

Innovation & Research



Issue No. 55 November 2003

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Slope stabilisation: plants-soil-slope interaction

The Academy's Global Research Awards scheme provides an exciting opportunity for engineers currently engaged in R&D in the UK to extend their research in centres of excellence overseas, for periods of three to twelve months.

The scheme encourages the involvement of engineers in advanced engineering techniques, in particular where such technologies are novel, or not readily available in the UK, and in networking around the world. The Academy will fund 50% of the costs of the visit(s) up to a ceiling of £35,000.

An indication of the broad spread of projects is exemplified by The Academy's support of Dr David Barker who is completing a series of secondments on slope stabilisation totalling nine months over three years.

The research – in the Unites States and in New Zealand – focuses on *in situ* tree root architecture characterisation and computer modelling for slope stability analysis.

Seasonal root growth patterns in forests have been observed for nearly 20 years using video images gained from minirhizotrons – small transparent tubes sunk 1m into shallow holes drilled into forest floors at sites extending from New Mexico to Alaska.

This work is centred at Michigan Technical University at Houghton. US foresters, under Forestry Professor Kurt Pregitzer, have been carrying out this work in forest carbon-sequestration research related to global warming concerns. The purpose of the secondments has been to adapt this work for assessing the mechanical contributions to slope stabilisation by tree roots.

The University of Georgia's Warnell School



Exhumed roots of white oaks

of Forest Resources, under Professor Ron Hendrick, is also part of the minirhizotron network. Here, David Barker and French co-researchers have exhumed trees using high-velocity air jet (greater than Mach II) lances to remove soil with high rates of fine root recovery.

Specialist digitisation, graphical visualisation and data-processing software is being used to obtain root architecture data for the slope stability modelling being undertaken by Barker and Emeritus Professor T H Wu of Ohio State University, USA.

These techniques have been used on exhumed root matrices of white oaks (see photo) growing on slopes in the University of Georgia's Whitehall Research Forest.

Barker is carrying out further root slope stabilising modelling with colleagues from Landcare in New Zealand.

International networking and dissemination are vital components of The Academy's scheme and to this end David Barker has presented his research at many conferences throughout the world.

For further information on all The Academy's Research Support schemes, please contact Mr Rob Barrett, Manager, Research Support, The Royal Academy of Engineering (020 7227 0500; E-mail: barrettr@raeng.co.uk; website: www.raeng.org.uk)



Non-ferrous waste in road construction: an update

BRE

A BRE project on the use of non-ferrous industry waste as bound aggregate in road construction has reached a key stage, with the recent laying of a demonstration asphalt road containing ISF slag as aggregate, at the Britannia Zinc site at Avonmouth near Bristol.

In September 2002, in an earlier phase of the project (see *Innovation & Research Focus* Issue 52), a concrete road pavement containing the ferro-silicate slag aggregate from the Imperial Smelting Furnace production of zinc (ISF slag) was laid at the site. Laboratory tests have indicated that ISF slag is also an effective fine aggregate when bound with bitumen and this was the subject of the latest trial.

Test and control sections (with and without ISF slag) were manufactured, laid and compacted by Aggregate Industries using full-scale plant under the direction of Scott Wilson Pavement Engineering. The section of road containing the ISF slag proved easy to lay.

These road sections will, as with the concrete roadway laid previously, carry a significant amount of heavy industrial traffic and will be monitored over the next year. This will involve coring, dynamic cone penetrometer and falling weight deflectometer testing. The data will be evaluated and the predicted pavement lives of the trial and control pavements for a hypothetical design traffic compared. A suite of performance-related tests will be used on the cores to determine the fundamental mechanical properties of the ISF slag asphalt and con-



The demonstration road, the right-hand side of which contains the ISF slag, the left-hand side the control mix.

trol material, and likely future behaviour.

The aim of this BRE partnership project is to encourage the use of non-ferrous waste in construction in areas local to the manufacturing sites, to reduce the use of valuable landfill space and to support the economic viability of the local manufacturing industry.

