Editorial

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Effective undergraduate education followed by monitored, continuing professional development (CPD) is essential to maintaining standards in any profession. In civil engineering, where risk management and safety are primary activities and the consequences of omissions can be severe, a culture of learning from known mistakes is something to be encouraged and is an aim of this journal. Many of these lessons are transferrable between different branches of the engineering profession and from a variety of projects and locations. They are not restricted to technical issues and can include systemic failings too.

It should be the role of university educators and supervising engineers to improve reflectively professional methodologies in the light of the lessons learned and to embed these within practice. In this way the frequency of forensic incidents should reduce. This is something that both of the editors of this themed issue on education have done for many years and they are delighted to introduce five papers from three continents, from engineering and legal practitioners, teachers and researchers, and in some cases, authors who are forensic hybrids, sharing their experiences and opinions to contribute to an international debate on forensic engineering education.

For civil engineering in the UK the primary institutions are the Institution of Civil Engineers and the Institution of Structural Engineers, and these, combined with the Chartered Institution of Highways and Transportation and the Institute of Highway Engineers, form the Joint Board of Moderators (JBM). Graduates from accredited courses are exempt from the institutions' equivalents to the degree examinations, so there is a considerable advantage to having one's course accredited. These institutions have done much through their journals, conferences and other CPD to promote an awareness of forensic issues and it is worthwhile to examine briefly, as an example of accreditation practice, the JBM's treatment of forensic engineering in undergraduate taught courses. They specifically say in Annexe D and F

The engineering profession has lacked an emphasis on feedback and learning; it is imperative that we get our young engineers to understand the importance of learning from failure (see <http://www.jbm.org.uk/downloads.aspx>)

Competency across the profession starts with university courses developing awareness, knowledge and skills so that graduates can make responsible engineering judgements. It is the role of the JBM to engage with universities in the UK and some overseas whose degrees it accredits. To accredit a degree, the JBM would expect to see programmes that contain a mixture of core and optional subjects. These subjects should be taught in the context of design with due regard to sustainability, safety and practice. Each issue is expected to form an integrating thread in the programme and lead towards safe professional practice.

Forensic studies within a historical, developmental description of technology and the professional ethos could play a more explicit role than is currently indicated. Studies could weave environmental, economic, political, interdisciplinary, global, social and ethical issues alongside risk management. JBM and their overseas equivalents have an opportunity to reconsider the current level of prominence given to this aspect of the engineering discipline. The authors and reviewers for this educational themed issue have provided a good place to start that reappraisal of balance and opportunity. This issue comprises four diverse papers and a briefing paper.

Ratay's briefing (Ratay, 2012) integrates undergraduate education, mid-career CPD and dispute resolution. This links well with the paper by Soo and Lam (2012) written from a barrister's viewpoint working within a different legal system. Ratay argues from experience as a consultant that education and practice of forensic structural engineering should have three goals. The first must be to reduce the number and magnitude of failures. The second is to learn and apply satisfactory methods of forensic analysis and the third is to

provide support to legal teams in disputes. Ratay advocates that teaching principles should be practically based rather than academic, and says that few courses in the USA now have a seasoned active practitioner delivering appropriate material. As editors, the authors of this editorial think the same is true of the UK and probably most countries. This is a challenge for everyone.

Continuing the US theme, Delatte (2012) examines the contribution made by the Technical Council on Forensic Engineering (TCFE) of the American Society of Civil Engineers in establishing and promoting forensic engineering as a distinctive specialisation. Delatte reviews the developments within TCFE, with particular emphasis on educational activities and the progress made to integrate failure case histories and forensics into graduate and undergraduate education. One major change over the 30 years of TCFE has been the development and testing of innovative approaches to teaching with case studies, which requires a broader education in the arts, humanities, ethics and sciences. Such education is expensive, but then so is the alternative.

Lewis (2012) emphasises the tradition that deep understanding of structural principles, load paths, morphology and materials underpins the designer's ability to discharge their responsibility for structural safety and efficiency. Case studies illustrate problems with exciting and ambitious space-enclosing or wide-span structures, including cable-supported and tensioned fabric structures, shells, arches and space frames. Practical model-making exercises and other strategies for effective teaching are described to broaden the students' understanding of design and deepen their comprehension. A key message is that the issue of structural form should be equally important to an engineer as it is to an architect, and that the architect should involve the engineer at the conceptual stage.

Lewis, in dealing with the large scale, is complemented neatly in the selection by James (2012), also teaching in the UK, who deals with failures at stress concentrations. Based on his consultancy work investigating fatigue and fracture of metallic components in mechanical systems, James has created for his university students, and others, an on-line, forensic engineering training resource to improve their education by providing information that can be readily accessed and understood. It is also available for CPD. The paper also explores current ideas related to definitions of failure, and ways of analysing and communicating learning about the cause–action–result sequence of events in a failure scenario. The paper is an example of where forensic principles cross the divides between disciplines.

The paper by Soo and Lam reinforces Ratay's observations about legal awareness. It concentrates on discussing, so usefully for engineers, from a lawyer's viewpoint what is the essential

body of legal knowledge that forensic engineers need. The authors observe that with growth in construction activities in some parts of the world, construction disputes are on the rise. As a consequence the industry worldwide deserves better ways for resolving these. By exploring and studying cases and practices, Soo and Lam introduce a protocol of conduct expected from forensic engineers and then highlight those issues that need to be considered by educators. A checklist is suggested for a syllabus that includes duties as an expert, together with legal, evidence and dispute resolution processes. It reminds engineers of the multidisciplinary nature of the forensic calling.

The paper authors wrote as individuals, and, as editors following on, the present authors have the forensic luxury of looking at the pattern of thoughts left behind. From these it can be seen that there should be a continuing investment in case studies and credible and enthusiastic people should be sought out to present them. Multidisciplinary teams, including lawyers and architects, make influential decisions in practice and this should be simulated in the teaching. Across the engineering disciplines, forensic examples have assisted with the teaching of structural principles, materials behaviour, non-linear behaviour of slender structures, and stress concentrations at small details. And that is only a sample.

It does seem that a forensically led teaching approach currently still depends on the enthusiasm of individual academic or visiting staff that have come to the topic by a variety of routes. There is a case that accreditation bodies may wish to revisit the profile of forensic engineering within courses and revisit what is taught and perhaps also who does the teaching.

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