

Geotechnical Frontiers 2025

GSP 363

Geotechnical Infrastructure

Selected Papers from Geotechnical Frontiers 2025
Louisville, Kentucky • March 2–5, 2025

Edited by
Melissa S. Beauregard, Ph.D., P.E., ENV SP
Aaron S. Budge, Ph.D., P.E., BC.GE

ASCE
G-I GEO-INSTITUTE ASCE

GEOTECHNICAL SPECIAL PUBLICATION NO. 363

GEOTECHNICAL FRONTIERS 2025

GEOTECHNICAL INFRASTRUCTURE

SELECTED PAPERS FROM SESSIONS OF GEOTECHNICAL FRONTIERS 2025

March 2–5, 2025
Louisville, Kentucky

SPONSORED BY
Geosynthetic Materials Association
Advanced Textiles Association
The Geo-Institute
of the American Society of Civil Engineers

EDITED BY
Melissa S. Beauregard, Ph.D., P.E., ENV SP
Aaron S. Budge, Ph.D., P.E., BC.GE

Published by the American Society of Civil Engineers

Published by American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, Virginia, 20191-4382
www.asce.org/publications | ascelibrary.org

Any statements expressed in these materials are those of the individual authors and do not necessarily represent the views of ASCE, which takes no responsibility for any statement made herein. No reference made in this publication to any specific method, product, process, or service constitutes or implies an endorsement, recommendation, or warranty thereof by ASCE. The materials are for general information only and do not represent a standard of ASCE, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or any other legal document. ASCE makes no representation or warranty of any kind, whether express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assumes no liability therefor. The information contained in these materials should not be used without first securing competent advice with respect to its suitability for any general or specific application. Anyone utilizing such information assumes all liability arising from such use, including but not limited to infringement of any patent or patents.

ASCE and American Society of Civil Engineers—Registered in U.S. Patent and Trademark Office.

Photocopies and permissions. Permission to photocopy or reproduce material from ASCE publications can be requested by sending an e-mail to permissions@asce.org or by locating a title in ASCE's Civil Engineering Database (http://cedb.asce.org) or ASCE Library (http://ascelibrary.org) and using the "Permissions" link.

Errata: **Errata, if any, can be found at https://doi.org/10.1061/9780784485965**

Copyright © 2025 by the American Society of Civil Engineers.
All Rights Reserved.
ISBN 978-0-7844-8596-5 (PDF)
Manufactured in the United States of America.

Preface

This is the first volume of six Geotechnical Special Publications (GSPs) containing papers from the Geotechnical Frontiers 2025 Conference held in Louisville, Kentucky on March 2-5, 2025. Geotechnical Frontiers occurs every six years and is the merging of the Geosynthetics Conference and the annual Geo-Congress replacing both events in 2025. This popular event is where the geotechnical, civil and geo-professional communities unite to share developments in geotechnical engineering and technologies. The four-day event featured more than 200 exhibits, plus a comprehensive program of short courses, panel discussions, round table discussions, technical paper lectures and posters presented by top industry experts as well as the industry's most influential plenary speakers. Geotechnical Frontiers 2025 was organized by the Advanced Textile Association's Geosynthetic Materials Association and the American Society of Civil Engineer's Geo-Institute. 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 Geotechnical Frontiers 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 nearly 300 accepted technical papers that were presented in 37 technical and special 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 Editors would like to express their appreciation for having been provided the opportunity to be a part of this Congress' organization along with their sincere thanks to the numerous session chairs and reviewers. We hope that these proceedings will be of use to the geotechnical engineering community for many years to come.

The Editors,

Melissa S. Beauregard, Ph.D., PE, ENV-SP, M.ASCE, U.S. Army Corps of Engineers

Aaron S. Budge, Ph.D., PE, BC.GE, M.ASCE, Minnesota State University, Mankato

© ASCE

Acknowledgments

Thanks are due to the authors, primary reviewers, session chairs, and program committee, without whom this publication would not be possible.

Geotechnical Frontiers 2025 Conference Program Committee

Program Committee Chair
Daniel Alzamora, PE | Federal Highway Administration

Technical Program Co-Chairs
Melissa Beauregard, Ph.D., PE, ENV-SP | US Army Corps of Engineers
Aaron S. Budge, Ph.D., PE, BC.GE | Minnesota State University, Mankato

Technical Program Committee
John Lostumbo, PE | Solmax
Michelle L. Barry, Ph.D., PE | University of Arkansas
Stan Boyle, Ph.D., PE | Shannon & Wilson, Inc.
Sara Khoshnevisan, Ph.D. | University of Cincinnati
L. Sebastian Bryson, Ph.D., PE, D.GE, F.ASCE | University of Kentucky
Samantha Schardein, PE | US Army Corps of Engineers
Brad Keelor | Geo-Institute
Fred Chuck, PE | Geosynthetics Materials Association
Barbara Connett | Advanced Textiles Association

Proceedings Editors
Melissa Beauregard, Ph.D., PE, ENV-SP | US Army Corps of Engineers
Aaron S. Budge, Ph.D., PE, BC.GE | Minnesota State University, Mankato