Whilst the quantities of non-ferrous indus-

try wastes are small in relation to the volumes of aggregates consumed annually by the UK construction industry, the requirement to landfill these materials is costly in both economic and environmental terms. The waste can easily be consumed in the locality of production without affecting the local economy reliant on production of primary aggregates.

In the longer term, the partners hope to secure funding for a demonstration trial using other secondary and recycled aggregate materials.

The project partners include Alcan Smelting and Power UK Ltd; Anglesey Aluminium Metal Ltd; Aluminium Federation Ltd; BRE; Britannia Zinc Ltd; Britannia Refined Metals Ltd; Engineering Industry Directorate, DTI; Environment Agency; Anson Premix; Hekett Multiserv; Highways Agency; The Non-Ferrous Alliance; Ready Mixed Concrete Bureau; Rowan House Ltd; Scott Wilson Pavement Engineering Ltd; and Tarmac Group.

For more information please contact Andrew Dunster at BRE (01923 664365; fax: 01923 664786; E-mail dunster@bre.co.uk).

WATER & DEVELOPMENT

Improving water services to poor consumers in Third World cities

DFID Department for International Development

Amongst many DFID-funded projects at WEDC at Loughborough University that look at ways of improving services to low-income communities in developing countries, one project has assessed the value of using marketing approaches.

Many urban utilities and municipalities provide water services directly to fewer than 20–50% of city dwellers. Consequently, those unserved typically have to use contaminated water sources or rely on unauthorised and unregulated water connections and expensive water vendors. However, there are several potential options for improving water service provision, including utility-supported private water kiosks, community-managed kiosks and local water distribution pipes, individual house and yard connections, and kiosks with storage tanks.

Where continuous water supply is not feasible, the old 'predict and provide' approach is ineffective. It is far better to promote water service, payment and management options that meet the specific needs of different consumer groups. Just as the number of payment options in the UK has increased, similar marketing concepts offer a means to extend utility water services to consumer groups in developing countries in a sustainable way.

Water supply needs and conditions differ between customer groups or market seg-

ments. In Mombasa, for example, the market encompasses those living in bungalows, flats, one- and two-roomed dwellings, and in informal settlements. Service provision between these groups varies substantially. For example, 35% of those living in bungalows do not have a direct utility water supply, compared to 96% in informal settlements. No bungalow dwellers were found to use water kiosks, compared to 79% of those in informal settlements.



Water kiosk, Arusha, Tanzania, Credited to Cyrus Njiru.

The 'Customer Value Chain' allows service options to be developed in a demand-responsive way. The vital links of the chain are:

- knowing and understanding the practices, perceptions, preferences and willingness to pay of actual and potential customer groups;
- targeting priority areas with appropriate options, using skilled facilitators to work with poor communities;
- selling options using suitable promotion techniques;
- service provision to a high standard, requiring utilities to adopt a programme of continual organisational improvement.

Appropriate marketing approaches have been tested and refined by WEDC and are to be included in several forthcoming guidance notes.

For further information please contact Kevin Sansom at WEDC, Loughborough University (01509 222885; E-mail: K.R.Sansom@lboro.ac.uk).

Carbon-neutral buildings from scratch

A new report describing how to build and afford carbon-neutral buildings has just been published. Part of the *Carbon Neutral Toolkit* series, and written by environmental organisation BioRegional, it's a practical guide to help the building industry make informed environmental decisions more easily and is based on lessons learnt at BedZED, the Beddington Zero Energy Development, the UK's largest carbon-neutral development. Development of the toolkit was part-funded by the DTI under the Partners in Innovation programme.

This year the London Sustainable Development Commission recommended to The Mayor that, to meet the Government's target of a 60% reduction in CO₂ by 2050, all new build in London should be carbon neutral. Carbon neutral means that the construction and occupation of a building creates no net contribution of CO₂ to the atmosphere.

There is a widespread aspiration in the construction industry to produce more-sustainable buildings but such buildings rarely come about because of the cost premium usually associated with design strategies. However, it is hoped that the report will help to break down this barrier.

The report is the second in the Carbon Neutral Toolkit series and describes the measures taken at BedZED to reduce environmental impact. It includes technical descriptions, monitoring results – which prove real-life environmental performance such as a 90% space heating reduction – and financial mechanisms that have allowed the innovations at BedZED to become a reality.

