

# **Instrumentation, Testing, and Modeling of Soil and Rock Behavior**

**Selected Papers from the GeoHunan 2011 International Conference  
Geotechnical Special Publication No. 222**

**Hunan, China  
9-11 June 2011**

**Editors:**

**Louis Ge  
Antonio Gomes Correia**

**Xiong Zhang  
Jason Wu**

**ISBN: 978-1-61782-999-4**

**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© (2011) by the American Society of Civil Engineers  
All rights reserved.

Printed by Curran Associates, Inc. (2011)

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

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

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

[www.asce.org](http://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: 845-758-2634  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# GSP 222 Table of Contents

1 [Embedment Depth Influence on an Uplifting Anchor](#)

Jinyuan Liu and Mingliang Liu

9 [Elucidating of Uplift Behavior of Underreamed Anchor Groups in Sand](#)

Shih-Tsung Hsu

17 [Measured Building Settlements Due to Excavation in Soft Clays](#)

Yong Tan and Mingwen Li

25 [Feasibility of Using Expansive Soil As Embankment Fill in the Construction of Nanning Outer Ring Expressway: A Demonstration Study](#)

Heping Yang, Yanqiang Liu, Wentao Zhan, Jie Xiao, and Xiao Ni

33 [Rational Approximation for Uni-Dimensional Consolidation Differential Equation of Saturated Soil](#)

You Wang and Xinghua Wang

39 [Treatments against Longitudinal Cracks on Cement Concrete Pavements](#)

Jia-liang Yao and Qing-hua Weng

47 [Study on Damage of Jointed Rock Tunnel by Stochastic Fractures](#)

Wantao Ding and Shucai Li

56 [Roadbed Deformation Rule and Assessment of Slab Track on Railway Passenger Special Line](#)

Ke Wu, Mingyue Ma, Wan-Tao Ding, Chenghao Gu, and Shucai Li

62 [Characterizing the Influence of the Evolution of Length Scale on the Strain Localization in Cosserat Media](#)

X. Liu, A. Scarpas, C. Kasbergen, and E. Kondo

70 [A Consolidation Model of Soil Dealt with the Variation of Consolidation State](#)

Zhenyu Li, Hongbin Xiao, Guolin Yang, and Yonghe Wang

78 [Study on Shear Strength Tests and Uniformed Constitutive Model of Shear Stress-Shear Displacement for Unsaturated Soils](#)

Gao-Feng Chen, Deng-Hong Chen, Shen-Wei Huang, and Ying-Fa Lu

85 [Experimental and Modeling Studies of Resilient Modulus of Cohesive Soils in Shanghai](#)

Yue Tan, Liang Zhou, Xiaopin Lin, and Zhigao Liao

91 [Microscale Analysis of Direct Shear Test Using Discrete Numerical Method](#)

Xueliang Zhao

99 [Numerical Simulation of Undrained Triaxial Test Using 3D Discrete Element Modeling](#)

Gui Yang, Tao Yu, and Hanlong Liu

107 [Modeling of Rheological Behavior of Geomaterials Based on Fractional Viscoelastic Equation with Variable Parameters](#)

Yifei Sun, Hanlong Liu, Yang Xiao, Hongmei Gao, and Yunliang Cui

115 [The Ubiquitous-Joint Model and Its Application in Predicting the Strength of Stratified Rock](#)

Qinghua Zhao and Zhong-ming He

123 [Energy-Based Method for Analyzing the Collapse Characteristics of Silt Subjected to Changes of Principal Stress Orientation](#)

Jun Yan, Yang Shen, Guofa Huang, and Gui Yang

132 [Modeling the Stress-Displacement Response and Crack Behavior of a Bi-Block Ballast-Less Track under Temperature and Shrinkage Loading](#)

Xiaoyu Lou and JianHua Liu

139 [Undrained Creep Behavior of a Silty Clay in Triaxial Tests](#)

