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GUEST EDITORIAL

Life-cycle performance of civil infrastructure systems

Civil infrastructure systems are the backbone of modern society and among the major drivers of the economic growth and sustainable development of countries. However, due to their inherent vulnerability, infrastructure facilities are exposed to the detrimental effects of ageing, deterioration processes, natural hazards, and man-made disasters. It is hence a strategic priority to establish criteria, methods and procedures to protect, maintain and improve the safety, durability, efficiency and resilience of critical infrastructure under uncertainty. To face this need, civil engineering is undergoing a profound change towards a life-cycle oriented design philosophy where the classical point-in-time reliability-based design criteria are extended to account for more comprehensive time-variant performance indicators over the service life by taking into account the effects of continuous deterioration processes, sudden damaging events, maintenance actions and repair interventions.

The International Association for Life-Cycle Civil Engineering (IALCCE) was founded in 2006 to support this challenge and to create a fertile ground for promoting the study, research, and applications in the design, assessment, prediction, and optimal management of life-cycle performance, safety, reliability and risk of civil structures and infrastructure systems (http://www.ialcce.org). To accomplish this mission and following a series of International Workshops on Life-Cycle Cost Analysis and Design of Civil Infrastructure Systems held in Honolulu, Hawaii, USA (LCC1, 2000), Ube, Yamaguchi, Japan (LCC2, 2001), Lausanne, Switzerland (LCC3, 2003), Cocoa Beach, Florida, USA (LCC4, 2005) and Seoul, Korea (LCC5, 2006), it was decided to bring together the main advances on life-cycle civil engineering and related topics at the First International Symposium on Life-Cycle Civil Engineering (IALCCE'08), held in Varenna, Lake Como, Italy, 10–14 June 2008 (http://www.ialcce08.org), and afterwards at the Second International Symposium on Life-Cycle Civil Engineering (IALCCE 2010), held in Taipei, Taiwan, 27–31 October, 2010 (http://www.ialcce2010.ntust.edu.tw), the Third International Symposium on Life-Cycle Civil Engineering (IALCCE 2012), held at the Hofburg Palace in Vienna, Austria, 3–6 October, 2012 (http://www.ialcce2012.org), and the Fourth International Symposium on Life-Cycle Civil Engineering (IALCCE 2014), held in Tokyo, Japan, 16–19 November, 2014 (http://www.ialcce2014.org).

IALCCE 2012 was organised on behalf of IALCCE under the auspices of the University of Natural Resources and Life Sciences, Vienna. The interest of the international civil engineering community in the fields covered by IALCCE has been confirmed by the significant response to the IALCCE 2012 call for papers, with about 600 abstracts received from over 50 countries and approximately 60% of them selected for final publication as technical papers and presentation at the Symposium within mini-symposia, special sessions and general sessions. The extended version of three selected keynote papers presented at IALCCE 2012, including the Fazlur Khan lecture, and one invited paper are published in this special issue of Structure and Infrastructure Engineering. These papers deal with emerging concepts and innovative applications in the field of life-cycle civil engineering and related topics. *Sarkisian* provides an insightful overview on Fazlur Khan's contributions to design of tall buildings and shows how Khan's legacy inspired to expand the possibilities in skyscraper engineering and architecture by reducing the impact of materials and structures on the environment and improving the long-term building performance and efficiency. *Ellingwood and Lee* discuss several key issues to be addressed in life-cycle reliability assessment of civil infrastructure facilities that must remain functional for service periods of several generations, and introduces perspectives on risk that are germane to ensuring sustainability and inter-generational equity in risk-informed decision-making. *Sabatino, Frangopol and Dong* investigate the optimum maintenance of civil infrastructure systems under uncertainty and propose to combine risk assessment techniques with multi-attribute utility theory to establish a decision support framework based on a tri-objective optimisation procedure balancing maintenance cost, risks and benefit, with potential applications to a wide array of engineering systems. Finally, *Esteva, Díaz-López, Vásquez, and León* investigate the influence of structural damage accumulation on the life-cycle optimum seismic performance of frame buildings and present results about estimates of accumulated damage and optimum damage threshold values for repair of frame structures or replacement of energy dissipating devices.

The guest editors thank the authors and the reviewers for contributing this special issue and hope that this collection of papers will represent a useful reference for researchers, students and practitioners to promote and advance research and applications in the field of life-cycle civil engineering.

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