The report also details the more recent 'ZED in a Box' design, which represents the next iteration in the ZED design and development process, incorporating further improvements since BedZED. The development of BedZED and 'ZED in a Box' has given the ZEDteam a vast bank of knowledge and practical experience in producing carbon-neutral developments.

BedZED is a mixed-use scheme in South London developed by the Peabody Trust in partnership with BioRegional and designed by Bill Dunster Architects. The scheme comprises 82 homes and 3,000m² of commercial or live/work space. The scheme was completed and occupied in Spring 2002.

The development enables people to live more-sustainably, within their share of the earth's renewable resources, without sacrificing a modern, urban and mobile lifestyle. It aims to achieve this within the cost constraints of a social housing budget. BedZED makes a more-sustainable lifestyle easy, attractive and affordable by challenging conventional approaches to housing by tackling sustainability in every area from the outset. Heat, electricity and water demands are greatly reduced, eliminating the need for space heating and reducing water consumption by half compared to conventional heating. Facilities and services are designed to make it easy to reduce waste to landfill, recycle waste and reduce car use. BedZED achieves the high densities recommended in the Urban Task Force report whilst still providing a healthy internal environment, with unprecedented access to green space and sunlight.



The BEDZED Development in South London (courtesy of Bill Dunster Architects)

In addition to the sustainability of the finished BedZED product, every aspect of construction was considered in terms of its environmental impact. For example, construction materials were carefully selected to reduce the embodied environmental impact of BedZED by 20 to 30%.

The new report describes the measures taken to achieve carbon savings in the following areas:

- Thermal performance;
- Electrical performance;
- Mains water consumption, rainwater collection and wastewater recycling;
- Transport;
- Renewable energy supply.

Monitoring results from the first year of operation at BedZED are also reported. The costs, savings and benefits associated with each measure are quantified, which should be valuable information for any architect, developer or engineer seeking to build a carbon neutral building.

The last chapter brings together factors affecting the quality of life of ZED occupants, being based on interviews and monitored lifestyle habits at BedZED, and identifying the benefits (and any disadvantages) of living there.

The total costs, savings and benefits from each area are brought together in the Project Balance Sheet, which also introduces ZED in a Box and a range of ZED products from A to Z.

For further information please contact BioRegional (020 8404 4880; E-mail: info@bioregional.com; website: www.bioregional.com).

SUSTAINABLE CONSTRUCTION

New SCiP Roadshow



A new round of the successful 2002–03 Sustainable Construction in Practice (SCiP) roadshow is being prepared for 2003–04. Funded by DTI, it addresses the use of recycled and secondary aggregates in construction, a topic of major importance in sustainable development. Organised by Viridis and TRL Limited, it will offer practical instruction from speakers who have direct experience with these materials.

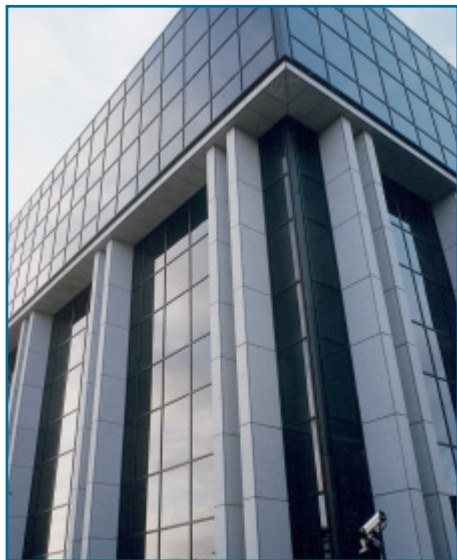
The one-day workshop will visit ten locations around the UK, starting in November 2003 and finishing in London in February 2004. Workshops will include lectures, worked examples, case studies and feedback/discussion sessions. The roadshow will be valuable to a wide range of construction professionals, from local authorities, contractors, consultants, clients, utilities, material producers and others who have to implement sustainable construction in their daily work.

For further information please contact Mary Treen at TRL (01344-770514; fax 01344-770990; E-mail: mtreen@trl.co.uk or visit the web site www.trl.co.uk/scip).

