

Geo-Congress 2024

Geotechnical Data Analysis and Computation

Selected Papers from Sessions of Geo-Congress 2024

Geotechnical Special Publication Number 352

Vancouver, Canada
25 – 28 February 2024

Editors:

T. Matthew Evans

Nina Stark

Susan Chang

ISBN: 978-1-7138-9220-5

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2024) by American Society of Civil Engineers
All rights reserved.

Printed with permission by Curran Associates, Inc. (2024)

For permission requests, please contact American Society of Civil Engineers
at the address below.

American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, VA 20191
USA

Phone: (800) 548-2723
Fax: (703) 295-6333

www.asce.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

Contents

Computational Geotechnics

Investigating the Potential of the Material Point Method to Model the Run-Out Behavior Observed in Centrifuge Experiments.....	1
Mengchen Wang, Yidong Zhao, Srikanth S. C. Madabhushi, and Jinyun Choo	
Discrete Element Analysis of Strike-Slip Surface Fault Rupture	10
Fernando E. Garcia	
Multi-Scale Study of Specimen Size Effect on Shear Strength of Polydisperse Granular Materials Using DEM	20
David Cantor and Carlos Ovalle	
Implementation of a Thermomechanical Clay Constitutive Model in Finite Element Analysis Framework.....	31
Irfan Ahmad Shah, Prasenjit Basu, and Santiram Chatterjee	
The Effect of Biopolymer Pore Fluids on Soil Properties Using Molecular Dynamics Simulations	41
Shoumik Saha, Dilip Gersappe, and Sherif L. Abdelaziz	
Application of Ensemble-Based Methods for Prediction of Undrained Shear Strength of Soft Sensitive Clays.....	52
Vaishnavi Bherde, Koushik P M V, and Umashankar Balunaini	
Multiphysics Simulation of the Effects of Wicking Geotextile on Mitigating Frost Effects on Cold Region Pavement	62
Yusheng Jiang, Zaid Alajlan, Claudia Zapata, and Xiong (Bill) Yu	
Extraction-Induced Deformation in the Gas Hydrate Reservoir Using a Multiphase-Coupled THMC Solver	72
Sahil Wani, Rahul Samala, Ramesh Kannan Kandasami, and Abhijit Chaudhuri	
Numerical Simulation of High-Speed Penetration of Munitions in Clay	82
Boules N. Morkos, Rachel White, Mehdi Omidvar, Magued Iskander, and Stephan Bless	
Applicability of MCC and CASM-Based Structured Soil Models	92
Balaji Bandaru, Ramesh Kannan Kandasami, and R. G. Robinson	
A Discrete Element Method-Based Simulation of a Block Toppling Failure on an Inclined Surface.....	101
Hooman Dabirmanesh and Attila M. Zsaki	

Comparison of DEM Software with Polyhedral Particle Shapes.....	111
Travis A. Shoemaker, Carine Tanissa, and Youssef M. A. Hashash	
Effect of Inherent Fabric on Cyclic Resistance of Granular Materials with Static Shear: A 3D-DEM Study.....	120
Ali Salehi, Ming Yang, and Mahdi Taiebat	
Three-Dimensional Coupled Stress and Fluid Flow Analysis and Design Provisions for Lake Mead Intake No. 3 Low Level Pumping Station in Fractured Rock Mass	130
Mohammad Moridzadeh	
Numerical Modeling of NATM Tunnels Pre-Supported with Umbrella Arch Method: Comparison with Field Measurements.....	140
Hakkı Erman Ergincan, Tolga Y. Ozudogru, and Irem Zeynep Yildirim	
DEM Simulations of the Seismic Response of Tunnels Embedded in Granular Deposits.....	152
Ahmed Khamiss and Usama El Shamy	
Comparison of Soil-Water Mechanisms in Hydration of Kaolinite and Montmorillonite through Molecular Dynamics Simulation	162
Jackson C. Stewart, Vance W. Jaeger, and Omid Ghasemi-Fare	
Validating the Use of Material Point Method and SANISAND Model for Relating the State Parameter with Cone Tip Resistance	172
Sara Moshfeghi, Mahdi Taiebat, and Arcesio Lizcano	
Construction of a Real-Time Hybrid Simulation Testing Facility and Validation for Offshore Wind Turbine System Behavior under Realistic Wind and Wave Loading Conditions	181
Qasim Abu-Kassab, Muhamnad T. Suleiman, Safwan Al-Subaihawi, James M. Ricles, Thomas Marullo, Richard Sause, Kevin Wyckoff, Liam Magargal, Arindam Banerjee, Justin W. Jaworski, and Mohamed Mekkawy	
Unified Slip Line Solution for Seismic Slope Stability in Cohesive-Frictional Soils Considering the Intermediate Principal Stress Effect.....	192
Shibsankar Nandi and Priyanka Ghosh	
MPM Coseismic Slope Runout Prediction Using the Intergranular Strain Anisotropy Hypoplastic Model	203
Abdelrahman Alsardi and Alba Yerro	
Numerical Modeling of the Thermal Effect on Wildfire-Burnt Quasi-Brittle Rocks.....	213
Yifei Ma and Fahd Mohammed Naimatullah Mujahid	

