

## BOOK REVIEW

**Frontier technologies for infrastructures engineering: structures and infrastructures book series**, Vol. 4, edited by Shi-Shuenn Chen and Alfredo H-S. Ang, CRC Press, 2009, 502 pp., \$155, ISBN 978-0-415-49875-3

This is an authoritative book on frontier and emerging technologies in structure and infrastructure engineering. It contains the papers of invited lectures presented by eminent world-renowned experts at the International Workshop on Frontier Technologies for Infrastructures Engineering that was held in Taipei, Taiwan, at the Taiwan Building Technology Center (TBTC) of the National Taiwan University of Science & Technology (Taiwan Tech) on 23–25 October 2008. These papers provide a wealth of information on structural, geotechnical and construction management aspects related to planning, design, construction and maintenance of civil infrastructure systems, including buildings, bridges, roadways, power generation and distribution systems. Specific topics covered include: life-cycle cost and performance; reliability engineering; risk assessment and management; optimisation methods and optimal design; role of maintenance, inspection, and repair; structural and system health monitoring; durability, fatigue and fracture; corrosion technology for metal and reinforced concrete structures.

The book consists of 502 pages divided into 19 self-contained chapters. Chapter 1 deals with the conceptual design of vibration sensitive buildings, such as production buildings for the semiconductor and precision engineering industry, and presents an approach of isolation-and-shield to mitigate vibrations from multiple sources such as traffic, wind and machineries. Chapter 2 reviews the historical performance of welded steel bridges in the USA with focus on fatigue cracking at welded steel details, as well as distortion-induced cracking at web gaps, and examines the impact of corrosion loss as a contributing time-dependant factor to fatigue resistance. Empirical, theoretical and numerical models for the prediction of corrosion in reinforced concrete structures are reviewed in Chapter 3, with emphasis on the available field measurement techniques for predicting corrosion incidence and rate. Chapter 4 presents an introduction to algorithms, cost functions, constraints and numerical procedures for structural optimisation and

applications to optimum design of structural systems. The role of reliability theory and quality assurance in foundation design and construction is discussed in Chapter 5 by considering both quantitative and qualitative information for updating model errors and design parameters. Chapter 6 introduces geosynthetic materials for soil reinforcement and briefly describes their types and manufacture, functions and applications, properties and tests, design, selection, and specifications. Chapter 7 illustrates the application of a risk-based framework to support decisions in developing and maintaining infrastructures for producing, processing and distributing energy. Chapter 8 summarises some of the advances in probability-based code development that have been made possible by structural reliability methods and explores the role of risk assessment methodologies as decision support tools for dealing with uncertainties rationally in performance-based engineering. Chapter 9 presents a Bayesian network methodology for information updating and risk-management of infrastructures subject to earthquake hazard. The value and use of probabilistic concepts in civil engineering practice are explored in Chapter 10, with a focus on an action-oriented approach in which the engineer identifies damage or failure risks and their consequences, and quantifies the effectiveness and benefits of data acquisition, design, and monitoring strategies in reducing risk. Chapter 11 introduces a quantitative risk analysis framework for multi-hazard management of infrastructures with applications focusing on protection systems of hurricane-prone regions and security protection of infrastructures. Chapter 12 summarises a simulation-based probabilistic methodology for evaluation of performance in terms of robustness, resilience and sustainability of spatially distributed systems serving urban population centres under operational and extreme event conditions. Recent developments of reliability analysis and reliability-based design of structures against earthquakes are reviewed in Chapter 13 with emphasis on treatment of uncertainties including inherent variability and modelling errors. Chapter 14 discusses the role of life-cycle cost optimisation in bridge management and provides suggestions to realise a rational and economic maintenance program and to develop a practical bridge management system. A review of the current practice of life-cycle cost analysis

of civil infrastructures is presented in Chapter 15, with focus on improved and practical approaches for uncertainty assessment in the application of life-cycle cost methodologies. Chapter 16 examines the role of structural health monitoring for life-cycle cost and performance prediction and identifies the most appropriate metrics, methods and actions for the inclusion of structural health monitoring into design, assessment and management of civil infrastructures. A novel nondestructive structural health assessment technique is presented in Chapter 17 for the detection of defects in new, deteriorated or rehabilitated existing structures on a continuing basis, or just after natural or manmade events. Chapter 18 highlights technological developments in smart sensors, mobile computing, wireless communications, and 3-D laser scanning for infrastructure inspection and field data collection. Finally, Chapter 19 describes the use of a discrete-event simulation technique in the design of complex earthwork operations based on dynamic strategies. References are provided at the end of each chapter for readers wishing to delve deeper into particular topics, whereas a complete bibliography with about 450 references is included at the end of the book for ease of use.

The book is well organised, the writing is clear and concise, and the technical content is informative and compelling. The book is mainly intended for researchers and practicing engineers working on civil structures and infrastructures, but the breadth of topics covered makes this collection of papers appealing to a broader readership. The technical background required of the reader is quite variable depending on the subject, and some prerequisite knowledge is necessary to take full advantage of the presented material. Overall, this is an excellent reference book which offers a convenient introduction and overview of current and frontier technologies in planning, design, construction and maintenance of civil infrastructures. Interested readers will find this valuable volume of the *Structures and Infrastructures Book Series* to be an indispensable addition to their technical libraries. I would certainly recommend *Frontier Technologies for Infrastructures Engineering* to all concerned with structure and infrastructure civil engineering systems.

Fabio Biondini  
Politecnico di Milano, Milan, Italy  
biondini@stru.polimi.it  
© 2013 Fabio Biondini