Srinivasan Chandrasekaran Shailendra Kumar Seeram Madhuri *Editors* 

# Recent Advances in Structural Engineering

**Select Proceedings of NCRASE 2020** 



# Lecture Notes in Civil Engineering

### Volume 135

#### Series Editors

Marco di Prisco, Politecnico di Milano, Milano, Italy

Sheng-Hong Chen, School of Water Resources and Hydropower Engineering, Wuhan University, Wuhan, China

Ioannis Vayas, Institute of Steel Structures, National Technical University of Athens, Athens, Greece

Sanjay Kumar Shukla, School of Engineering, Edith Cowan University, Joondalup, WA, Australia

Anuj Sharma, Iowa State University, Ames, IA, USA

Nagesh Kumar, Department of Civil Engineering, Indian Institute of Science Bangalore, Bengaluru, Karnataka, India

Chien Ming Wang, School of Civil Engineering, The University of Queensland, Brisbane, QLD, Australia

Lecture Notes in Civil Engineering (LNCE) publishes the latest developments in civil Engineering (LNCE) publishes the civil Engineering (LNCE) publishes (LNCE) p Lecture Notes in Civil Engineering (Live July 1997). Though original research Civil Engineering - quickly, informally and in top quality. Though original research core of LNCF and post-proceedings represents the core of LNCF. Civil Engineering - quickly, informative and the core of LNCE, edited reported in proceedings and post-proceedings represents the core of LNCE, edited considered also be considered. reported in proceedings and post-proceedings. The reported in proceedings and post-proceedings and interest may also be considered, edited volumes of exceptionally high quality and interest may also be considered subfields. volumes of exceptionally high quarry and substance all aspects and substance for publication. Volumes published in LNCE embrace all aspects and substance for publication. Volumes published in LNCE embrace all aspects and substance for publication. Civil Engineering. Topics in the series include: publication. volumes published in subject the series include:

- Construction and Structural Mechanics
- Building Materials
- Concrete, Steel and Timber Structures
- Geotechnical Engineering
- Earthquake Engineering
- Coastal Engineering
- Ocean and Offshore Engineering; Ships and Floating Structures
- Hydraulics, Hydrology and Water Resources Engineering
- Environmental Engineering and Sustainability
- Structural Health and Monitoring
- Surveying and Geographical Information Systems Indoor Environments
- Transportation and Traffic
- Risk Analysis
- Safety and Security

To submit a proposal or request further information, please contact the appropriate

- Pierpaolo Riva at pierpaolo.riva@springer.com (Europe and Americas);
- Swati Meherishi at swati.meherishi@springer.com (Asia except China, - Wayne Hu at wayne.hu@springer.com (China).

All books in the series now indexed by Scopus and EI Compendex database!

More information about this series at http://www.springer.com/series/15087

Srinivasan Chandrasekaran · Shailendra Kumar · Seeram Madhuri Editors

# Recent Advances in Structural Engineering

Select Proceedings of NCRASE 2020



Editors
Srinivasan Chandrasekaran
Department of Ocean Engineering
Indian Institute of Technology Madras
Chennai, Tamil Nadu, India

Seeram Madhuri Department of Civil Engineering National Institute of Technology Jamshedpur Jharkhand, India Shailendra Kumar

Department of Civil Engineering Guru Ghasidas Vishwavidyalaya Bilaspur, Chhattisgarh, India

ISSN 2366-2557 ISSN 2366-2565 (electronic)
Lecture Notes in Civil Engineering
ISBN 978-981-33-6388-5 ISBN 978-981-33-6389-2 (eBook)
https://doi.org/10.1007/978-981-33-6389-2

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2021

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.

The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

#### **Lecture Notes in Civil Engineering**

Srinivasan Chandrasekaran · Shailendra Kumar · Seeram Madhuri Editors

## **Recent Advances in Structural Engineering**

**Select Proceedings of NCRASE 2020** 

The book presents the select proceedings of National Conference on Recent Advances in Structural Engineering (NCRASE 2020). Various topics covered in this book include advanced structural materials, computational methods of structures, earthquake resistant analysis and design, analysis and design of structures against wind loads, pre-stressed concrete structures, bridge engineering, experimental methods and techniques of structures, offshore structures, composite structures, smart materials and structures, port and harbor structures, structural dynamics, high rise structures, sustainable materials in the construction technology, advanced structural analysis, extreme loads on structures, innovative structures, and special structures. The book will be useful for researchers and professional working in the field of structural engineering.



▶ springer.com