Appearance criteria for façades



The appearance of façades is an important aspect of building performance and is often the cause of dispute. On some projects the designers have not understood the manufacturing tolerances inherent in a design. In other cases the specifier has omitted acceptance criteria for appearance, including geometrical criteria of dimensions, alignment, flatness and surface characteristics of colour, texture, gloss and blemishes. The costs of rectifying unacceptable appearance can be a high proportion of the façade cost, but these can be avoided by a better understanding of the underlying issues by both specifiers and suppliers.



Financial Times Building, Southwark Bridge, London

CWCT has published a series of Technical Notes on *Assessing the appearance of new curtain walling* (TN34); *Assessing the appearance of glass* (TN35); *Assessing the appearance of metals and finishes* (TN36).

The Technical Notes set out a structured approach to assessment, starting with setting objectives for inspections and the conditions under which they should be undertaken. This includes use of specifications and samples for comparison.

Assessing the appearance of glass reviews the existing standards and trade guidance. It gives guidance on viewing distances, lighting conditions and the factors that may affect the colour of plain, tinted, printed or painted, coated and toughened glasses. A further section gives guidance on acceptable tolerances for overall dimensions, bow and roller wave of heat-treated glasses.

Assessing the appearance of metals and finishes deals with flaws arising from grain, texture, colour, opacity and inherent markings such as die lines. It is applicable to unfinished metals, and to anodised and coated surfaces. Information is also given on flatness of surfaces and the potential problem of oil canning.

The set of three documents allows users to:

- specify the appearance of a façade in line with currently achievable criteria;
- specify appearance criteria that can be verified on a completed building;

- understand visual flaws inherent in particular materials and processes;
- plan a façade inspection and evaluate the appearance against current standards and best practice.

For further information please contact CWCT (01225 826541; fax: 01225 826556; E-mail: cwct@bath.ac.uk).

BUILDING & DESIGN

Enabling social inclusion



The implementation of inclusive design principles in the design and construction sector is the subject of a recently approved project under the Partners in Innovation scheme. It will enable professionals to achieve a greater understanding of new regulations and design standards, especially on the needs of elderly and disabled people.

The aim of the project is to raise the skill level of designers and architects through a modular training programme in disability access issues and inclusive design. The project will be led by JMU Access Partnership, the access consultancy department of the Royal National Institute of the Blind. The partners include The Royal Association of Disability and Rehabilitation, the Royal Institute of British Architects and the Royal Institute of Chartered Surveyors.

Started in September 2003, the work is due to be completed in summer 2004 in advance of the implementation of Part 3 of the Disability Discrimination Act in October 2004.

The full training programme, including training modules, resources and reference material, will be available to training providers, professional organisations and academic institutions, who will be able to offer the programme to individuals as a component of Continuing Professional Development (CPD) for people working in the construction industry.

For further information, contact Ron Corbett, JMU Access Partnership, 106 Judd Street, WC1H 9NE (020 7391 2002; fax 020 73877109; E-mail ron.corbett@rnib.org.uk).

Escaping sediment



Dredging plant varies, but it all allows some sediment to escape. Environmental impact assessments often require the prediction of sediment release rates, but the mechanisms that give rise to these are poorly understood. VKBO of the Netherlands commissioned HR Wallingford and Dredging Research Ltd (DRL) to investigate.

Early in 1999, under Phase 1 of the project, researchers developed models capable of predicting the rate of release of sediment from the main types of dredger. Inputs included information on dredger type (e.g. grab, backhoe, trailing suction hopper), bucket size, speed of working and the type of material being dredged (including its particle size). They also reviewed the ways in which sediment escaped from each type of dredger and incorporated this information into relevant models. Grab dredging, for example, is a non-continuous process – so sediment releases occur sequentially and modelling codes must reflect this.

Phase 2 of the study concentrated on developing standard field data measurement protocols for calibrating the models, since a review of published reports revealed that current methods for collecting this data are incomplete and inconsistent. Draft protocols were developed for each of the five dredger types covered by the project, and field tests were carried out in May 2000 using a grab dredger on the River Tees (in cooperation with Tees and Hartlepool Port Authority Ltd) and a trailing suction hopper dredger at Rotterdam in June 2002.

