, consultants and contractors.

**T**he first part of this two-year study was directed to answering three questions: How well does UK construction manage its geotechnical risks? Does it employ the latest information technology? Does it employ the latest relevant risk software packages? Thirty project case studies were then collected and analysed in order to investigate the relationship between project planning, management methods and project success.

When completed in 2000, the study will assist in promoting the same degree of technological sophistication in risk management in UK construction as is taken for granted in other industries. In addition to a comprehensive set of Guidance Notes, a video and CD-Rom, the output will include lectures and seminars around the UK, together with articles in the construction and national press.

For further information please contact Project Director Mr Neil Trenter (tel & fax: 020 8979 4681; E-mail: ntrenter@globalnet.co.uk) or Ms Liz Marwood at the ICE (020 7665 2238; fax: 020 7799 1325; E-mail: marwood\_l@ice.org.uk.)



## Assessing sediment plumes from dredging

Sediment plumes arising from marine aggregate and contract dredging are perceived by many stakeholders in the marine and coastal environment to lead to environmental impacts requiring investigation, monitoring or mitigation. CIRIA, in collaboration with a consortium made up of Posford Duvivier Environment, HR Wallingford and The Centre for Environment, Fisheries & Aquaculture Science (CEFAS), has brought together the current knowledge on plumes into a central document that is designed for developers and regulators. The aim has been to address how plumes should be assessed, having considered the likely or possible effects of dredging operations.

**U**nder current UK legislation, all dredging licence applications, and most harbour maintenance dredging, is subject to environmental assessment. Most investigations include a review of the potential environmental impacts of the sediment plumes. All environmental assessments include extensive consultations with stakeholders, including fishery, recreational, navigational and coastal interests.

Simplistically, the action of dredging releases sediment into the water column to form a plume of material. The development of this plume occurs in two distinct stages.

In the dynamic phase, plume behaviour is mainly decided by the nature of the material and the conditions of dredging control. The zone of impact of the dynamic plume is relatively small, at most affecting an area within 100–200 m of the dredger. The suspended sediment concentration within the dynamic plume can be of the order of thousands of milligrammes per litre.

In the passive phase, plume movement is much more a function of the surrounding hydrodynamic environment. The zone of impact of the passive plume can be very large – several square kilometres or more. Suspended sediment concentrations within the



Sediment plume shows at the sea surface  
(Courtesy of Dr I Selby)

plume can be in the order of hundreds of milligrammes per litre in the vicinity of the dredger, reducing to tens of milligrammes per litre with distance from the dredger.

This work has identified that the environmental effects associated with sediment plumes are often secondary in importance to those associated with the direct loss of seabed. In addition, whilst the loss of the seabed and its environmental resource is a fundamental and unavoidable consequence of dredging, environmental effects associated with sediment plumes need not be.

The necessary components of a structured framework for assessing the environmental effects arising from dredging plumes are outlined in the report. It considers the steps required to inform the decision-making process, and the data and tools required to inform the steps. Such a framework needs to remain sufficiently flexible to accommodate the different types of environment that characterise the UK's maritime zone and the different types of dredger that operate within it.

For further information please contact Stuart Meakins at CIRIA  
(020 7828 4441; fax: 020 7828 4055;  
E-mail: rfocus@ciria.org.uk).



## BRIDGES & MATERIALS

### Monitoring reinforcement corrosion

Reinforcement corrosion caused by ingress of de-icing salts is the major cause of deterioration to reinforced concrete bridges in the UK. It causes not only loss of steel but also cracking and spalling of the concrete. If corrosion can be detected before the first visible signs appear, then more maintenance options are available.

**T**RL is presently carrying out a number of projects for clients, including the Highways Agency, to evaluate NDT techniques for assessing the condition of steel reinforcement. In addition to assessing the accuracy and reliability of each technique, the practical relevance of the results is also being considered.

Methods for estimating the 'corrosion current' of the reinforcement (which is related to the loss of steel) have been evaluated. Generally, the results indicated that there was little, if any, practical improvement in a corrosion assessment carried out using these methods over that made using a half-cell potential survey.

Different types of embeddable probes have also been tested. Although



Typical corrosion of a reinforced concrete bridge

there are only a small number of generic types, each can be applied in a number of ways, and each has its own advantages and disadvantages.

Overall, it has been concluded that their inclusion into new structures does have some merit. However, in certain circumstances, the relevance of the information they provide can be limited. Attempting to retrofit them into existing structures is likely to be less informative.

For further information please contact Robert Walker at TRL  
(01344 770185;  
fax: 01344 770356;  
E-mail: rwalker@trl.co.uk).



# Demonstrating that construction waste minimisation pays

CIRIA is currently assisting 10 live design projects and construction sites with implementation of construction waste minimisation, in order to document the economic and environmental benefits that proper waste minimisation can bring.

