the UNIVERSITY of GREENWICH

Working in partnership with ATKINS

Research and Consulting Capability

Civil infrastructure

Civil infrastructure is part of the "built environment" and plays a pivotal role in a nation's economy, social well-being and quality of life. Unfortunately, much current infrastructure, such as bridges and coastal structures, is ageing and deteriorating. Ensuring its continued high level of safety and serviceability is a matter of increasing challenge to engineers and asset managers alike and demands the use of advanced, risk-based decision-making tools.

The Infrastructure Management Research Group at the University of Greenwich has recently developed such decision-making tools and is specialising in researching corrosion-affected concrete infrastructure, a global problem contributing to the premature failures of these structures. Worldwide, the maintenance cost for corrosion-affected concrete infrastructure is around US$100 billion a year; in the UK it is around £800 million for bridges alone. The Department of Civil Engineering at Greenwich has formed a strong partnership with Atkins to develop cutting-edge research in this field.

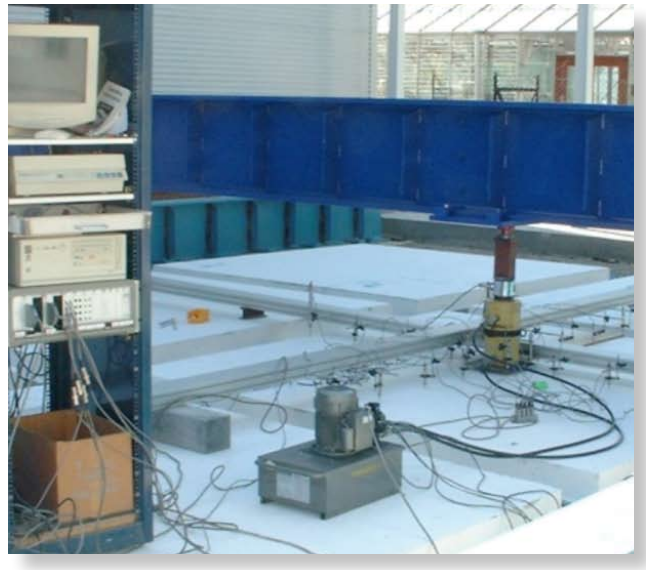
Specialised environmental chamber

Testing facilities and methods

The Department of Civil Engineering has a range of standard civil engineering testing facilities, equipment and methods for all disciplines, e.g. materials, structures, hydraulics and geotechniques. It also has two facilities that are unique in Europe: a specialised environmental chamber and a testing rig for full-size ground slabs.

The environmental chamber, which measures 4 x 8 x 3 m, regulates temperature, humidity, saltwater spray, etc. This is ideal for investigating the whole-life behaviour of materials and structures under hazardous conditions (such as a corrosive environment) and the effects of climate change on materials and structural behaviour. Calibration methods for test data under accelerated conditions are also available.

The ground slab testing rig is the largest in Europe. It measures 6 x 12 m and has a loading capacity of 1,000 kN, ideal for investigating the behaviour of full-size ground slabs under realistic loading and service conditions.



Ground slab testing rig

People and expertise

The research team is led by Professor Chun-Qing Li, Atkins Chair in Civil Engineering, whose research is **rated 4***, i.e., **world-leading**, in **RAE2008**. The team comprises three academics (all senior lecturers and above) and four research assistants and/or fellows, who are specialised in structures, materials and geotechniques. The team is well-supported by technical and computing staff.

Main expertise

1. Time-dependent reliability methods and their applications to risk assessment and service-life prediction of civil infrastructure
2. Whole-life assessment of steel corrosion in concrete and its effects on structural deterioration
3. Development of risk-cost optimised asset management strategies for civil infrastructure
4. Methods to prolong safe and serviceable life of existing infrastructure
5. Reliability assessment of traffic congestion with public service agreements and other measures
6. Assessment and testing of reinforced concrete ground slabs and soil-structure interaction
7. Assessment and testing of fibre-reinforced concrete materials and structures
8. Modelling and testing of geomaterials, composite materials and geopolymers and their products

Opportunities for research students

The research environment in the group is second to none for both PhD and Master's studies, with specialist supervisors, well-equipped facilities and innovative research projects relevant to current issues facing the civil engineering profession. Students will also benifit from direct involvement of Atkins engineers in a role of mentoring.

