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IntechOpen Series
Civil Engineering, Volume 15

Facade Engineering
Concepts, Materials, Techniques
and Principles of Construction

Edited by Silvia Brunoro



Facade Engineering
- Concepts, Materials,
Techniques and Principles
of Construction

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Published in London, United Kingdom

Facade Engineering – Concepts, Materials, Techniques and Principles of Construction

<http://dx.doi.org/10.5772/intechopen.1007223>

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Contributors

Fabio Conato, Giacomo Di Ruocco, Habtamu Bayera Madessa, Iliaria Spasari, Luca Morganti, Mary Ben Bonham, Rubén Rodríguez Elizalde, Tatsuhiro Yamamoto

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First published in London, United Kingdom, 2025 by IntechOpen

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British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library

Facade Engineering – Concepts, Materials, Techniques and Principles of Construction

Edited by Silvia Brunoro

p. cm.

This title is part of the Civil Engineering Book Series, Volume 15

Topic: Construction Engineering

Series Editor: Assed Haddad

Topic Editor: Amin Akhnoukh

Print ISBN 978-1-83635-094-1

Online ISBN 978-1-83635-093-4

eBook (PDF) ISBN 978-1-83635-095-8

ISSN 3029-0287

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Civil Engineering
Volume 15

Aims and Scope of the Series

Civil engineering is a traditional field of engineering from which most other branches of engineering have evolved. It comprises traditional sub-areas like transportation, structures, construction, geotechnics, water resources, and building materials. It also encompasses sustainability, risk, environment, and other concepts at its core. Historically, developments in civil engineering included traditional aspects of architecture and urban planning as well as practical applications from the construction industry. Most recently, many elements evolved from other fields of knowledge and topics like simulation, optimization, and decision science have been researched and applied to increase and evolve concepts and applications in this field. Civil engineering has evolved in the last years due to the demands of society in terms of the quality of its products, modern applications, official requirements, and cost and schedule restrictions. This series addresses real-life problems and applications of civil engineering and presents recent, cutting-edge research as well as traditional knowledge along with real-world examples of developments in the field.

Meet the Series Editor



Professor Assed N. Haddad is a Civil Engineer with a degree from the Federal University of Rio de Janeiro (UFRJ) earned in 1986, as well as a Juris Doctor degree from the Fluminense University Center earned in 1993, and a Master's degree in Civil Engineering from the Fluminense Federal University (UFF) obtained in 1992. He completed his Ph.D. in Production Engineering from COPPE / Federal University of Rio de Janeiro in 1996. Professor Haddad's academic pursuits have taken him to postdoctoral stays at the University of Florida, USA in 2006; at the Universitat Politècnica de Catalunya, Spain in 2010; and at the University of New South Wales Sydney, Australia in 2019. Currently, he serves as a Full Professor at the Federal University of Rio de Janeiro. He has held visiting professorships at various institutions including the University of Florida, Universitat Politècnica de Catalunya, Universitat Rovira i Virgili, and Western Sydney University. His research expertise encompasses Civil, Environmental, and Production Engineering, with a primary focus on the following topics: Construction Engineering and Management, Risk Management, and Life Cycle Assessment. He has been the recipient of research grants from the State of Rio de Janeiro, Brazil: CNE FAPERJ from 2019 to 2022 and from 2023 to 2025. Additionally, his research grants obtained from the Brazilian Government CNP since 2012 last to this date. Professor Haddad has been involved in several academic endeavors, being the Guest Editor of the International Journal of Construction Management; MDPI's Sustainability, Energies, and Infrastructures; Associate Editor at Frontiers in Built Environment / Sustainable Design and Construction; Guest Editor at Frontiers in Built Environment / Construction Management; and Academic Editor of the Journal of Engineering, Civil Engineering Section of Hindawi. He is currently a Professor of the Environmental Engineering Program at UFRJ and the Civil Engineering Program at UFF.

Meet the Volume Editor



Silvia Brunoro is an Associate Professor of Technology in Architecture in the Department of Architecture at the University of Ferrara, where she teaches Environmental Design and the Design and Construction Laboratory. She received a Ph.D. in Technology of Architecture in 2003 and has been involved in international and national research projects and networks since 2004, with a primary focus on integrated technologies for safe, resilient, efficient, sustainable, and durable building renovation. Her primary areas of research include sustainable refurbishment, energy efficiency, and innovation in technologies and materials for façade design. She is an editorial board member and reviewer for several scientific journals (*Energy*, *Buildings*, *Sustainability*, *Energy Research and Social Science*). She is the author of several publications concerning energy efficiency and sustainable design, mainly related to the envelope of the building, such as “Energy efficiency of façades. Standards, needs and examples for the refurbishment”.

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Preface

Façades play a crucial role in architecture, as they represent the building's image. They also account for approximately 60 % of a building's energy consumption and play a crucial role in meeting energy-saving and carbon reduction targets outlined in recent global policies on Climate Change.

The building envelope is the boundary between the external and internal environments, and it is responsible for important requirements, including thermal insulation, thermal inertia, lighting, weatherproofing, load distribution, and sound insulation. In the last twenty years, façades have become increasingly complex to meet both structural and energy efficiency regulations.

“Dynamic”, “smart”, “intelligent”, “climate-active”, and “adaptive” façades using self-regulating systems to respond to changing light and weather conditions have become more and more diffuse. Multiple objectives are required for these building systems that concern the development of innovative design concepts and new technologies.

Therefore, façade systems can play a significant role in developing high-performance buildings at scale. Key criteria for selecting an appropriate façade system include structural performance, constructability, cost, and environmental impact.

This book presents a selection of research contributions from international scholars and façade experts regarding new strategies, technologies and materials of façade design, and it is divided into two sections: Section 1, *Materials and Techniques*, which offers an overview of the main solutions and façades applications, by considering glass and opaque materials and their main characteristics. Section 2, *New Technologies, Design Planning and Tools for Sustainable Design and Energy Efficiency*, focuses on innovative solutions and design procedures to improve global quality, safety, and energy efficiency.

These aspects are investigated through the application of innovative procedures to fulfil new requirements, the use of smart materials, and the development of innovative design concepts.

The selected book chapters are the result of recent research efforts by several authors, as well as the support and input from a team of experts on the topic.

I would like to gratefully acknowledge the authors and reviewers for sharing their time and experience.

Silvia Brunoro
Department of Architecture,
University of Ferrara,
Ferrara, Italy



Edited by Silvia Brunoro

Facade engineering and design is a challenging task that requires the optimal consideration and addressing of multidisciplinary issues and aspects. Over the past 15 years, Facades have become increasingly complex, with dynamic and smart Facades able to adapt to changing temperature and lighting conditions. Newly developed materials and technologies have broadened the scope of Facade functions. This book presents a selection of research contributions to provide a comprehensive overview of Facade design, focusing on material analysis, strategies, and approaches for energy-efficient Facades based on scientific sustainable principles, as well as high-performance requirements such as fire risk and heat transfer, and environmental design and process methodologies. Contributions focus on the development of new strategies for maintaining and designing traditional Facades, as well as the optimal application of new technologies for modern adaptive Facades and building envelopes.

Assed Haddad, Civil Engineering Series Editor

Published in London, UK

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IntechOpen

ISSN 3029-0287

ISBN 978-1-83635-095-8



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