

# FORENSIC ENGINEERING 2022

*Collaborative Reporting for Safer Structures*

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SELECTED PAPERS FROM THE NINTH CONGRESS ON  
FORENSIC ENGINEERING

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# Preface

The Forensic Engineering Congress is organized by ASCE's Forensic Engineering Division and is held every three years to disseminate information on building and civil infrastructure failures and to discuss the application of engineering principles to the investigation of failures and other performance problems. The Congress provides a platform for forensic experts from various disciplines to share their knowledge and experience, to network, and to learn from others involved in the discipline.

In mid-2020 the organizers of the 9<sup>th</sup> Congress contacted us as the Directors of Collaborative Reporting for Safer Structures – US to invite CROSS-US to participate in the Congress. We enthusiastically accepted the invitation and engaged our CROSS colleagues within and outside the US to prepare the nine papers that comprise this Volume 2 of the proceedings.

Established in the UK in 2005 as Confidential Reporting on Structural Safety, CROSS encourages individuals to submit through a confidential and secure internet portal reports on structural failures, near misses, and general safety concerns. The reports are anonymized and then forwarded to CROSS's Expert Panel for input on lessons learned and recommendations to improve practice. The Expert Panel commentary is compiled, summarized, and appended to the anonymized report, and the resulting final report is posted on-line, where it is available to all for the benefit of improving structural safety. Since 2005 the CROSS system has accepted over 1000 reports, and it has been shown to have a very direct, positive influence on safety practices and culture in the UK. In the seventeen years since its inception, CROSS has flourished and expanded internationally. CROSS-Australasia was established in 2018 and CROSS-US in 2019.

Enquiries into the tragic fire at Grenfell Tower in London in 2017 highlighted the importance of fire safety in our structures and the value of the CROSS system in promoting a safety culture. The UK government supported the strengthening of the CROSS infrastructure and its expansion into fire safety in CROSS-UK.

The nine papers of this volume track the founding and development of CROSS in the UK, its expansion internationally, and its expansion to fire safety. The papers include contributions from the UK, Australasia, the US, and Germany, and span both structural and fire safety. CROSS's unique role in our system of assuring structural safety is described, and its tremendous potential for even greater impact internationally is envisioned.

All abstracts and manuscripts submitted to the 9th Forensic Engineering Congress were peer-reviewed, with each paper receiving a minimum of two positive reviews to be accepted for presentation and publication. Reviewers applied the following review criteria:

- Is the submission applicable and relevant to forensic engineering?
- Is the paper original for its publication in the Congress?
- Are the methods of forensic investigation or research satisfactorily explained?
- Are the tables, figures, and photographs included in the submission clear and necessary?
- Are the conclusions clear and supported by the discussion and evidence?

- Are the references verifiable?
- Is the paper logically structured?
- Are the writing style, grammar, and formatting appropriate according to ASCE publication guidelines?

We thank the organizers of the Congress, particularly Rui Liu, Carmen Mulea, Kevin Parfitt, and Tara Cavalline, as well as other members of the Steering Committee, for inviting CROSS-US to participate in the Congress. The collaboration between the ASCE Forensic Division and ASCE/SEI/CROSS-US has flourished in the two years since that initial outreach. We thank the Reviewers for their thoughtful reviews and comments on the draft manuscripts. Jay Snyder, Senior Manager, Committee on Technical Advancement of ASCE, provided constant encouragement, guidance, and coordination between the editorial board and ASCE since the planning phase of the Congress. And, we want to thank the ASCE team from Conferences, Sponsorship, and Publications for their support during the Congress planning process. We want to acknowledge Erin Ryan, project manager of Omnipress, for her assistance in managing the abstracts and manuscripts submissions, peer reviews, and coordinating communications between the authors and the conference steering committee. The CROSS Executive Committee, particularly its Secretary, Laura Champion, provided invaluable support and advice for these nine papers.

While the initiation and development of CROSS involved the teamwork and support of many, Alastair Soane is the recognized founder of the CROSS system and has been its driving force for the last seventeen years. For his foresight, professionalism, and unwavering energy we dedicate this Volume 2 of the proceedings to him.

**Glenn Bell and Andrew Herrmann**  
Directors, CROSS-US

# Acknowledgements

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