

Research Focus

Issue No. 37

MAY 1999

PROMOTING THE APPLICATION OF RESEARCH IN BUILDING AND CIVIL ENGINEERING

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Slimdek robustness confirmed

British Steel's *Slimdek* floor system comprises the new asymmetric *Slimflor* beams (ASB's) and SD225 deep decking. It was recently tested in a two-bay floor structure at City University to provide information on the performance of large floor slabs and to investigate certain innovative features of the system.

The test system comprised two adjacent bays of 6 m × 6 m composite floor slab 300 mm thick supported on three beams. The central beam and one edge beam were of the 280 ASB 100 section and the other edge beam was a RHS *Slimflor* beam comprising a 300 × 200 mm RHS and a 15mm thick flange plate welded to the underside. The RHS was over-sized structurally in order that it could act as a conduit for air in an air-delivery system which was the subject of separate experimentation. The internal ASB beam had a series of 160 × 320 mm openings in its web for the passage of air and services.

The main structural objectives of the test were to establish:

- the construction load deflection of the decking and the beams;
- the combined structural action of the beam and slab;
- the deflection and vibration performance of the complete structure;
- the effect of openings in the slab;
- the effect of openings in the beams.

The test arrangement is illustrated in the photograph. Loading was applied by four jacks on the slab and one placed centrally on the beam. Four load cases were included:

- weight of concrete and operatives during construction;
- loading on the central beam alone;
- an equivalent load of 10 kN/m² on the slab, followed by increased loading on the beam until failure of the beam;
- loading on the slab alone until failure of the slab and beam.



Above: Large scale SlimDek test.
Right: Summary of test results on the SlimDek construction

Deflections of the beams and decking were monitored during casting of the concrete, using an innovative photogrammetric technique developed at the University of London.

The load tests were continued until the plateau in the load-deflection curve was reached (at approximately 90% of the failure moment). The final load test was continued until a total deflection of approximately span/50 was reached. The final equivalent failure load was 19 kN/m², which is expressed as an equivalent distributed loading over the plan area. The natural frequency of the floor system was measured as 6.4 Hz. No significant adverse effect was noted due to the presence of the openings in the slab or beams. A summary of the test results is given in the table.

For further information please contact
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fax: 01344 622944;
E-mail:
j.rackham@steel-sci.com).



Summary of test results on the Slimdek construction

| Property | Measured Property | Design Property* |
|--|-------------------|------------------|
| Failure load (kN/m ²) | 19 | 12.2 |
| Beam plastic resistance (kNm)* | 802 | 493 |
| Slab bending resistance (kNm/m) | 216 | 98 |
| Beam second moment of area (cm ⁴) | 41074 | 32446 |
| Slab second moment of area (cm ⁴ /m)* | 5863 | 4262 |
| Natural frequency of system (Hz) | 6.4 | 5.5 |

* Properties included web opening^s

x Stiffnesses in steel units



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, lively 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 (0171-665 2242; fax 0171-799 1325; Email 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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ENVIRONMENT

Reducing local authority costs and environmental impacts

Every local authority in Britain is under pressure to reduce the impact of its operations on the environment. Inefficient heating, lighting, waste management and transport all have a damaging effect – not only on the ecosystem but also on the cost of running local government services.

BRE and PA Consulting Group have worked together to produce a solution to both of these problems: the Local Authority Toolkit, a software-based package recently distributed free to the Chief Executive of every local authority in the country.

The Toolkit, in the form of a multimedia CD-ROM, is designed to run on the majority of personal computers in local authorities. It takes the user through the key steps needed to achieve real benefits in reducing environmental impacts, including reviewing the effects on the environment of specific operations, determining the priority actions, and implementing those actions. It is the ideal stepping stone to accreditation to the European Eco-Management and Audit Scheme standard.