Effects of Landslide Sliding Surface Characteristics on the Impact Force on Rigid Structures	224
Aaditaya R. Roshan and Alba Yerro	
3D Slope Stability Analysis by Finite Element Methods	235
Edward Wei Hua Gu	
Modelling of Strip Footing Problems Using Consistent Particle Method	245
Shi-Tong Li, Chan Ghee Koh, and Yean Khow Chow	
Numerical Analysis of Two-Dimensional Tank Experiment of Microbially Induced Desaturation (MID) in Layered Silts and Sands	254
Patrick Kwon, Deepesh Karmacharya, Leon A. van Paassen, and Edward Kavazanjian	
Stability Prediction of Highway Slope on Highly Plastic Clay Using Particle Swarm Optimization (PSO)-Based Neural Network.....	264
Nobahar Masoud, Fei Han, Abolfazl Eslami, Sadik Khan, and Farshad Amini	
Estimating Critical Velocity for High-Speed Rail.....	275
Alberto Jaen-Toribio, Alice Duley, Jun Wang, Donald Anderson, and Paul Murphy	
Implementation of a New Strain Softening Constitutive Model in the Material Point Method for the Simulation of Retrogressive Failure in Sensitive Clays	286
Zinan A. Urmi, Ali Saeidi, Alba Yerro, and Rama V. P. Chavalli	
Automatic Calibration Tool for Efficient Parameter Optimization of SANISAND Models under Cyclic Loading.....	297
Sheng Zeng, Jan Machaček, and Mahdi Taiebat	
Advances in Imposing Nonconforming Neumann Boundary Conditions in the Material Point Method	307
Joel Given, Yong Liang, and Kenichi Soga	
A Coupled Finite Element Method in Slope Stability Analysis	316
Edward Wei Hua Gu	
Dynamic Response of the Shore Connection of Submerged Floating Tunnel Considering Ground Nonlinearity	325
Seok-Jun Kang, Hyun-Joong Hwang, Jin Kim, Joohyun Park, and Gye-Chun Cho	
<i>Machine Learning and AI</i>	
Three-Dimensional Granular Flow Simulation Using Graph Neural Network-Based Learned Simulator.....	335
Yongjin Choi and Krishna Kumar	

Considerations for Augmented Flood Control Infrastructure Inspection Using Convolutional Neural Networks	345
Zachary H. Nick, Joe G. Tom, and LinBin Zhang	
Sediment Characterization Based on Portable Free Fall Penetrometer Measurements Using a Deep Neural Network	354
Md. Rejwanur Rahman, Eric Hunstein, Adrian Rodriguez-Marek, Nina Stark, Grace Massey, Carl Friedrichs, Kelly M. Dorgan, and Chesna Cox	
Improved Estimation of California Bearing Ratio Value from Dynamic Cone Penetrometer Test Data Using Hierarchical Bayesian Modeling.....	364
Laith Sadik, Sara Khoshnevisan, and Lei Wang	
Differentiable Programming for Inverse Estimate of Soil Permeability and Design of Duct Banks.....	374
Anusha Vajapeyajula and Krishna Kumar	
Simplicity versus Complexity in Machine Learning Models—Focusing on Soil Resilient Modulus Prediction	386
Laith Sadik and Sara Khoshnevisan	
On the Underutilization of Artificial Intelligence Models in Geotechnical Practice	396
Brett W. Maurer and Morgan D. Sanger	
Predicting Soil Liquefaction Potential Using XGBoost Algorithm with Bayesian Hyperparameters' Optimization	406
Laith Sadik and Sara Khoshnevisan	
A Deep Learning Model to Evaluate Cracks in the Underground Structure of New Domains	415
Jin Kim, Seungbo Shim, Hyun-Joong Hwang, Joo-Hyun Seong, and Gye-Chun Cho	
Application of Deep Reinforcement Learning to Control Drainage in a Lab-Scale Geosystem	425
Aynaz Biniyaz and Zhen Liu	
Estimating In Situ Shear Wave Velocity Using Machine Learning Techniques	436
Longde Jin, Andrew Fuggle, Haley Roberts, Christian P. Armstrong, and Lina-Maria Pua	
Using Machine Learning to Predict Consolidation Parameters.....	445
Patrick A. Thurmond and H. Clay Worley	
Exploration of Feature Engineering Techniques and Unsupervised Machine Learning Clustering Algorithms for Geophysical Data on Levees.....	454
Brittany M. Russo and Adda Athanasopoulos-Zekkos	

Application of Machine Learning within an Asset Management Framework for Realizing the Impact of Trenching in Urban Environments	464
Aryan Hojjati, Reza Movahedifar, and Mehran Eskandari Torbaghan	
Co-Seismic Landslide Mobility Assessment Using Machine Learning Models	475
Jhih-Rou Huang, Dimitrios Zekkos, and Marin Clark	
Performance of Machine Learning Algorithms for Predicting Jet Grout Column Diameter.....	485
Rakam Tamang and Joseph Coe	
<i>Data and Software for Geotechnical Engineering</i>	
Leveraging Digital Tools for Efficient and Reliable Ground Characterization	495
Angela Tran, Ronak Mehrabi, Francisco Ciruela-Ochoa, Marzieh Shahraki, and Wylie Tsang	
Site Investigation Database for Geophysical and Geotechnical Data Collected on a USCS SM Soil Type	504
Katrina Burch, Wade Lein, and Dan Glaser	
Use of Orbital Synthetic Aperture Radar Data in Monitoring Geotechnical and Transportation Infrastructure Assets	513
Amit Gajurel, Anand J. Puppala, Nripojyoti Biswas, and Hiramani R. Chimauriya	
InSAR Measurements for Landslide-Induced Damage Assessment on Part of North Alabama Highway, Morgan County	523
Zahra Ghorbani, Ali Khosravi, Yasser Maghsoudi, and Behzad Voosoghi	