Once the models have been calibrated and verified, they will be incorporated into turbidity assessment software (known as TASS). This should prove useful to regulators and the dredging industry, helping them to predict sediment release during dredging.

For further information please contact Neville Burt at HR Wallingford (01491 822348, Email: neu@hrwallingford.co.uk).



The grab appears to have fully closed but there is still significant release of material due to spillage from the top of the grab.

Easy access environmental management



The construction industry has a significant impact on the environment, and managing this issue is not always easy. Environmental management systems (EMSs) are relevant to all companies operating in the construction sector, regardless of activity and size – but it is very important to develop each EMS to match the needs, aspirations and culture of the target organisation, to ensure that it delivers tangible benefits.

A new British Standard (BS 8555) has been launched that offers construction-related companies the chance to introduce an environmental management system through a straightforward step-by-step approach without the need to commit to ISO 14001 certification. CIRIA has developed *Easy Access Environmental Management* as a guidance pack on implementing an EMS using this phased approach. The Easy Access package includes detailed guidance material on each step of the EMS development and implementation process, combined with template documents

for a company to use when developing its own EMS.

External auditors can assess the EMS at any of the six phases and provide a recognised certificate of achievement. CIRIA hopes that the Easy Access package holds the prospect of a new EMS benchmark that could become acceptable to clients and supply chain leaders for EMS pre-qualification purposes.

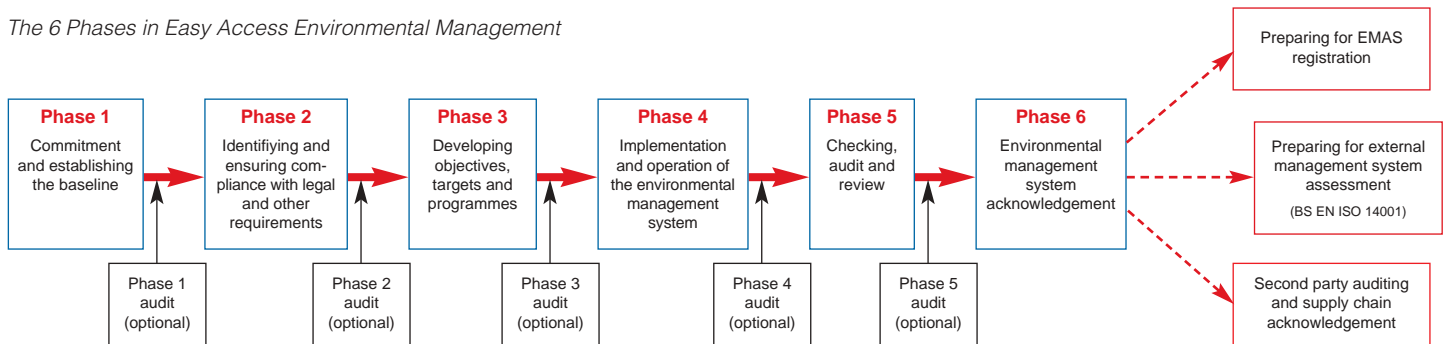
Following piloting with selected companies from the supply chains of AMEC, BAA and French Kier Anglia, very positive feedback has been received from participating companies of all types and sizes. Andrew Wilson of

Banner Holdings said ‘As a company not wanting full ISO 14001 recognition, the Easy Access approach will certainly provide benefit and differentiate our approach to EMS.’

Materials for Phases 1–3 are now available from CIRIA at £20 to members (£35 to others). Materials for Phases 4–7 are currently being finalised and will be available later in the year. A support package of workshops is also available covering each Phase.

For further information please contact CIRIA (020 7549 3300; fax 020 7253 0523; E-mail: irf@ciria.org; website: www.ciria.org).

The 6 Phases in Easy Access Environmental Management



Easy Access Environmental Management also covers integration with other systems. This can be undertaken at any of the above Phases

BUILDINGS, DESIGN & MATERIALS

Design of composite beams using pre-cast concrete slabs



Design of composite beams using pre-cast concrete slabs, a new research-based design guide, draws together new and existing information to provide guidance on a method of construction that is not properly covered by the current codes of practice.