Our track record

Project: stochastic modelling of the corrosion process for service-life predictions of civil infrastructure

Client: Engineering and Physical Sciences Research Council

This project developed a model for the whole process of steel corrosion in concrete, including various phases of corrosion progression (see below).

Project: development of risk assessment models for corrosion-affected reinforced concrete infrastructure

Client: Royal Academy of Engineering

This project developed models to assess the risk of structural failures, including safety and serviceability.

Project: corrosion resistance of concrete structures modified with the Everdure Caltite System

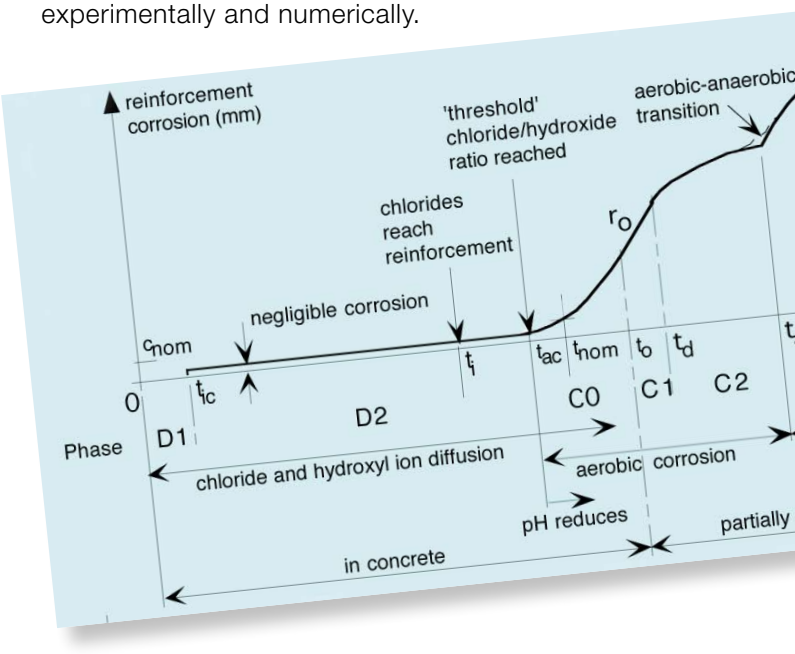
Client: Cementaid (UK)
This project investigated the structural capacity deterioration of caltite-modified concrete walls.

Project: preliminary study on public service agreement congestion measure for route performance

Client: InterRoute
This project quantified the public service agreement congestion measure for each link of a route and analysed its reliability.

Project: testing and assessment of fibre-reinforced concrete ground slabs

Client: Propex
A large number of concrete slabs were investigated experimentally and numerically.



Computer packages

In addition to standard computer software for structural, geotechnical analysis, a range of specialist software for structural and geotechnical assessment and asset management is available in the group. Different programs are used to:

- Quantify the risk of failures over time, based on safety, serviceability and user-specified criteria
- Quantify the risk of failures in each phase of service life for corrosion-affected concrete structures
- Develop a maintenance scheme which determines when, where and what actions are required for deteriorated infrastructure to ensure its safe and serviceable operation at the minimum total cost (see image below)
- Predict concrete crack width under the combined effect of steel corrosion and applied load
- Predict structural deflection under the combined effect of steel corrosion and applied load
- Quantify the journey time with public service agreement congestion measure and the reliability of journeys
- Predict the risk of overtopping for coastal structures.