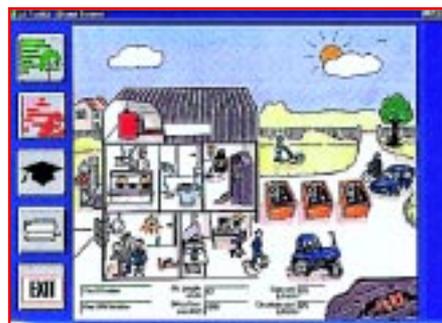
The CD-ROM features benchmarks, case studies and extensive supporting material to enable local authorities to carry out a comprehensive cost and environmental review of every one of their sites, from offices and schools to composting centres and recycling depots. A prototype was tested in various types of site within the sponsoring local authorities – Cambridgeshire County Council, Chelmsford Borough Council and Nottinghamshire County Council – providing practical experience and valuable feedback for the final version.

Third in a series of Toolkits (the Office Toolkit was launched in June 1995 and the School Toolkit in February 1997), the Local Authority Toolkit has been sponsored by the Department of the Environment, Transport and the Regions (DETR), The BOC Foundation and the Local Government Management Board.

For further information please contact Ms Susheel Rao at BRE (01923 664565; fax: 01923 664084 E-mail: raos@bre.co.uk)



Example screen from the Local Authority Toolkit



MANAGEMENT

Construction risk registers

The management of risks in the construction industry is often perceived as a means for one party to shift responsibility for risk onto another. The communication of risk also suffers because inappropriate records of decisions are kept where risks are involved. Hence project stakeholders may be unaware of a vital risk-related decision taken by another party on the project.

The following three areas of risk management especially need improvement:

- inconsistency in risk terminology, leading to unclear risk identification;
- unclear ownership of risk-mitigation measures;
- lack of documented communication on risk issues.

Building on *Control of risk*, a previous CIRIA publication, the new study – A strategic framework for risk management – will promote risk management throughout the industry supply chain, enabling projects to deliver increased value and certainty to clients. This will be achieved through the production of an encyclopaedia of generic risks together with a glossary of risk concepts, and a high-level risk list.

User-friendly risk registers will be developed that will help to systematically capture project risks, to agree mitigation measures, and to agree the parties responsible for managing them. The final outputs are expected to be electronic systems accompanied by guidance documentation, from which the industry will be able to reap significant benefits:

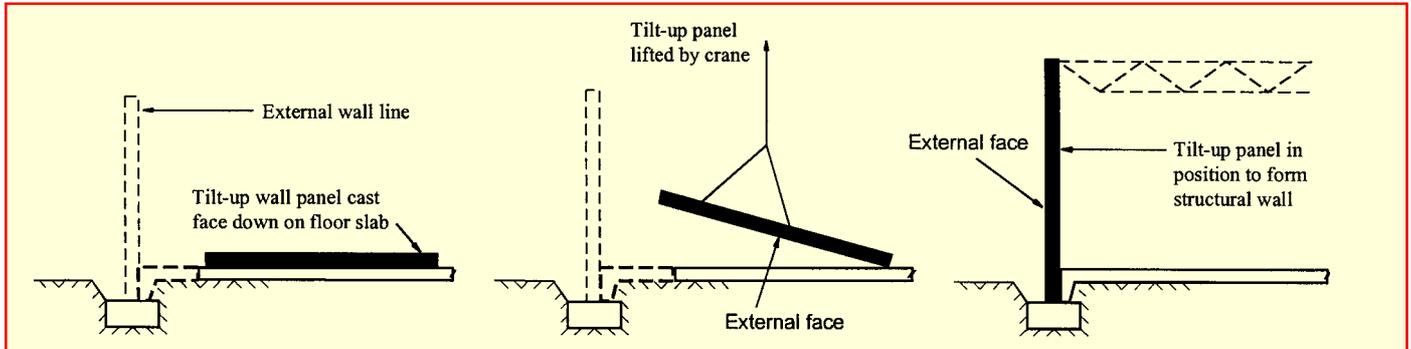
- increased confidence in project delivery, and the encouragement of best practice within risk management;
- a common language for understanding risk issues;
- improved designs that take account of potential risks at the conceptual stage.

For further information please contact Das Mootanah at CIRIA (0171 222 8891; fax: 0171 222 1708; E-mail: das.mootanah@ciria.org.uk).



