Foundation Systems for High-Rise Structures

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Preface

Various urban areas in the world are experiencing scarcity of land, and the spatial expansion of buildings and structures is becoming increasingly problematic. High-rise structures are the only solution to this problem. The design, construction, and performance of such high-rise structures mostly depend on the stability of the foundation systems. High-rise structures, such as the Burj Khalifa building in Dubai or the proposed Kingdom Tower in Jeddah, depend upon the performance of their foundation systems. This book is the first to assemble the latest research on the analysis, design, and construction of such foundation systems for high-rise structures.

Based on the authors' own scientific research and extensive experience, and those of researchers from engineering practices, *Foundation Systems for High-Rise Structures* presents the theoretical basics of the analysis and design of all types of foundation systems and explains their application in completed construction projects.

This book deals with the geotechnical analysis and design of all types of foundation systems for high-rise buildings and other complex structures with a distinctive soil–structure interaction. The basics of the analysis of stability and serviceability, necessary soil investigations, important technical regulations, and quality and safety assurance are explained, and possibilities for optimized foundation systems are given. Additionally, special aspects of foundation systems, such as geothermally activated foundation systems and the reuse of existing foundations, are described and illustrated. To complete this book, a comprehensive chapter on the analysis and design of foundation systems and the dynamic behavior of foundation systems for high-rise structures has also been included.

At the end of each chapter, the reader finds an overview of the references used, which is helpful for finding additional information in high-quality literature. To understand the boundary conditions for analysis and design of foundation systems, the standards and regulations are named as well. Due to the complexity of the analysis, design, and construction of the combined pile-raft foundation (CPRF), international guidelines on CPRFs by the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) are also included in the Appendix.

The authors thank Mr. Ashutosh Kumar of IIT Bombay for helping to assemble the contents of the chapter about the dynamic behavior of foundation systems. The authors also thank CRC Press/Taylor & Francis Group for publishing this book for professionals in engineering practice and for students and faculty members who will be working in the future in this special field of application.

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Deepankar Choudhury is a professor at the Department of Civil Engineering at the Indian Institute of Technology Bombay, Mumbai, India, and adjunct professor at the Academy of Scientific and Innovative Research, New Delhi, India. He is an Alexander von Humboldt fellow of Germany, JSPS fellow of Japan, TWAS-VS fellow of Italy, BOYSCAST fellow of India, fellow of the Indian Geotechnical Society, and fellow of the Indian Society for Earthquake Technology. He is an internationally known academic and researcher with expertise in geotechnical earthquake engineering, foundation engineering, computational geomechanics, and dynamic soil–structure interaction. He serves as editorial board member of various reputable journals, including *ASCE International Journal of Geomechanics*, *Canadian Geotechnical Journal*, *Indian Geotechnical Journal*, and *INAE Letters*. He is secretary of the technical committee TC 207 – Soil–Structure Interaction and Retaining Walls, former secretary of TC 212 – Deep Foundations, a member of TC 203 of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE), and a member of International Building Code (IBC) 1803 on Foundations of USA. A globetrotter, he has given several keynote, plenary, and invited lectures across the world, published several papers in reputable journals, supervised many doctoral and masters students, and been involved in various national and international projects of importance and practical significance. More details about him are available at http://www.civil.iitb.ac.in/~dc/.

Rolf Katzenbach is the director of the Institute and Laboratory of Geotechnics at the Technische Universität Darmstadt, Germany. He is a board member of several international and national organizations. He is a member of the chamber of engineers, a publicly certified expert of geotechnics, and an independent checking engineer providing expertise for national and international courts of justice, arbitration committees, insurance companies, state ministries, building authorities, and large national and international financial institutions and investors. He is responsible for the successful application of the Combined Pile-Raft Foundation at important projects all over the world, and he is a respected specialist for retaining

systems, slope stability, and underground constructions, including tunnels for metro systems and high-speed railway lines.

Steffen Leppla is a scientific research assistant at the Institute and Laboratory of Geotechnics at the Technische Universität Darmstadt, Germany. He has worked on several national and international major geotechnical engineering projects concerning high-rise buildings, tunneling, and large mine heaps. His research topics are soil–structure interaction, anchor systems, and salt mechanics as well as the construction and engineering inspection of tunnels. Since 2013, he has been a certified, independent expert and proof engineer for the geotechnics of underground metro systems and tramways. In addition to his research activity at TU Darmstadt, he is currently a visiting professor at St. Petersburg Polytechnic University in Russia.