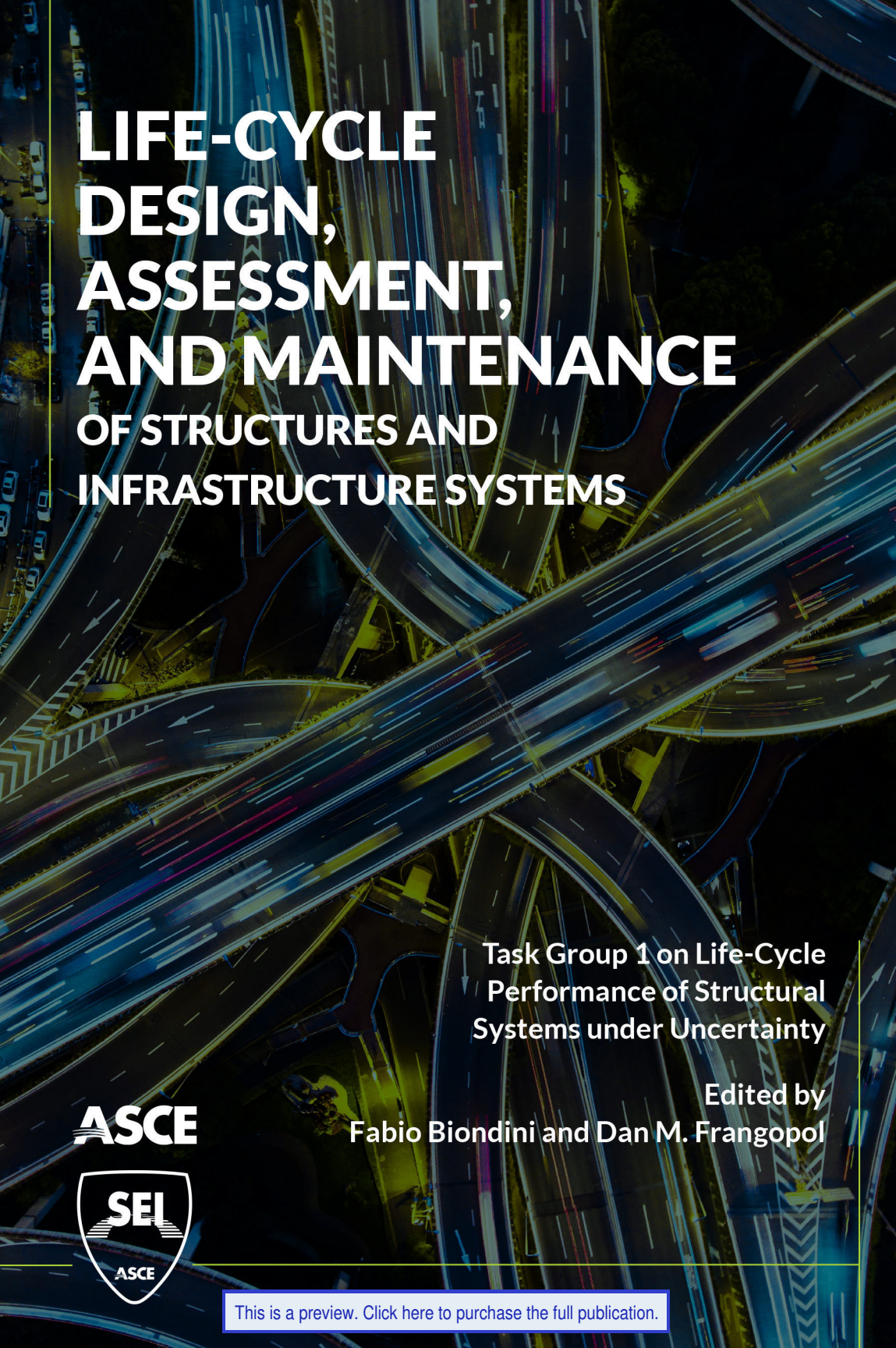

LIFE-CYCLE DESIGN, ASSESSMENT, AND MAINTENANCE OF STRUCTURES AND INFRASTRUCTURE SYSTEMS

Task Group 1 on Life-Cycle Performance of Structural Systems under Uncertainty

Edited by
Fabio Biondini and Dan M. Frangopol

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Life-Cycle Design, Assessment, and Maintenance of Structures and Infrastructure Systems

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Published by the American Society of Civil Engineers