Tilt-up concrete construction

Tilt up concrete construction involves casting the concrete walls of a building on its floor slab or in a separate casting bed and then tilting and lifting them into position by crane. The method is well established and widely used for low rise buildings throughout the world, particularly in the USA where use grew by 25% last year. Despite this, the UK has been slow to realise Tilt-up's obvious benefits. A recently completed project by the Reinforced Concrete Council, with part-funding under the DETR Partners in Technology programme, has been aimed at changing attitudes and practice.



The primary output of the project is a publication entitled *Tilt-up Concrete Construction: Design and Construction Guide* – the result of three years' investigation of world and UK experience in tilt-up, distilled and adapted for UK markets, codes and practice. Recognising cultural, historical and market differences between countries, which can be a barrier to innovation, the work was both detailed and broad ranging. It has been presented in sections and in a form appealing to clients, architects, designers and contractors.

The aim of bringing all necessary information into a single document has entailed considerable original work. Detailed cost modelling at Oxford Brookes University by Dr Jacqueline Glass has show tilt-up to be particularly cost-effective against existing methods, without considering the added benefits of thermal mass, fire resistance, durability, sound insulation and security. Design methods were reviewed and adapted to UK codes and practice.

Tilt-up brings factory planning and production processes to construction sites,

with economic, efficiency and quality gains worthy of the Egan initiative. Many US and Australian companies have built their success and reputation on the back of Tilt-up. With a potential market share of over 2000 buildings a year, the same could well happen here.

For further information or copies of the publication, please contact Martin Southcott at the RCC (01344 725733; fax: 01344 761214; E-mail: Msouthcott@bca.org.uk).



BUILDINGS

New research-based guidance on facade design

There have been many advances in facade technology over the last ten years driven by new materials, new uses of materials and new forms of construction, for instance the use of glass and the introduction of rainscreen technology. Higher performance levels required of energy efficient facades are also leading to change in design and specification. A new series of Technical Notes published by the Centre for Window and Cladding Technology gives guidance for designers and specifiers of building envelopes and components.

The DETR has funded the writing of the first thirty Technical Notes as part of the Partners in Technology scheme. The first ten have just been published and cover wind loading, pressure equalisation, air leakage, weather testing, threat resistant windows, and selection and specification of windows.

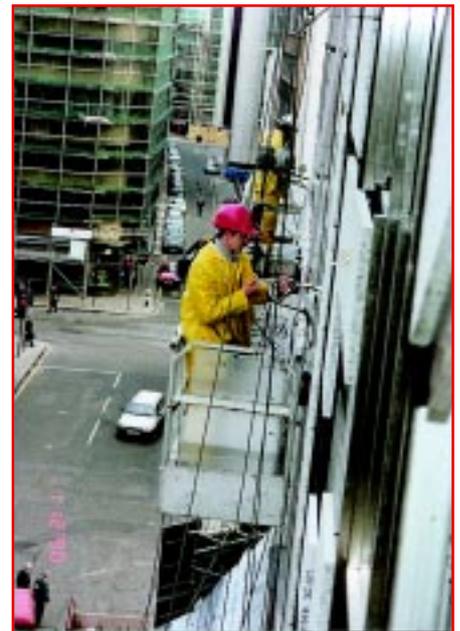
Notes still being prepared will deal with glass, glazing, sealants, structural aspects of cladding, joints, weathertightness, fire, thermal performance and earthquakes. Further notes will be added to the series as appropriate.

Each Note (4 to 8 pages long) aims to introduce the subject, provides basic guidance for designers and specifiers, and gives references to other sources and standards. They

provide quick access to the CWCT's research output in a practical and readily usable form. They also address many of the simpler questions frequently asked of the CWCT and will assist those using the CWCT Standards and guides to good practice for curtain walls, ventilated rainscreens and slope glazing.

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

A full list of notes (available individually or as a set) is maintained on the CWCT website at <http://www.cwct.co.uk>.



New guidance from CWCT will assist in the design of building facades

Concrete corrosion – a £550m-a-year problem

Corrosion of the reinforcing steel in concrete structures such as motorway bridges, buildings and marine installations is estimated to be costing the UK £550m per year. Many of these structures continue to require extensive maintenance or replacement. A two-year research project to help overcome such problems is currently under way.