© ASCE

Contents

Embankments, Dams, and Slopes

Site-Specific Seismic Coefficient for Slopes and Earthquake-Induced Deformations 1
Mahmood Seid-Karbasi and Roberto Olivera

Steel Slag Utilization in Levee Drainage Trenches for Climate Resilience 18
Joseph Schulenberg, Jagadeesh Kumar Janga, and Krishna R. Reddy

Effects of Pollutants on Soil Shear Strength Parameters and Slope Stability 28
Seyed A. Osia and Daniel R. VandenBerge

Laboratory Investigations on Infrared Thermography-Based Seepage Detection in Earthen Dams 38
Vaishnavi Bherde and Umashankar Balunaini

Numerical Study of the Effect of Rainfall on the Stability of an Unsaturated Clay Slope 46
Rupsa Roy, Beena Ajmera, and Binod Tiwari

Evaluating Landslide Occurrences in North Dakota—Traditional Interpretation versus Multivariate Logistic Regression Analysis 56
Yuderka Trinidad Gonzalez, Beena Ajmera, Amanda Sampaio, and Benjamin Shafer

Case Histories of Two Recent Slope Failures: Lessons Learned and Future Recommendations 69
Ayush Kumar, Nripojyoti Biswas, and Anand J. Puppala

An InSAR-Based Remote Sensing Approach for Monitoring Levee Deformation—A Case Study of Lake Tholocco, Alabama 84
Ghorbani Zahra, Khosravi Ali, Maghsoudi Yasser, and Ethan T. Vroman

Probabilistic Modeling of Earthen Levees Considering Variability in Flood Hydrographs and Hydraulic Properties of Unsaturated Soils 94
Julio Copana, Meraj Sohrabi, Farshid Vahedifard, and Hamed Moftakhari

Reliability Analysis of Consolidation Settlement of Earthen Embankment Dams 105
Aseel Y. Ahmed, Andrzej S. Nowak, Bryan P. Kumm, and Stephen P. Matychuk

Numerical Prediction of Weather-Induced Embankment Failures 117
Amr M. Morsy and Peter R. Helm

© ASCE

3D Numerical Analysis of the Seismic Response of a Clay-Core Rockfill Dam under Drought....128
Hossein Bahmyari, Mohsen Ajdari, and Mohammad Parang

Soil Response and Modeling of Soft Soil Subgrades under Cyclic Rail Loading 139
Buddhima Indraratna, Bin-Hua Xu, and Cholachat Rujikiatkamjorn

Revisiting the Global Stability Analysis of Column-Supported Embankments 150
Danilo Botero Lopez, Aaron Gallant, and Michael McGuire

Highways and Bridges

A Numerical Study on the Effectiveness of Driven Sheet-Pile Walls as Barriers to Reduce Settlement in Preexisting Structures due to Adjacent Loading....163
Sukrityranjan Samanta, Alba Yerro, and Reihaneh Hosseini

Pelican Creek Bridge Replacement Project—Yellowstone National Park, Wyoming....174
Evan Garich and Brian Collins

Soil Arching Efficiencies in Load Transform Platforms of Column-Supported Embankments....189
James A. McKelvey III, Miguel A. Pando, and Mailei Schechterly

Performance of Lightweight Aggregate Backfilled Geosynthetic Reinforced Soil Piers under Axial Load 201
Christian H. Matemu, Joshua Vincent, Scott Wasman, and Larry Jones

Management of Resilient Infrastructure

Development of Novel DFOS-Embedded Ground Anchor for Resilient Design and Construction 216
Maksymilian Jasiak, Shih-Hung Chiu, Chien-Chih Wang, Kenichi Soga, Wonjun Cha, Deh-Jeng Jang, Jinho Park, Seungwoon Han, Keegan Arnt, and Bernhard Froemel

Pavements

In Situ Stiffness Evaluation of Full-Depth Reclaimed Asphalt Pavements with Portable Field Tests 226
Victor M. Garcia, W. Jeremy Robinson, and Margarita Ordaz

Seasonal Moisture Dynamics in Northeast Subgrade Soils: Insights from Central New York Instrumentation....237
Asif Ahmed, Md. Azijul Islam, Md. Jobair Bin Alam, and Sathvika Katikaneni

© ASCE

Use of Laser-Based Method for Measuring Small Strains in Geomaterials under Repetitive Loads in Triaxial Environment 248
Sopharith Chou, Kyle Parr, Nripojyoti Biswas, and Anand J. Puppala

Advanced Spectroscopic Analysis Technique for the Development of Aging Index Chart for Asphalt Binder 258
Adnan Sadiq, Saad Ullah, and Debanjana Ghosh

Validation of Custom-Built Accelerometers for Monitoring the Process of Soil Compaction 269
William J. Baker III, Siamak Yoosefi, Mohammadreza Jebeli, and Christopher L. Meehan

Initial Approach to Develop Balanced Mix Design Method in New Mexico 281
M. S. Hossain, M. M. Hasan, B. S. P. Biswas, M. T. Alam, and R. A. Tarefder

