

# IFCEE 2021

GSP 325

## From Traditional to Emerging Geotechnics

Selected Papers from the  
International Foundation Congress and Equipment Expo 2021  
Dallas, Texas ■ May 10–14, 2021

Edited by

Chadi El Mohtar, Ph.D.;  
Stacey Kulesza, Ph.D.; Tugce Baser, Ph.D.;  
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GEOTECHNICAL SPECIAL PUBLICATION NO. 325

# IFCEE 2021

## *FROM TRADITIONAL TO EMERGING GEOTECHNICS*

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SELECTED PAPERS FROM SESSIONS OF THE INTERNATIONAL  
FOUNDATIONS CONGRESS AND EQUIPMENT EXPO 2021

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May 10–14, 2021  
Dallas, Texas

SPONSORED BY  
International Association of Foundation Drilling  
Deep Foundations Institute  
Pile Driving Contractors Association  
The Geo-Institute of the  
American Society of Civil Engineers

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# Preface

This is the third volume of four Geotechnical Special Publications (GSPs) containing papers from the 2021 International Foundations Congress and Equipment Expo (IFCEE21) held in Dallas, Texas on May 5–10, 2021. This volume includes a wide variety of topics from advances in traditional geotechnical engineering to innovative approaches for characterization of soil behavior and improvement of soil properties at multiple scales. As the world moves into further into the digital and stranger times where a new normal is currently being defined, the authors contribute to the challenges in new-era educational approaches in this volume. The IFCEE conference series combines a technical conference and equipment show dedicated to the design and construction of foundation systems, using the latest geoenvironmental and geoconstruction technologies and practices. The IFCEE conference series is a one of a kind event that attracts attendees from around the world for the world's largest equipment exposition dedicated solely to the deep foundations industry. This Congress combined the 2021 annual meetings of ASCE's Geo-Institute, the International Association of Foundation Drilling (ADSC), the Pile Driving Contractors Association (PDCA) and the Deep Foundations Institute (DFI). This event was the fourth Congress in the IFCEE conference series, following the successful 2009, 2015, and 2018 meetings, in which these leading geotechnical and geotechnical-related organizations joined together for a single and singular annual congress. IFCEE'21 provided an international forum despite the unusual times to discuss technological advances, case histories, and present challenges and emerging topics related to geotechnical and foundation engineering. The congress was attended by a wide range of geo-professionals including engineers, contractors, academicians, equipment manufacturers, geo-technologists, researchers, and service, material, and tooling suppliers.

This publication culminates two years of effort by the technical planning committee whose focus has been to continue the success of the previous meetings in the IFCEE conference series. Many individuals are responsible for the content of this volume, all of whom served in the efforts to maintain the standard set by previous proceedings. An international call for papers and a rigorous peer review process yielded 189 accepted technical papers, that were presented in 36 sessions, in addition to invited keynote presentations. Papers were reviewed in accordance with ASCE GSP standards. Accordingly, each paper was subjected to technical review by two or more independent peer reviewers. Publication requires concurrence by at least two peer reviewers.

The year 2020 has opened a global outpouring for a change, exposing some of the most insidious elements of the health and societal regime to public examination. Despite the difficulties, the Editors worked hard with the members of the organization committee and session chairs closely. The Editors would like to express their appreciation for having been provided the opportunity to be a part of this Congress' organization, their sincere thanks to the numerous session chairs and reviewers, and they hope that these proceedings will be of use to the geotechnical engineering community for many years to come.

## The Editors,

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