Engineers need better techniques for assessing when maintenance is required, and when a structure must be replaced. In addition, while there are several techniques for reducing the likelihood of corrosion in new concrete structures, it is often difficult to make the correct choice of protection – a problem exacerbated by a lack of appropriate best practice guidance from within the industry.

A team led by TREND 2000 Ltd, and including specialists from BRE, John Broomfield Consultancy and Risk Review Ltd, has been awarded a £350,000 contract by DTI under the Degradation of Materials in Aggressive Environments Programme.

The project aims to establish and/or evaluate:

- the key issues in measuring and controlling corrosion in concrete;
- methods for predicting the performance of reinforcement and concrete degradation;
- a range of protection strategies for new-build structures;



Corrosion of the reinforcing steel in concrete structures such as motorway bridges is costing the UK an estimated £550m a year.

- a range of protection strategies for maintenance and repair of existing structures.

The results will be used to develop new and validated industry guidance documents. These recommendations will be made widely available to the grass roots of the industry,

as well as practising engineers, and ultimately the information will be fed into harmonised European Standards.

The project's findings will be actively disseminated throughout the next two years and beyond via a web site, an interactive CD database of corrosion references, and a series of one-day seminars and site workshops. To encourage the next generation of engineers, a series of lecture courses will be prepared for university undergraduates.

Wide consultation with the industry, drawing on experience gained in combatting this increasing problem, is planned when developing the guidelines. Participating organisations will be invited to discuss materials, structures, surveys, monitoring and repair techniques and protection strategies.

For further information please contact David Richardson at BRE (01923 664291; fax: 01923 664786; E-mail: richardsondm@bre.co.uk).



ENVIRONMENT & MANAGEMENT

Partnering delivers improved environment

A recent research project has investigated the opportunities and actual environmental improvements achieved in the design and construction of five projects where team working was adopted. The results, published in *Environmental Improvement in Construction*, by the Chartered Institute of Building with BRE and Wimtec Environmental, illustrate how the industry is continuing to positively respond to the challenges posed by both Latham and Egan.

Carried out with support from the DETR through the Partners in Technology scheme, and guided by the CIOB Environment Committee, the project's objectives were:

- to establish how traditional arrangements for design and procurement may inhibit environmental performance;
- to identify how this may be improved with a partnering approach based on the ideas suggested by Latham and subsequent working groups.

In meeting these objectives, the project included a series of telephone interviews with client groups, to establish their perceptions of the findings from *Constructing the Team* and their awareness of environmental issues. From these interviews, five projects were selected and more detailed interviews carried out with representatives of the client, consultants and contractor.

The case studies demonstrated that the companies actively adopting the recommenda-

tions of *Constructing the Team* and the subsequent working group reports were able to meet their clients' demands, often exceeding their expectations. Client organisations indicated increasing expectations about higher standards of environmental performance, expectations that will continue to grow with pressure to meet sustainable development criteria.

Adoption of team working in itself did not necessarily lead to an environmentally sensitive construction process or a reduced environmental impact, but enabled environmental issues to be handled in a more effective manner due to the integration of the design process.

This was most effectively illustrated in the construction of Fazakerley Prison, a private finance initiative project, constructed by Tarmac Building and operated by Group 4. The longer-term management and use of the building focused the consortium's design criteria, the impact of which was a design with a reduced environmental impact in terms of carbon dioxide emissions and operating costs. Consideration of the impact of the building on the lo-

cal community resulted in landscaping that enhanced the area and maintained existing wildlife habitats. The team working arrangements established a project management system that was highly successful at motivating the team to ensure a successful project and was capable of resolving problems as they arose. Tarmac Building has subsequently adopted many of the management systems adopted or developed for the project as their standard practice.

The fundamental principle of partnering has been further endorsed by the most recent report by Sir John Egan, *Rethinking Construction*. All five of the projects benefited from adopting ideas for new ways of working, often achieving a higher level of client satisfaction by comparison with previous projects.