Use of Shear Wave Velocity to Evaluate Curing of Cement-Stabilized Carbonate Quarry By-Products at Different Temperatures 292
Taeyun Kong, Chirayu Kothari, Youngdae Kim, Issam I. A. Qamhia, Erol Tutumluer, and Nishant Garg

A Comparative Study on Effectiveness of Geogrid and Geotextile Reinforcement in Expansive Subgrades of Flexible Pavements 303
Sundaram Srivastava and Umashankar Balunaini

Cyclic Loading Type Effect on Performance of Base Aggregates with 12% Fines under High Stress Ratio 314
Nirajan Khanal, Abdolreza Osouli, Gokul Khatri, and Ashish Aryal

Coupled Effect of Ground Granulated Blast Slag and Bagasse Fibers to Enhance the Compressive Strength and Durability Characteristics of Expansive Soil 323
Mohammad Nuruddin, Arif Ali Baig Moghal, Romana Mariyam Rasheed, Ghatta Geetha Krishna Sravya, Ravuri Balaramakrishna, and Yebushi Vyshnavi

Cellulose Nanocrystal Modified Bitumen Pavement Materials 332
Isaac L. Howard, Amanda Hufft, and Gregory T. Schueneman

Evaluating the Resilient Performance of Unpaved Road Materials under Freeze-Thaw Effects 342
Celso Santos, Umar Farooq, Bora Cetin, Jeramy Ashlock, Mahsa Belalzade, and Kanika Lamba

Structural Evaluation of Substandard Asphalt Pavements with Falling Weight Deflectometer Data 352
Jeremiah M. Stache, Victor M. Garcia, W. Jeremy Robinson, and Brendon Quon

© ASCE

Underground Engineering and Construction

Evaluation of Engineering Properties of Portland Limestone Cement-Based Systems and Their Application for Underground Infrastructure.....363
Md. Maruf Hasan, Felix Oppong, Matthew P. Adams, and Oladoyin Kolawole

Investigating the Effect of Wall Friction on Tunnel Testing Results.....372
Thuyet Nguyen, Jiro Kuwano, Thang Pham, and Yota Togashi

© ASCE

Site-Specific Seismic Coefficient for Slopes and Earthquake-Induced Deformations

Mahmood Seid-Karbasi, Ph.D., P.Eng.[1]; and Roberto Olivera, Ph.D., P.Eng.[2]

[1]Principal and Geotechnical Engineer, WSP Canada, Inc., Vancouver, BC, Canada.
Email: mahmood.seid-karbasi@wsp.com
[2]Senior Principal and Geotechnical Engineer, WSP Canada, Inc., Vancouver, BC, Canada.
Email: roberto.olivera@wsp.com

ABSTRACT

Earthquakes are a major concern for the stability and performance of natural slopes, man-made excavations, and other earth structures such as dams and embankments. Conventionally, pseudo-static analysis and Newmark-type procedures are used for assessing the seismic performance of slopes from where displacement estimates are obtained. Limit equilibrium methods utilize a seismic coefficient based on a code or guidelines presented in the technical literature. This paper presents the results of a series of site response analyses using the computer program FLAC^{2D} carried out for a steep 300 m high rock slope reinforced with multiple anchors. The results of the site response simulations are used to define a site-specific seismic coefficient for use in limit equilibrium pseudo-static analyses. The paper also compares the results of this study with available data from similar ground conditions.

Keywords: *Dynamic Analysis, Seismic Coefficient, Newmark-Displacement Procedures, Rock Anchors, Steep Slopes, Earthquakes*

INTRODUCTION

Earthquakes remain a major hazard concern for the stability and performance of natural slopes, man-made excavations and other earth structures such as dams and embankments, particularly with steep slopes. Earthquake loading is considered one of two possible extreme events (Lorig, 2016) when engineering open pit slopes. There are numerous case histories where earthquake loading has caused large displacements in slopes and earth embankments. In the past, pseudo-static analysis and Newmark-type procedures (Newmark, 1965) have been used for assessing the seismic performance of slopes (e.g., Sarma, 1975, Makdisi & Seed, 1978) with the assumption that these methods provide an accurate estimate of earthquake-induced displacements. These procedures consider a seismic coefficient, defined in terms of a fraction of gravitational acceleration acting in horizontal direction, acting within a defined sliding mass. This approach was proposed by Terzaghi (1950) based on shear-beam concept by Mononobe et al. (1936) and since then has been widely used by geotechnical engineers due to its simplicity (Seed 1979) and ease of use in stability programs. In the original Newmark method (1965), acceleration was considered constant within the sliding mass, however, determining a representative value is challenging as accelerations vary with time and within the slope as seismic waves propagate towards the surface as depicted in Figure 1.

Over the years, many improvements and modifications have been proposed to original procedure by Newmark (e.g., Sarma 1975; Makdisi & Seed, 1978; Franklin & Chang 1977; Hynes-Griffin & Franklin 1984; Ambraseys & Menu 1988; Yegian et al. 1991; Kramer & Smith,

© ASCE