Technology transfer

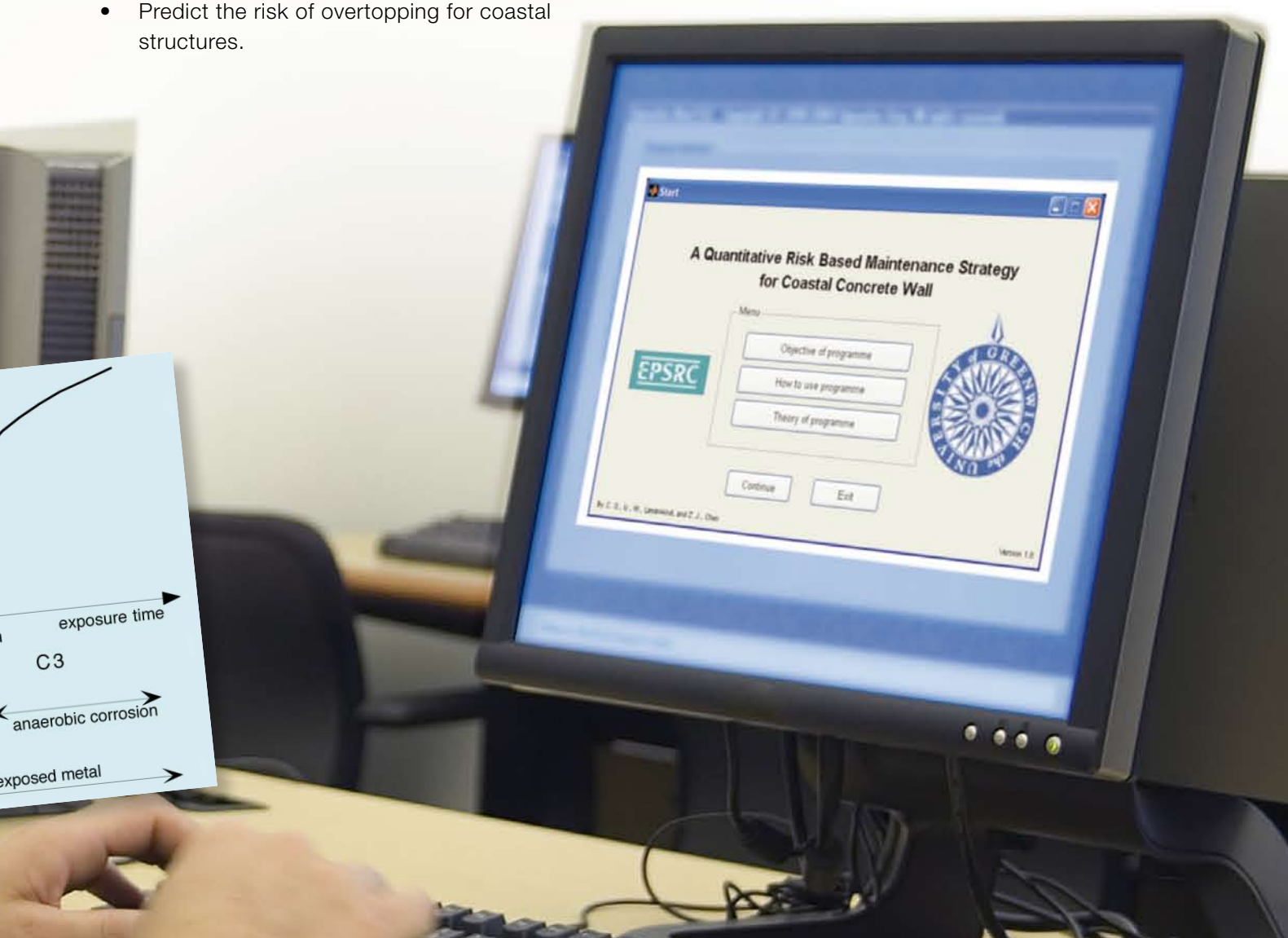
All technologies developed in the Infrastructure Management Research Group are available for transfer to interested parties in various forms. Interested personnel and parties are most welcome to join the group in jointly developing new technologies; the intellectual property rights will be distributed proportionately.

A large number of publications in our areas of expertise detail the theories, methodologies, applications and test data. Examples are shown below.

"Analytical Model for Corrosion Induced Crack Width in Reinforced Concrete Structures", ACI Structural Journal, 103, (4), 2006, 479–87.

"Time Dependent Risk Assessment of Structural Deterioration Caused by Reinforcement Corrosion", ACI Structural Journal, 102, (5), 2005, 754–62.

"Reliability Based Service Life Prediction of Corrosion Affected Concrete Structures", ASCE Journal of Structural Engineering, 130, (10), 2004, 1570–77.



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To find out more about the university's research and consulting capability in civil infrastructure assessment and management, please contact:

Professor Chun-Qing Li

Atkins Chair in Civil Engineering

Head of the Department of Civil Engineering

University of Greenwich at Medway

Chatham Maritime

Kent ME4 4TB

Tel: 01634 883518

Mobile: 0771 9712633

Fax: 01634 883605

E-mail: c.q.li@gre.ac.uk

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