For further information please contact Keith Chamberlain at the Chartered Institute of Building (01344 630700; fax: 01344 630713; E-mail: kchamberlain@ciob.org.uk)



SPICE: Standardised process improvement for construction enterprises

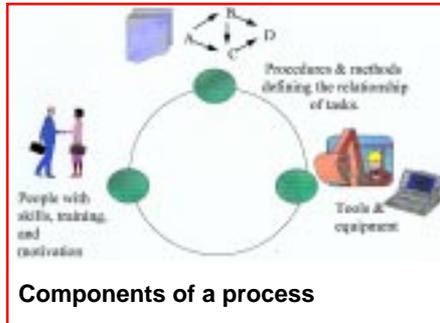
The UK construction industry is becoming increasingly aware that life cycle performance improvements require significant attention to process standardisation and improvement. SPICE is a DETR-funded project at the University of Salford, which aims to transfer best practice from the IT industry to construction. Now half way through its 2-year term, the project is developing an evolutionary process improvement framework for the construction industry.

The IT industry has achieved significant productivity improvements through the use of the Capability Maturity Model (CMM). The CMM framework for continuously measuring and improving processes was originally developed for the US Department of Defense and has since gained acceptance amongst IT, telecommunications and engineering companies. Organisations that have implemented the CMM improvement programme have reported high productivity gains.

Whilst SPICE will use many of the basic concepts of process capability and maturity from CMM, it will concentrate on construction-specific processes. There are three key questions for the research project to address.

- Are the CMM process improvement concepts meaningful in the construction sector?
- Is CMM's assessment mechanism applicable in construction?
- Will the assessment results be of value to construction firms?

The SPICE assessment mechanism will provide a set of features that all processes need in order to achieve sufficient capability. These are:



- (i) commitment to perform;
- (ii) ability to perform;
- (iii) activities performed;
- (iv) analysis and evaluation;
- (v) verifying implementation.

SPICE will not, however, constrain how process improvement is implemented.

A maturity framework will be used to assess whether firms are 'mature' or 'immature' organisations. This is important since setting sensible goals for process improvement requires an understanding of the organisation's current capability. Mature organisations gener-

ally have systematic and proven methods for managing design, construction and maintenance. They have objective, quantitative bases for judging product quality and analysing problems with the product and process, and a reflective element to their organisational culture.

In an immature organisation, practitioners and project managers generally improve construction processes during the course of the project. A construction process may not be rigorously followed or enforced – and managers often focus on fire fighting. However, projects can still produce excellent results. This is generally due to a dedicated team's efforts, rather than following the more disciplined procedures adopted by mature organisations.

Having identified their current level of process maturity using the maturity framework, firms can then use the SPICE framework to identify their process improvement priorities.

For further information please contact Marjan Sarshar, University of Salford, Department of Surveying, Salford M5 4WT (0161-295-5317; fax: 0161-295-5011; E-mail: m.sarshar@surveying.salford.ac.uk).



HIGHWAYS

Improving traffic flow at motorway interchanges

MOVA, Microprocessor Optimised Vehicle Actuation, is the self-optimising control system for traffic signals developed by TRL for the Department of the Environment, Transport and the Regions (DETR). A recent trial at a major motorway junction has led to approval for development next to the junction with no major road layout modification.

In previous trials for DETR, MOVA has been shown to offer reduced delays, increased capacity and reduced accident rates. Particularly beneficial on high speed roads, it is recommended for conversions of existing traffic signals, mandatory on new trunk road signals and often chosen for sites where additional capacity needs to be created. In use at more than 300 sites, MOVA has been used on all types of junctions.

Recently, a study by Peter Finalyson Associates and TRL has investigated MOVA performance at a part-time partially-signalised roundabout, one of the first such applications. At the

M1 Junction 21, with the M69 and the A5460, the main connection into Leicester, the Eastern half of the interchange is controlled by traffic signals during peak times. MOVA-controlled signals are used to create gaps in the circulating flow to assist traffic entering the roundabout from another, priority-controlled approach.

The developer of an adjacent site, Grove Park Commercial Centre Ltd, funded the project. Results indicate a significant reduction in delay, a capacity increase, and other benefits, including improved control of queuing on slip roads, as shown in the table. These results were accepted by the Highways Agency as sufficient



to mitigate the effects of the development, and the MOVA solution made permanent, avoiding significant and expensive road construction work.