Pre-cast concrete floors are widely used in building construction, but there is little detailed design guidance on their application in steel framed buildings. The use of hollow core or solid plank pre-cast units offers benefits in terms of cost (the long spanning capabilities of the pre-cast slabs lead to fewer secondary beams) as well as the advantages offered by composite construction.

Guidance is provided on the design of steel beams acting compositely with pre-cast concrete slabs in multi-storey buildings. The design basis is generally in accordance with BS 5950-3, supplemented by recommendations from Eurocode 4 and data from tests. It applies to hollow core units of 150 to 260 mm depth, and to solid pre-cast planks.

The guidance also emphasises the importance of the design of the steel beam in the



non-composite construction stage, where out-of-balance loads can occur during installation of the pre-cast concrete units.

A step-by-step design procedure is given for composite beams using various forms of pre-cast concrete units, with or without a concrete topping. This is supplemented by a fully worked design example for a composite beam in a 15.8m x 7.2m grid, and a series of design tables for concept design.

For further information please contact Dr Stephen Hicks at The Steel Construction Institute (01344 623345; E-mail: s.hicks@steel-sci.com).

Purchase online at www.steelbiz.org/shop or contact the Publications Dept., SCI (01344 872775; E-mail: publications@steel-sci.com).

Low water use in domestic buildings: gain or pain?



UK water consumption is around 150 litres/person/day and seems set to rise with increased use of water-based appliances and changes in washing habits. Simultaneously, a growing awareness of the importance of water conservation is prompting a trend towards low-water-use machines and WCs. Such environmentally-positive efforts could, however, have undesirable impacts on drainage infrastructure. Researchers at HR Wallingford have been investigating the implications of low water usage on drainage design under a DTI Partners in Innovation contract.

We carried out a literature review to investigate the water usage of appliances, including modern, low-demand ones,' explains Christine Lauchlan of HRW. The review identified discharge characteristics and usage patterns for two different scenarios – 'conventional use' which focused on 1985–1995 households and 'future use'. 'The key likely trends in water usage between 2010–2025 are an increasing use of dishwashers – with a drop in sink usage – and substitution of showers for baths,' says Christine. Discharge volumes of most appliances are likely to fall, with some changes in discharge rate.

Statistical methods were used to estimate appliance discharge characteristics for various types of household under both 'conventional' and 'future' scenarios.

Researchers then assessed the performance of drainage networks, comprising ten households, under these different flow conditions. Pipes were either 100mm or 150mm diameter and gradients varied between 1:150 and 1:40. 'A wide range of homes were simulated, with different numbers of appliances and levels of occupancy,' explains Christine. The ability of pipe flow to transport solids, based on data from studies carried out by project partners at Imperial College London, was then analysed.



'Trends in water use will change over the next twenty years or so

The 'conventional' scenario showed that 100mm pipe networks satisfied solids transport criteria for all gradients considered. Pipe diameters of 150mm required a minimum gradient of 1:60 to do this. These findings are consistent with current UK recommendations involving ten (or fewer) houses. 'Future scenario' conditions resulted in lower flow depths and velocities for both pipe sizes under all the gradients tested, but gradients needed for self-cleansing to occur were similar to those required in 'conventional' scenarios. Analysis of a 'water-recycling' scenario, where all water within a property is re-used except that from the kitchen sink and any WCs indicated that criteria for solids transport might not always be met and that there could be problems with achieving satisfactory solids transport.

Although this research does not raise immediate concerns about the impact of low water usage on drainage design, much depends on the dominant mechanism for solids transport in pipes (about which there is still some uncertainty) and on the magnitude of future changes in water use.

For further information about this work please contact Dr Christine Lauchlan at HR Wallingford (01491 822524; E-mail: cs1@hrwallingford.co.uk).

BRIDGES & MATERIALS

Heavy vehicle impact on bridge piers



TRL is carrying out tests for the Highways Agency to assess how wrapping bridge piers in FRP (fibre reinforced plastic) can increase their strength under impact loading.