**H**aving published a series of guidelines for the implementation of construction waste minimisation, CIRIA is now bringing best practice to ten live construction projects within the research project: Waste reduction, re-use and recycling in construction – demonstration projects. The objective is to demonstrate that adopting construction waste minimisation measures saves money on site.

The work involves the training of staff in waste minimisation, gathering data on waste generation and handling, advising on waste minimisation strategies, and monitoring progress over a period of time.

To raise industry awareness of construction waste minimisation, a range of publications and other outputs will result from the project – case study reports from each demonstration project, a series of workshops, a final dissemination seminar and publication of strategic guidance on implementing waste minimisation initiatives.

The project is funded by the DETR, AMEC, Biffaward, The BOC Foundation, CAPITB, Hanson Environment Fund, Scottish Executive and SNIFFER (the Scotland and Northern Ireland Federation for Environmental Research).



Careful storage of construction materials reduces waste

For further information please contact Martin Hunt at CIRIA (020 7222 8891; fax: 020 7222 1708; E-mail: rfocus@ciria.org.uk).



## ENERGY, MATERIALS & ENVIRONMENT

# Refrigeration opportunities

The refrigeration and air-conditioning industries are currently undergoing significant changes. Production of CFC refrigerants has now ceased and there are mounting pressures to replace HCFCs. A recently completed PII project addressed the opportunities for incorporating energy efficiency measures at the time of replacement.

**M**onitoring of three replacement schemes demonstrated the potential for savings of 16–20%, primarily through:

- correct sizing of heat exchangers;
- variable voltage motor controllers;
- effective AC plant controls.

These case studies formed part of generic guidance for replacement strategies launched at a workshop for major supermarket chains, high street retailers and office stock.

One of the industry partners, Earthcare Products Ltd, has incorporated the recommendations into their range of split system air-conditioning units launched at the end

of 1998. As a result of the enhancements to their products, Earthcare were also shortlisted finalists in the H&V News Awards 1999 for Air-conditioning product of the year. Another industry sponsor, Fairford Electronics are now working with EA Technology Ltd to develop and incorporate variable voltage motors into ac units.

Other Project partners included NatWest, Norweb, East Midlands Electricity, Calor and ICI Klea.

For further information please contact Russell Benstead at EA Technology, Capenhurst, Chester CH1 6ES (0151 339 4181; fax: 0151 347 2131; E-mail: rb@eatl.co.uk).



## SPONSORING ORGANISATIONS

### GOVERNMENT

**Department of the Environment, Transport and the Regions,**  
Eland House, Bressenden Place,  
London SW1E 5DU  
(020 7890 5704, fax 020 7890 5759)  
Website: www.detr.gov.uk

### RESEARCH ORGANISATIONS

**British Cement Association,**  
Century House, Telford Avenue, Crowthorne,  
Berkshire, RG11 6YS  
(01344 762676, fax 01344 761214)  
Website: www.bca.org.uk

### BRE,

Garston, Watford, Hertfordshire, WD2 7JR  
(01923 664000, fax 01923 664010)  
Website: www.bre.co.uk

### Centre for Window and Cladding Technology,

University of Bath, Claverton Down, Bath,  
BA2 7AY (01225 826541, fax 01225 826556)  
Website: www.cwct.co.uk

### Construction Industry Research and Information Association,

6 Storey's Gate, Westminster, London, SW1P  
3AU (020 7222 8891, fax 020 7222 1708)  
Website: www.ciria.org.uk

### HR Wallingford Ltd,

Wallingford, Oxfordshire, OX10 8BA  
(01491 835381, fax 01491 832233)  
Website: www.hrwallingford.co.uk

### The Steel Construction Institute,

Silwood Park, Ascot, Berkshire, SL5 7QN  
(01344 623345, fax 01344 622944)  
Website: www.steel-sci.org.uk

### Transport Research Laboratory,

Old Wokingham Road, Crowthorne, Berkshire,  
RG45 6AU (01344 773131, fax 01344 770356)  
Website: www.trl.co.uk

## PROFESSIONAL INSTITUTIONS

### The Chartered Institute of Building,

Englemere, King's Ride, Ascot, Berkshire,  
SL5 7TB (01344 630700, fax 01344 630777)  
Website: www.ciob.org.uk

### Institution of Civil Engineers,

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

### Institution of Structural Engineers,

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

## INDUSTRY

**ABP Research & Consultancy Ltd**

**Ove Arup Partnership**

**Bechtel Limited**

**Fordham Johns Partnership**

**Geotechnical Consulting Group**

**Laing Technology Group Ltd**

**Sir Robert McAlpine Ltd**

**Mott MacDonald Group Ltd**

**Pick Everard**

**Posford Duvivier**

**Rofe, Kennard & Lapworth**

**Scottish Hydro-Electric plc**

**Southern Testing Laboratories**

**Symonds Travers Morgan**

**Taywood Engineering Ltd**

**Wilde & Partners**

**George Wimpey plc**