For further information please contact John Peirce at TRL (01344 770032; fax: 770864; E-mail: jpeirce@trl.co.uk) and John Spence at PFA (01793 542555; fax: 542600; E-mail: PFA_swindon@compuserve.com).

| | Reduction of Delay | | Increase in Capacity | |
|------------|--------------------|----------------------|----------------------|----------------------|
| | Whole Interchange | Signalled Approaches | Whole Interchange | Signalled Approaches |
| AM Peak Hr | 24% | 27% | 14% | 23% |
| PM Peak Hr | 15% | 18% | 8% | 16% |

Thaumasite Expert Group's Report published

Sulfate attack of concrete, which has long been recognised, is minimised in the UK by following best practice. However, a new form of attack – the thaumasite form of sulfate attack (TSA) – was discovered in buried concrete in 1990. Then, during 1998, TSA was discovered in the foundations of several 30-year-old bridges on the M5 in Gloucestershire. The Report of the Thaumasite Expert Group – which was set up by DETR Construction Minister Nick Raynsford – contains guidance and interim recommendations to minimise the risk TSA.

Thaumasite is a calcium silicate sulfate carbonate hydrate. The characteristic feature of its formation as a deterioration product in buried concrete is to transform the surface of the concrete into a white, pulpy mass. Unlike the well understood sulfate attack – when gypsum and/or ettringite are formed – TSA requires cold, wet conditions and a source of carbonate (generally from the aggregate used in the production of concrete).

In the light of these discoveries, Nick Raynsford set up an Expert Group under the Chairmanship of Professor Les Clark, the President of the Institution of Structural Engineers. The Group's remit was to produce interim advice and guidance on the implications for existing structures, and for the design and specification of new construction.

The Expert Group's Report concludes that TSA will only occur in buried concrete when four primary risk factors are present simultaneously and developed to a significant degree. These are:

- presence of sulfates and/or sulfides in the ground;
- presence of mobile groundwater;
- presence of carbonate, generally in the concrete aggregates;
- low temperature (generally below 15 degrees centigrade).

Additionally, there are a number of secondary factors that influence the occurrence and severity of TSA and its effects:

- the type and quantity of cement used in concrete;

- the quality of the concrete;
- changes to ground chemistry and water regime resulting from construction;
- the type, depth and geometry of buried concrete.

The Expert Group concluded that the probability of these factors all being significantly developed and occurring together is low; accordingly, the number of buildings and structures potentially at risk of the occurrence of TSA in the UK is small. The structural consequences of TSA are not a serious public safety concern, as most buildings and structures would exhibit warning signs of distress. Such distress would manifest itself as progressive cracking well before there would be any danger of collapse.

In order to minimise the risk of TSA for new construction, the Report presents a range of options for specifiers and designers – including selecting alternative mix designs and the provision of drainage and/or surface coatings.

DETR is initiating a research programme in collaboration with industry to take forward the Report's recommendations. Nick Raynsford has asked Professor Clark to review the Report's conclusions one year on from publication, to take account of further research being commissioned.

For further information please contact Ian Longworth at BRE (01923 664180; fax: 01923 664085; E-mail: longworthi@bre.co.uk).

To order a copy of the Thaumasite Expert Group Report – 'The thaumasite form of sulfate attack: risks, diagnosis, remedial works and guidance on new construction', price £45, contact DETR Publication Sales Centre, Unit 21, Goldthorpe Industrial Estate, Goldthorpe, Rotherham S63 9BL (01709 891 318; fax: 01709 881 673) or branches of the Stationery Office.



GROUND ENGINEERING

Making firm foundations

Many hectares of land, typically those adjacent to broad river estuaries and in fenlands, are underlain by soft, organic soils. These soils present problems for foundation designers because of their high compressibility even at low stresses, and buildings and other structures founded on them may suffer large short and long-term settlement.

A European research project is under way to address this problem, aimed at developing a system to mix the organic soil with binders to improve strength and stiffness and, thereby, significantly reduce the settlements. The project includes laboratory and field work to predict behaviour and to prove the system, using full scale trials to assess the viability of the soil mixing system.

