IFCEE 2024

GSP 355

Earth Retaining Systems, Ground Improvement, and Seepage Control

Selected Papers from the International Foundations Congress and Equipment Expo 2024

Dallas, Texas | May 7–10, 2024

ASCE

EDITED BY

Diane M. Moug, Ph.D.

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Preface

This is the second volume of two Geotechnical Special Publications (GSP) containing papers from the 2024 International Foundations Congress and Equipment Expo (IFCEE) proceedings. This volume, *Earth Retaining Systems, Ground Improvement, and Seepage Control*, contains papers that cover advances and case histories of earth retaining systems, including excavations and slope stability, and ground improvement and seepage control, including polymer-amended soil, soil-cement mixing, and rigid inclusions.

This IFCEE was held in Dallas, Texas, from May 7 to 10, 2024. The 2024 IFCEE was organized in partnership by the International Association of Foundation Drilling (ADSC), Deep Foundations Institute (DFI), Geo-Institute of ASCE (G-I), and Piledriving Contractors Association (PDCA). The 2024 event is the sixth IFCEE, following previous meetings in 2009, 2012, 2015, 2018 and 2021. IFCEE is a landmark event for industry leaders to share the most current developments in equipment, design, and research with an international audience representing contractors, engineers, researchers, government agencies, students, and other geo-professionals. In addition to technical sessions, special sessions, and keynote lectures, the event includes a large indoor and outdoor exhibition to showcase services and equipment advances and capabilities.

IFCEE 2024 and the technical proceedings represent two years of planning by the partner organizations and the technical program committee. All papers in the proceedings were compiled after an international call for abstracts, abstract review by the technical program committee, and a peer review process that followed the ASCE GSP standards. Each paper was accepted into the proceedings after receiving two favorable reviews by peer reviewers. The paper review process was managed by the five technical track chairs. These proceedings include 94 technical papers that were presented at IFCEE 2024 in 15 technical sessions and a poster session, in addition to keynote presentations and special sessions.

As the Editor of these proceedings, I would like to express sincere thanks for the opportunity to be part of IFCEE's organization and compilation of these proceedings. The IFCEE and proceedings are only possible due to substantial time and effort contributed by the partner organizations, technical program committee, and session moderators. Particular thanks must be given to those who facilitated and contributed to the peer review process. I hope that these technical proceedings will serve the foundation construction industry's continued advancement and be of use to the geotechnical engineering community over the coming years.

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Numerical Analysis to Investigate the Static and Dynamic Performance of GRS Bridge Abutments

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ABSTRACT

This research study involves two numerical models representing the realistic field conditions of GRS bridge abutments to investigate the static and dynamic response of these structures. The accuracy of the simulation was assessed first against the results of instrumented and monitored GRS systems in static condition and then was evaluated in dynamic analysis under harmonic base acceleration up to 0.4 g. To capture the wall behavior accurately during construction, the numerical simulation was developed within several steps, including placement of the facing blocks following by the backfill soil layer-by-layer, representing the bottom-up construction stages. The numerical analysis was found to give reasonably accurate prediction of the experimental results at both the end of construction and after the dynamic load was applied.

INTRODUCTION

In a geosynthetic reinforced soil (GRS) bridge abutment, the traffic loads and the bridge deck are directly applied on top of the GRS wall. GRS bridge abutments are mostly used as alternatives to conventional pile-supported bridge abutments (Helwany et al. 2003). Due to their advantages in terms of lower construction and maintenance costs, speed of construction, and ability to adapt to site geometry and geotechnical conditions in comparison with their counterparts, the use of GRS bridge abutments has expanded as a critical component of transportation systems. Because the Federal Highway Administration's (FHWA) primary design method is based on the allowable bearing capacity of the soil-reinforcement composite mass and an empirical design process (Adams and Nicks 2018), the seismic resistance of GRS structures may be attributed to the high level of such a conservative design procedure. This is mostly related to the high safety factor in these structures' static design. (Ling et al. 1997). In this context, given the growing use of GRS walls and abutments, as well as progressive design approaches that inevitably reduce the safety factor to save money and time, the seismic response of such structures to ground vibrations has remained understudied (Fakharian and Attar 2007 and Ling et al. 1997).

Lee and Chang (2012) conducted comprehensive parametric studies on a GRS wall under different earthquake time history records. Their findings highlighted the significance of facing displacements at the wall crest and maximum tensile load in the highest geogrid layer. They identified block separation as one of the primary failure modes following earthquake loads. Additionally, they suggested that reducing the vertical spacing of the reinforcement would lead to decreased lateral displacements of the facing. In the study conducted by Ling et al. (2005), an examination was carried out on a GRS wall subjected to sinusoidal seismic horizontal motion with an acceleration amplitude of 0.2 g. The findings revealed a significant influence of the vertical spacing of reinforcements on the lateral deformations of the facing. Building upon this,

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