Some piers on older bridges, because they were built to previous standards, may not meet the current standard. Conventional strengthening methods, using steel and concrete, are expensive and aesthetically poor. An alternative is to strengthen piers using axial and hoop FRP wrapping. This is relatively cheap, quick to install, and causes little change to the appearance of the structure.

To simulate the force-time history of a lorry impacting a bridge pier, a pendulum rig – 5 metres long with a mass of up to 5,000kg – has been designed and constructed in TRL's



Pendulum rig constructed at TRL

Structures Hall (see photograph). A 'crush pad' on the face of the pendulum controls the peak force and duration of each impact.

Analysis of the stresses and strains generated in the columns under dynamic loading will enable TRL to devise more-effective design methods, as well as providing guidance on the most appropriate forms of FRP wrapping.

For further information please contact Val Atkinson at TRL (01344-770220; fax 01344-770356; E-mail: vatkinson@trl.co.uk)

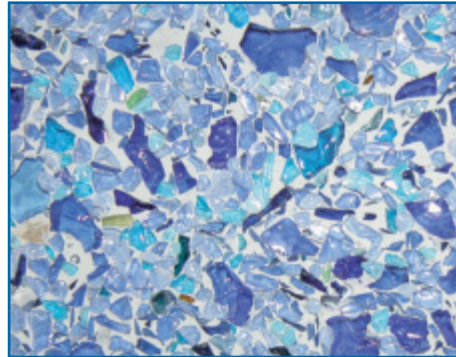
ConGlassCrete – a high-value use for waste glass



The Waste and Resources Action Programme (WRAP) and the University of Sheffield, in collaboration with the British Cement Association and other partners, have funded the University of Sheffield's Centre for Cement and Concrete to carry out investigations in the potential for using waste glass (cullet) as a high-value ingredient for concrete. The work arises in response to pressure from the European Union to increase the recycling of glass and comes ahead of 'End of Life Vehicle' legislation.

The cullet types under investigation include post-consumer container glass – that is those bottles and jars we return to the bottle bank – as well as plate glass, automotive glass, fluorescent tubes and waste glass fibres.

One of the main objectives of the ConGlassCrete Projects (Project ConGlassCrete I covers concrete technology and ConGlassCrete II deals with certification and strategic marketing) is to develop high value uses for glass as an aggregate in concrete and to give a complete range of pigment and glass colours. In addition to polished finishes, decorative acid etched finishes are being developed. Virtually any colour is available but the most common are clear, green, blue and amber. Another objective is to assess the potential for using powdered or ground



Decorative acid-etched exposed aggregate ConGlassCrete finish

glass as a cementitious material that could be used in combination with Portland cement, as

it contributes to the strength of the concrete. There is the potential for expansive reaction between glass – either as aggregate or as powdered material of particle size between 25 and 100 mm – and alkalis in the cement paste. The risk of damage due to these types of alkali silica reaction (ASR) can be minimised by use of pozzolanic additions such as pulverised fuel ash, metakaolin or ground granulated blast-furnace slag.

Engineers and architects interested in specific finishes or applications are invited to register with the project.

For further information please contact Dr Ewan Byars at ConGlassCrete Projects, Centre for Cement and Concrete, University of Sheffield, S1 3JD (0114 222 5715; fax 0114 222 5700; E-mail: DrByars@aol.com).

INNOVATION & CONSTRUCTION FUTURES

Investment for future prosperity



A new ICE publication *Safeguarding our future* celebrates high profile construction projects that have made a major contribution to the UK's quality of life. It highlights the research and innovation aspects of these 'lighthouse projects' and argues that they would not have been possible without continuous public and private investment in construction research.

The UK spends about £65 billion on construction every year, and a significant proportion of this is in civil engineering. Most civil engineering projects are innovative, and almost every project is unique and different. They are created from scratch and sometimes made possible only because of someone's vision or through a new and innovative way of applying engineering knowledge acquired through research. But construction research is not something that simply benefits a single project. It is a continuous and cumulative process that underpins civil engineering and construction as a whole.