BRE is the major UK partner in the project in collaboration with Keller Ground Engineering who carried out the soil-mixing site trials. These have been completed with a total of 196 stabilised columns in three zones, each with a different configuration of column stabilisation. The stabilised zones, and a control zone without stabilisation, have been fully instrumented and will be loaded using an embankment of sand.

The project includes partners in five other countries who will stabilise and test-load soils of differing organic contents and using differing loading conditions for the field trials.

The principal output of the project will be a design guide to enable engineers to select

binders, dosage and stabilisation depth for a range of both organic soils (including peat) and loading conditions.

For further information please contact Tony Butcher at BRE (01923 664831; fax: 01923 664085; E-mail: butcher@bre.co.uk).

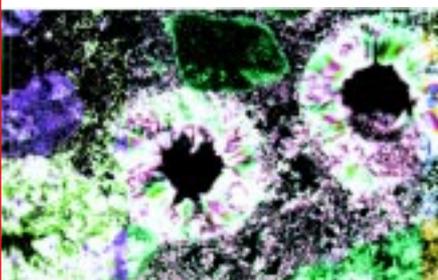


Soil mixing site trial at the test site.



The thaumasite form of sulfate attack:
Risks, diagnosis, remedial works and
guidance on new construction

Report of the Thaumasite Expert Group



Source control – investigating infiltration drainage

Researchers at Wallingford are working towards an improved understanding of soakaways and other infiltration drainage systems. The 3-year project, part funded by the DETR, holds potential benefits for flood control and the management of water quality.

Cath Abbott, project leader at HR Wallingford, explains. 'Our research aims to monitor the real performance of infiltration systems, and compare it against expected behaviour. We will also be looking at how systems age'.

In the UK, road and building runoff is usually piped into sewers and ultimately discharged into rivers. These sudden, large, influxes of water can overwhelm sewer networks, causing flooding. Over the longer term, piping runoff away depletes local water tables. Where ground conditions are suitable, and permissions granted, infiltration drainage systems (which control runoff at or near its source) can provide a more sustainable solution.

Various manuals set out best practice and design guidelines for these systems, including for example CIRIA Report 156, *Infiltration drainage – Manual of good practice*, 1996 and BRE Digest 365 *Soakaway design*, 1991. Much of this information is based on the output from mathematical models; this new research at HR sets out to provide evidence from real systems.

Cath Abbott's group started their first field investigation, at a nearby school, in May 1998. 'New buildings are being erected, and W S Atkins have installed seven large soakaways to handle the runoff from roofs, playgrounds and parking areas,' she explains. 'We set up a flow monitor in one of the pipes feeding a soakaway and fitted a pressure transducer at the bottom of the chamber to record changes in water depth. This has allowed us to follow water movements over time and relate them to rainfall – we have logged 15 major events so far.' Once data collection has been completed, soakaway performance will be assessed, and compared with design predictions, to check if the system is performing as expected.

A further site is being monitored at Wheatley Services on the M40. Here, the car park has been surfaced with porous blocks, allowing runoff to soak through into a stone sub-base from where pipes convey it to holding ponds and reed beds. These both contain runoff and help to improve its quality. Cath Abbott's team has been allowed to install flow monitoring equipment in a special research tank, in cooperation with the Environment Agency. 'We are measuring rainfall over the car park and comparing it with flows in the collection pipe to see how quickly water is moving through the system,' she explains. 'We will also be looking at how the behaviour of the system changes over time, which will provide information on ageing.'

Research outputs are planned to include a report, technical papers and a Workshop. The anticipated results should enable enhancement of existing design guidelines. Because they help reduce flows into sewers, infiltration drainage systems are potentially



Installation of soakaways at the Wallingford site.

helpful in the fight against flooding and pollution and this work should help to improve the design and performance of such systems. This, combined with a fuller exploration of the legislative issues involved, could help to open up more sustainable drainage options in the future.

For further information about this work, please contact either Cath Abbott (01491 822488, fax: 01491 826352, E-mail: cath@hrwallingford.co.uk) or Richard May (01491 822251, fax: 01491 825916, E-mail: rwpm@hrwallingford.co.uk).



