

Structural Engineering Documents

**14**

# **Sustainable Structural Engineering**

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International Association for Bridge and Structural Engineering (IABSE)

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IABSE Working Commission 7 – Sustainable Engineering



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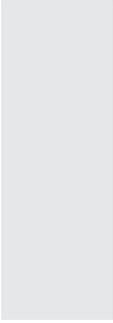
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## Preface

From resource consumption and water use to waste generation and greenhouse gas emissions, the built environment is critical for a sustainable future. While the challenges of sustainability have been known for decades, urgency of action is driven by the findings of the United Nations Intergovernmental Panel on Climate Change. Consequently, structural engineers face a new design paradigm: safe, economic, reliable, and *sustainable*.

Sustainable development is defined by the Brundtland Report as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” The three pillars of sustainability—environment, social, and economic—must be taken into account for engineering projects to achieve sustainability. This *Structural Engineering Document* presents the latest research and practical applications of sustainable structural engineering from around the world.

In the opening chapter, Kanda details the role of the structural engineer in sustainable design with a focus on safety. This is followed by Limsuwan’s chapter on an integration concept of sustainability engineering. Zordan then outlines a sustainable approach to structural design. Lourenço, Branco, and Coelho illustrate the importance of existing structures in their chapter on cultural heritage and structural systems. Anderson and Yang discuss life-cycle assessment as a crucial analysis tool to evaluate environmental sustainability criteria. Matos, Neves, and Gonçalves subsequently present the importance of asset management for aging infrastructure. Martin and Kirk provide a crucial review of sustainability in bridge design and maintenance. Bucher and Brehm then present structural reassessment for the lifetime extension of structures. The importance of disaster risk reduction as a sustainability strategy is presented by Grundy. Finally, de Brito and Silva review green materials for concrete production.

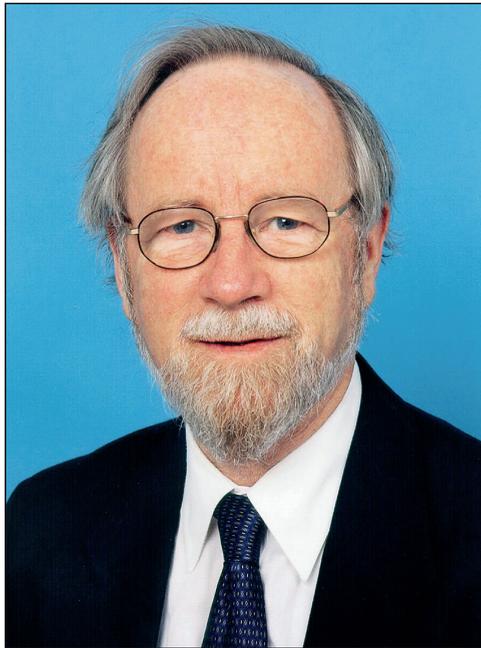
Sustainability is a broad and complex topic. Through this *Structural Engineering Document* we aim to provide practicing engineers and researchers with insights, tools, and recommendations to advance sustainable structural design.

**John E. Anderson, Christian Bucher, Bruno Briseghella, Xin Ruan, and Tobia Zordan**

**August, 2015**

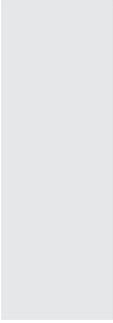
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## Dedication



Paul Grundy (1935–2013)

This book is dedicated to the memory of Professor Paul Grundy –  
A devoted IABSE member, colleague, and friend.



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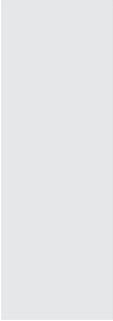
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# Structural Engineering Documents

## Objective:

To provide in-depth information to practicing structural engineers in reports of high scientific and technical standards on a wide range of structural engineering topics.

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The International Association for Bridge and Structural Engineering (IABSE) operates on a worldwide basis, with interests of all type of structures, in all materials. Its members represent structural engineers, employed in design, academe, construction, regulation and renewal. IABSE organises conferences and publishes the quarterly journal *Structural Engineering International (SEI)*, as well as reports and monographs, including the SED series, and presents annual awards for achievements in structural engineering. With a membership of some 4,000 individuals in more than 100 countries, IABSE is the international organisation for structural engineering.

## Readership:

Practicing structural engineers, teachers, researchers and students at a university level, as well as representatives of owners, operators and builders.

## Publisher:

The International Association for Bridge and Structural Engineering (IABSE) was founded as a non-profit scientific association in 1929. Today it has more than 3900 members in over 90 countries. IABSE's mission is to promote the exchange of knowledge and to advance the practice of structural engineering worldwide. IABSE organizes conferences and publishes the quarterly journal *Structural Engineering International*, as well as conference reports and other monographs, including the SED series. IABSE also presents annual awards for achievements in structural engineering.

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## Sustainable Structural Engineering

Sustainability is the defining challenge for engineers in the twenty-first century. In addition to safe, economic, and efficient structures, a new criterion, *sustainable*, must be met. Furthermore, this new design paradigm—addressing social, economic, and environmental aspects—requires prompt action. In particular, mitigation of climate change requires sustainable solutions for new as well as existing structures. Taking from both practice and research, this book provides engineers with applicable, timely, and innovative information on the state-of-the-art in sustainable structural design.

This *Structural Engineering Document* addresses safety and regulations, integration concepts, and a sustainable approach to structural design. Life-cycle assessment is presented as a critical tool to quantify design options, and the importance of existing structures—in particular cultural heritage structures—is critically reviewed. Consideration is also given to bridge design and maintenance, structural reassessment, and disaster risk reduction. Finally, the importance of environmentally friendly concrete is examined. Consequently, structural engineers are shown to have the technical proficiency, as well as ethical imperative, to lead in designing a sustainable future.

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