As an example, cumulative research progress on bridges over the past 40 years has included:

- **structural engineering** – leading to cable-stayed bridges using high tensile steel cables, external post tensioning, or stiffened plate technology;
- **computational and modelling techniques** – leading to sophisticated, imaginative designs and improved structural capabilities;
- **failure investigations** – leading to new knowledge about the causes of box girder buckling and bridge deck collapse;
- **geophysical surveying** – leading to lower risk and reduction of tender costs;



- **materials, concrete and composites** – leading to composite bridge decks and slender, high-capacity structures.

Without much of this work, many modern bridges would not have been possible, and the UK's leading-edge knowledge and international export-earning capability would have been lost.

The maintenance of design and engineering skills in key areas such as tunnelling, bridges, roads and infrastructure is only made possible because constant funding gives rise to new research concepts and underpins innovation. But statistics show that investment in construction research is steadily declining. If we are to continue to innovate within the built environment, it is vital that we maintain the culture of research and innovation in the construction industry that has served us so well. Without it, UK civil engineering cannot sustain its capability and reputation: it is a matter that potentially affects us all.

For further information, or a free copy of the report, please contact Julia Christie at the Institution of Civil Engineers (020 7665 2223; E-mail julia.christie@ice.org.uk)

- **wind tunnel and wind generator testing** – leading to aerodynamic stability and all-weather vehicle access;

Beware super bugs!



The recent SARS outbreak (Severe Acute Respiratory Syndrome) is of great interest to civil and building engineers. In the 19th century water engineers were able to double life expectancy; it is now time to dust off Bazalgette's building sanitation guide.

There are still huge pools of infectious diseases in the developing world that can be rapidly deployed by modern transport. At least one billion people in the world have unsafe drinking water and twice as many unsafe sanitation. The US Centre of Disease Control and Prevention has reported its first ever increase in water-borne disease.

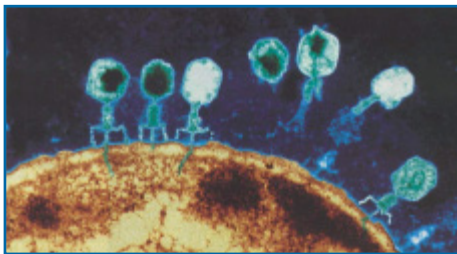
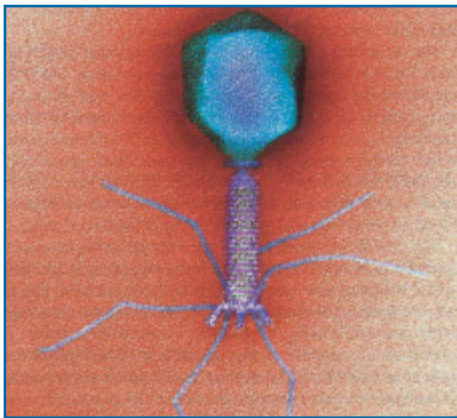
At Loughborough we have recently finished a project on how stressed-water filters perform against *Cryptosporidium*, a newly emergent protozoan that is resistant to normal disinfection. We are now, with colleagues at Nottingham University, investigating how

well treatment plants cope with newly discovered viruses like SARS, a very rapidly evolving group of infectious hazards.

For further information please contact Professor A Wheatley, Department of Civil and Building Engineering, Loughborough University (01509 222626; Email: a.d.wheatley@lboro.ac.uk)

ENVIRONMENT

Awards launch



(Top) *Bacteria eater* (Above) *A cell under attack*



The first eight Awards under the CEEQUAL Environmental Quality Assessment & Awards Scheme were presented to the successful applicants by ICE President Professor Adrian Long at the public launch held at the ICE on 9 September. Pictured are some of the 140+ people at the event.

For scheme details please go to www.ceequal.com in the first instance. To register your interest please contact the CEEQUAL Project Team, (020 8399 4389; via the website or Email: ceequal@crane-environmental.co.uk).



SPONSORING ORGANISATIONS

GOVERNMENT

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Innovation & Research Focus is published by the ICE, typeset by PJM Design and produced by Thomas Telford Services Ltd, 1 Heron Quay, London E14 4JD, UK. ISSN 0960 5185

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