IFCEE 2021

GSP 326

Geoenvironmental Engineering, Geomaterial Modeling, Transportation Geotechnics, and Case Histories

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.;
and Michael D. Venezia, P.E.

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

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Dallas, Texas

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Deep Foundations Institute
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Preface

This is the fourth 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 case histories from around the world on topics such as applied geophysics for infrastructure and novel solutions for stabilizing historical structures. This volume also includes state-of-the-art research papers on topics related to soil properties and modeling, transportation geotechnics, and geoenvironmental engineering. The IFCEE conference series combines a technical conference and equipment show dedicated to the design and construction of foundation systems, using the latest geoengineering 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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Optimizing Construction Processes in Special Foundation Engineering with New Process Documentation Instruments

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ABSTRACT

The optimization of all construction processes rests on the exact recording of data. But until recently, especially in Germany as well as in other places around the world, work processes in special foundation engineering were roughly jotted down by hand. Until now, a reliable and well-founded determination of detailed key performance indicators was only possible with a great deal of effort. If, for example, process times were to be recorded on a bored pile construction site, an additional employee was needed since the operator of the device, in addition to operating his highly complex machine, had no way of documenting his work steps with sufficient accuracy. Today's special foundation engineering machines allow data to be comprehensively recorded and sent to servers. The article provides an introduction to a system that, on the one hand, enables any construction processes whatsoever to be documented and, on the other hand, reduces the need for manual entries on the part of the machine operator to an absolute minimum. The new concept intelligently couples the machine with a cloud in real time using the latest IT in order to guarantee access to the current data inventory of the equipment at all times. Using the method presented in the article, the machine's current process is determined on the basis of these data, whereby missing data are requested for manual entry via an alternative communication channel. In order to effectively manage highly dynamic process changes on a typical special foundation site, algorithms and approaches from theoretical computer science have been implemented, which enable dynamic adaptation to such process modifications. In this way, the operating status for suitable processes can be automatically determined under ideal conditions and the data is recorded in full. The concept also involves the realization of cooperative work between operator and (special foundation engineering) machines, enabling interaction between operator and machine, and thus minimizing the effort needed for documentation purposes. The key performance indicators are thus based on measured values (sensor data from special foundation engineering machines). As part of the article, the results and findings from construction site operations are presented and optimization cases are explained.

INTRODUCTION

The dynamic upward trend in construction happening around the world will continue into the next decades. The principal driving forces are the explosion in the earth's population and the breakneck speed of urbanization. Worldwide, more than 1.7 billion people are younger than 20 years of age. Most of them were born in rural areas and will soon move to urban centers. The total volume of construction work during the industrialization period from 1800 to around 1950,

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