Library of Congress Cataloging-in-Publication Data

Names: Biondini, Fabio, editor. | Frangopol, Dan M., editor. | American Society of Civil Engineers, host institution.
Title: Life-cycle design, assessment, and maintenance of structures and infrastructure systems / edited by Fabio Biondini and Dan M. Frangopol.
Description: Reston, Virginia : American Society of Civil Engineers, 2019. | Product of a SEI/ASCE Special Project on Life-Cycle Performance of Civil Structure and Infrastructure Systems. | Includes bibliographical references and index. | Summary: "This book outlines methodologies, tools, and research to incorporate life-cycle design, assessment, and maintenance concepts into civil engineering structures and infrastructure systems"–Provided by publisher.
Identifiers: LCCN 2019031827 | ISBN 9780784415467 (paperback) | ISBN 9780784482636 (adobe pdf)
Subjects: LCSH: Structural health monitoring–Congresses. | Building inspection–Congresses. | Public works–Maintenance and repair–Congresses. | Public works–Service life–Congresses. | Life cycle costing–Congresses.
Classification: LCC TA656.6 .I67 2019 | DDC 624.1/71–dc23
LC record available at https://lccn.loc.gov/2019031827

Published by American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, Virginia 20191-4382
www.asce.org/bookstore | ascelibrary.org

Errata: Errata, if any, can be found at https://doi.org/10.1061/9780784415467.

ISBN 978-0-7844-1546-7 (print)
ISBN 978-0-7844-8263-6 (PDF)

Manufactured in the United States of America.

25 24 23 22 21 20 19 1 2 3 4 5

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Preface

Structural engineering is facing a profound change toward a life-cycle oriented design philosophy to address the continuously increasing demand from societal, political, economic, and environmental needs associated with aging, deterioration processes, and other multiple natural and man-made hazards affecting infrastructure facilities. In this perspective, the classical point-in-time design criteria must be revised and extended to account for more comprehensive time-variant performance indicators over the entire service life. ASCE strongly supports a change of design paradigm and proposed the use of Life-Cycle Cost Analysis in conjunction with the Grand Challenge of reducing life-cycle costs of civil infrastructure projects by 50% by 2025. Furthermore, research and implementation of life-cycle design, assessment, prediction, and optimal management of structures and infrastructure systems under uncertainty are promoted within the Structural Engineering Institute (SEI) of ASCE by the Technical Council (TC) on Life-Cycle Performance, Safety, Reliability, and Risk of Structural Systems. The TC and its three Task Groups provide a forum for reviewing, developing, and promoting the principles and methods of life-cycle performance, safety, reliability, and risk of structural systems in the analysis, design, construction, assessment, inspection, maintenance, operation, monitoring, repair, rehabilitation, and optimal management of civil infrastructure systems under uncertainty. In particular, the purpose of Task Group 1 (TG1) on Life-Cycle Performance of Structural Systems under Uncertainty is to promote the study, research, and application of scientific principles of safety and reliability in the assessment, prediction, and optimal management of life-cycle performance of structural systems under uncertainty.

The activities of SEI/ASCE TC TG1 included a Special Project approved by SEI Executive Committee of the Technical Activities Division (TAD) for the development of this state-of-the-art report outlining the current status and research needs in the fields of life-cycle of civil structure and infrastructure systems. This task included a Survey and an International Workshop on Life-Cycle Performance of Civil Structure and Infrastructure Systems, held on November 10, 2015, at ASCE headquarters in Reston, Virginia. The objectives of these activities were to overview the advances accomplished in the field of life-cycle civil engineering, promote a better understanding of life-cycle concepts in the structural engineering community, and discuss methodologies and tools to incorporate life-cycle concepts into structural design codes and standards. In fact, despite relevant advances and accomplishments, life-cycle concepts are not yet explicitly addressed in structural design codes, and the checking of system performance requirements is referred to the initial time of construction when

the system is intact. In this approach, design for durability with respect to chemical-physical damage phenomena is based on simplified criteria associated with classes of environmental conditions. However, design for durability cannot be based only on such indirect evaluations of the effects of structural damage but also needs to take into account global effects of local damage phenomena on the overall system performance of the structure. This report is responding to these needs and presents the current status and research needs in the field of life cycle assessment and design of structural systems under uncertainty, including the results of both the survey and workshop, for the implementation of criteria, methods, and tools for life-cycle design and assessment of civil structure and infrastructure systems.

This book is the product of a dedicated work of several colleagues involved in the activities of SEI/ASCE Technical Council. We sincerely thank all the authors for their contributions, all members of the Technical Council for their useful comments, and the SEI TAD Executive Committee for the support provided to the Special Project. Special thanks are due to Robert Nickerson for his continuous and enthusiastic support to the Special Project and all the activities of the Technical Council. We hope that this report will advance the understanding of life-cycle concepts in the structural engineering community and benefit the profession by providing methodologies and tools to incorporate these concepts into design standards and practices. In this way, we also hope that ASCE will further solidify a leading role in promoting and advancing the application of life-cycle concepts in design practice, influencing the development of structural design codes and standards, and enhancing the state of the nation's infrastructure to protect the public safety and improve the quality of life.

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