ENVIRONMENT & BUILDINGS

Rainwater and greywater systems – barriers to uptake

The use of recycled rainwater and greywater for certain domestic tasks, or even as a potable water supply, has the potential to solve some of the recent problems caused by drought and the high demand for water. CIRIA is undertaking a project to address all of the issues surrounding rainwater and greywater systems and the barriers to their use.

Some of the important barriers to greywater and rainwater re-use identified at a recent CIRIA workshop were:

- **Unproven technology** – despite the components of these systems being commonplace, there is a perception of risk that discourages developers and building owners to include the technology;
- **Unproven cost benefit** – the systems reduce the costs of water usage but the

public perception is that the economic benefits are largely unproven;

- **Water quality standards and public health** – at present, there are no standards set specifically for rainwater or greywater systems, which means that it is difficult to evaluate them and there is an uncertainty over potential health risks;
- **Lack of design guidance** – the low use of these systems in development was largely attributed to a lack of guidance for those designing the development.

Rainwater collection system (photo courtesy of BSRIA).



The new project includes seven demonstration sites where different systems are having both their water saving and water quality performance monitored by BSRIA. This work should help to tackle the barriers to use and will provide practical guidance on the design and use of such systems.

For further information please contact Daniel Leggett at CIRIA (0171-222 8891; fax: 0171-222 1708; E-mail: daniel.leggett@ciria.org.uk).



Bridge management in Europe

Europe's large capital investment in the road network includes bridges, which for many are the most vulnerable element. As bridges age, deterioration caused by heavy traffic and an aggressive environment becomes increasingly significant, resulting in a higher frequency of repairs and, possibly, a reduced load-carrying capacity. The direct cost of the engineering work necessary to maintain a satisfactory road network is high. However, indirect costs due to the resulting traffic congestion and disruption can be much higher and cause a severe economic penalty, particularly on the increasing number of roads where traffic flows are reaching saturation.

TRL is coordinating a collaborative European research project called BRIME to develop an outline framework for a bridge management system for the European road network. The work is being done in collaboration with the Bundesanstalt für StraBenwesen in Germany, the Centro de Estudios y Experimentacion de Obras Publicas in Spain, the Laboratoire Central des Ponts et Chaussées in France, the Norwegian Public Roads Administration and the National Building and Civil Engineering Institute in Slovenia. The purpose of the project is to develop the modules required for a bridge management system that enables bridges to be maintained at minimum overall cost, ie taking all factors into account including the affect on traffic, life of the repair and the residual life of the structure.

The project is part-funded by the European Commission Directorate General for Transport, with balancing funds provided by the authorities responsible for the national road networks in the participating countries. The Highways Agency is providing the funding in the UK.

Work started in January 1998 and will last for two years. Work to date has centred on reviewing existing bridge management systems, examining the procedures used to assess the condition and load carrying capacity of bridges both now and in the future, and studying how this information is used to set maintenance priorities.

For further information please contact Richard Woodward (01344-770667; fax: 01344-770748; Email: rwoodward@trl.co.uk).



Effectively managing bridge maintenance on heavily trafficked roads is a major challenge



COASTAL ENGINEERING

Tackling coastal construction risk

Coastal engineering projects can be large-scale and costly. They are often carried out in difficult locations with attendant risks of bad weather. A new manual *Construction risk in coastal engineering* considers the risks that occur during coastal construction, along with the measures that can be taken to reduce or control the impact of those risks.



Stormy weather – a typical coastal construction risk.

Produced as a result of research carried out by HR Wallingford under the DETR's Partners in Technology Programme, and co-sponsored by the Environment Agency and a number of marine and civil contractors, the manual should assist all involved in coastal engineering in their management of construction risk.

Construction risk in coastal engineering, is available from Thomas Telford Ltd. (0171 665 2459, fax: 0171 537 3631) or HR Wallingford Ltd. (01491 822360, fax: 01491 825483), price £60.00 (plus p&p outside the UK).

Related Workshops are to be held at Gatwick on 21 May and in Birmingham on 26 May.

For further information please contact the organisers of the Workshops, Jacqueline Watts or Wendy Beech (01491 835381, fax: 01491 832233, E-mail: jhw@hrwallingford.co.uk)



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