Jun-Gao Zhu, Yan-Hui Zhao, and Jian-Hua Yin

147 [Evaluation of Pre-Consolidation Stress Determination Methods](#)

Omar Conte, Stephanie Rust, Louis Ge, and Richard Stephenson

155 [Study of Effective Friction Angle of Normally Consolidated Soils](#)

Jeffery C. Chang, Jason Y. Wu, and Mingshu Lee

163 [Study of Landslides in Multilayer Soils](#)

Omar Boudlal and Bachir Melbouci

171 [Study of Interparticle Ultimate Shear Stress in Soils](#)

Jeffery C. Chang, Jason Y. Wu, and Mingshu Lee

179 [Research on Triaxial Shear Properties of Glass Fiber Cement Soil](#)

Yong Yin and Xiao-jun Yu

186 [True Triaxial Experimental Study of Stress-Induced Anisotropy of Sand](#)

Kunyong Zhang, Jai K. Jung, and Ting Zhang

194 [Properties of Circulating Fluidized Bed Combustion Ash and Pulverized Coal Bottom Ash Used for Backfill](#)

An Cheng, Hui-Mi Hsu, Sao-Jeng Chao, Ran Huang, Tsan-Ching Cheng, and Howard Hwang

---

- 202 [Frost Heave Mitigation by Incorporating Expanded Polystyrene Bead into Earth Fill](#)  
An Deng, Ya-dong Zhou, and Yong-tang Yu
- 209 [Characterization of Crushed Rock-Concrete Interface Behavior through the Parallel Gradation Technique](#)  
Domenica Cambio, Xing Kang, and Louis Ge
- 217 [Laboratory Study on Soil Shear Strength under Unloading Conditions](#)  
Jun-Ping Yuan and Hoang Viet Nguyen
- 225 [Characterizing Lateral Soil-Structure Interaction of Drilled Shaft in Rock](#)  
Ke Yang, Ehab Shatnawi, and Robert Y. Liang
- 233 [Numerical Simulation of Triaxial Test on the Dense Sand by DEM](#)  
Hong-hua Zhao, Long-tan Shao, and Shun-ying Ji
- 242 [Modeling Unbound Granular Materials under Complex Stress Paths](#)  
Cheng Chen and Louis Ge
- 248 [Creep Numerical Analysis of Bedded Rock Salt Gas Storage](#)  
Yan-lin Zhao and Ying Zhang
- 256 [Construction on Expansive Soils in Semi Arid Zone](#)  
Liaqat Ali and Zulfiqar Zafar
- 264 [Verification of Scientificity and Rationality of Three Indices for Classification of Expansive Soil Filler](#)  
Heping Yang, Bin Cheng, Wentao Zhan, Jie Xiao, and Wenjian Zhao
- 272 [Analysis on Improvement Effect of Expansive Soil by Soil-Water Characteristic Curve](#)  
Heping Yang, Cunran He, Jie Xiao, and Wentao Zhan
- 280 [Theoretical Analysis and Research on Soil Disturbance by Sampling Penetration in Soft Soil Area](#)  
Yue-dong Wu, Wei Xie, and Wen-rong Zuo
- 289 [Development of Nuclear Density Transducer for Measuring Cement Pulverized Fuel Ash Grout with High Accuracy](#)  
Wei Chen, Meng Xu, and Jianzhong Li
- 296 [A Simple Method of Rock Properties Testing](#)  
Wei Wang, Weiya Xu, Stephane Corn, and Patrick Lenny
- 305 [Pavement Premature Failure on a Moisture Susceptible Base](#)  
Dar-Hao Chen, Zhiyi Huang, and Jeffrey Lee
- 313 [A Study of Defective Roadway Infrastructure Leading to Government Compensation](#)

Tung-Tsan Chen and Yao T. Hsu

322 [Grain Incipient Motion Considering Randomness of Grain Location](#)

Liang Chen and Jiting Xu