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Page 3 Introduction

Introduction

Welcome to this special issue of *Civil Engineering* on forensic engineering.

While many people are increasingly aware of forensic science and accounting in criminal investigations, particularly through glamourised portrayals in film and television, far fewer are likely to be aware of forensic engineering. So what is it?

In a civil engineering context, forensic engineering involves the investigation of failures of constructed facilities and the built environment. While collapses are the most spectacular and potentially lethal type of failures – particularly when caused by criminal acts such as terrorism and arson – the discipline also includes investigation of failures in serviceability and performance, both during and after construction.

The key to forensic engineering is that the investigative practice and procedure should be sufficiently robust to stand up to rigorous scrutiny. It needs to embrace examination of a range of technical and organisational factors that may have contributed to a failure, especially where it results in claims and litigation.

There is a wider benefit, however, in that the outcomes of forensic investigation and assessment can increase the sustainability of infrastructure by prolonging its use. For example, forensic engineering may indicate that the life of a failing structure can be extended by refurbishment or strengthening rather than ended through demolition. Indeed, forensic feedback into all design, construction and management activities can ensure society gets more value and benefit from its built environment.

The papers in this special issue report on the forensic investigation of everything from collapses to cracks in a diverse range of structures from around the world, with causes including blast, fire, storm, flood, erosion and corrosion.

The first paper by Bill Keane and Philip Esper describes their experiences of investigating the many British buildings blasted by bomb and vapour explosions over the past two decades.[1] They explain how forensic techniques – including laboratory, on-site testing and computer modelling and analysis – are vital to such investigations.

Jeremy Ingham then discusses forensic engineering of fire-damaged structures in the UK, where building fires have more than doubled over the past 50 years.[2] He describes the role of forensic engineers in investigating burnt concrete, steel and masonry and stresses the importance of looking for repair solutions rather than demolition.

Not all failures are as rapid: corrosion, for example, can take place over decades but the results can be just as devastating. Gareth John, Tony Edwards, Adrian Wright, Mike Broadhurst and Chris Newton recommend a root-cause analysis to identify corrosion-failure mechanisms involving both macroscopic and microscopic methods.[3]

In addition to corrosion, some coastal structures with suspended decks have suffered unexpectedly from wave action during storms. John Alderson, William Alsop, Giovanni Cuomo, Yves Duchene and Vicent De Vill De Goyet report on how one such mystery was forensically resolved for a pier in Belgium.[4]

Moving inland, Milan Holický and Miroslav Sýkora then report on the forensic investigation of fluvial flood damage in the Czech Republic in 2002.[5] The work included statistical analysis of hydrological data dating back to 1827 to examine climate trends, as well as using Eurocodes to assess structural robustness.

Flooding is one of many causes of foundation failure, which can lead to litigation and even criminal action. Harry Poulos from Australia describes a systematic approach to forensic foundation engineering, which he illustrates with a case study of a tilting office block in Indonesia.[6]

Ken Ho, Tony Lau and Jonathan Lau continue the geotechnical theme in their paper on forensic landslide investigations in Hong Kong, where dense development, steep terrain and heavy rainfall can lead to deadly consequences.[7] The government's systematic landslide investigation programme has proved to be an important asset-management tool.

We then cross the Pacific for an overview of forensic structural engineering practice in the USA, arguably the world's most litigious environment for construction. Bob Ratay highlights the all-important procedures that need to be followed to ensure robust results and outcomes that will stand up in court.[8]

The final paper by Stuart Matthews and Gerry Saunders looks both backwards and forwards, highlighting the wealth of past forensic studies that already exists and suggesting how they can be better used to improve future design and construction practice.[9]

We are very grateful to all authors for their papers and to the referees for reviewing them. We trust this special issue of *Civil Engineering* contributes to a better understanding of structural failures, the processes of investigation and the lessons that can be learned. We also hope it strengthens the case for forensic engineering becoming an integral part of civil engineering degree courses and continuing professional development programmes.

Readers wishing to learn more about the topic can refer to the proceedings of the Institution of Civil Engineers' fourth international conference on forensic engineering held in London in December 2008.[10]

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