Monday 3/13/2017

9:45–11:15 a.m.

Soil and Rock Testing and Modeling 1

Chairs: Maurice Morvant, Trautwein GeoTAC; Neil Schwanz, U.S. Army Corps of Engineers

Strain-Dependent Settlement Analysis of Heavily-Loaded Structures

John R. Davie, Bechtel Infrastructure; Jose L.M. Clemente, Bechtel NS&E; Michael R. Lewis, Bechtel Infrastructure; Tyler Liao, Bechtel Infrastructure

This paper describes the rationale behind using strain-dependent stiffness values for settlement analysis. Normalized elastic stiffness versus axial strain curves are presented for several soil types. Comparisons are made between the predicted settlement using (1) strain-dependent soil stiffness and (2) single value high-strain soil stiffness for each layer beneath a major soil-supported structure using different soil profiles. Although the predicted settlement using strain-dependent soil stiffness is smaller in each case, the differences vary depending on various factors, including the level of loading (and hence strain) in the soil, and the ratio of low-strain to high-strain elastic modulus.

Analysis of Various Drained and Undrained Instability Modes in Medium Dense Sand Subjected to Biaxial Loading Condition

Mousumi Mukherjee and Anurag Gupta, Indian Institute of Technology, Kanpur; Amit Prashant, Indian Institute of Technology, Gandhinagar

The present study theoretically explores instability behavior of medium dense sand under both drained and undrained biaxial test. The instability analysis has been posed as a plane strain bifurcation problem within a large deformation framework. A generalized pressure-dependent 3D constitutive model has been employed to simulate the drained and undrained biaxial tests on a medium dense sand sample assuming two types of lateral boundaries, namely rigid and flexible. The lateral boundary condition can influence significantly the onset of undrained soild-fluid instability and drained diffused intabilities. Localization gets delayed with increasing lateral confinement for both drained and undrained cases. Elastic parameters have strong impact on the instability onset.

Experimental Investigation on Settlement of Fills under Saturated and Unsaturated Conditions

Wen-bo Chen, Jian-Hua Yin, Lalit Borana, and Wei-Qiang Feng, Hong Kong Polytechnic Univeristy

The aviation industry in mainland china is growing rapidly and to cater to this growing demand numerous airports have been planned and constructed in the hilly and mountainous regions of mainland China. The formation of the airport is commonly based on a high embankment. The filling material for the high embankment possesses large self-weight and experiences seasonal variation in water content and temperature, and various external loadings. The variation in water content renders the fill material to be unsaturated. This paper presents the experimental results obtained by performing a series of tests on a poorly-graded sandy gravel using a newly designed suction controlled oedometer apparatus. Special emphasis is given to study the stress-strain behavior of fills for different stress paths. Particularly, the creep behavior of fills is investigated under different stress state variables. The results show that the matric suction increases the soil strength until the plastic deformation state is reached. Several important observations and findings from the study are presented and discussed in detail.

Numerical Prediction of Stress-Deformation Behavior for a Bridge Approach Embankment on Soft Compressible Clay

Evan S.Y. Ma, Arup; Andrew J. Whittle, Massachusetts Institute of Technology

The mechanically stabilized earth (MSE) approach embankments for a new state highway bridge across the Indian River were founded on 8-9m of dense sand overlying a 20m thick layer of soft, normally consolidated, high plasticity clay. Consolidation of the clay was accelerated through an array of prefabricated vertical (PV) drains. The instrumented 13.8m high fill was monitored during staged construction and for a period of 1.25 years after construction. The embankment settled more than 2m, while large lateral spreading (~0.5m) was restrained by overlying sand layers. The available site investigation data was carefully reinterpreted and a 2D finite element analyses was performed using rate-independent, effective stress models (Modified Cam-Clay and MIT-E3). The numerical predictions are generally in very good agreement with measured ground settlements and lateral deflections. This study highlights the importance of careful parameter selection in modeling the performance for soft ground construction in order to predict key features such as the asymmetric lateral spreading of the clay during consolidation.

Effect of Sand Overconsolidation and Extensive Liquefaction on K0

Waleed El-Sekelly, Mansoura University; Tarek Abdoun and Ricardo Dobry, Rensselaer Polytechnic Institute

In the first part of this research, centrifuge model testing was used to investigate the relationship between the coefficient of lateral earth pressure at rest, K0, and overconsolidation ratio, OCR, for clean sand for the whole loading-unloading-reloading cycle. Tactile pressure sensors were used to measure the change in K0 in two saturated centrifuge models conducted on Ottawa sand. A relationship was developed between the change in K0 and OCR both for unloading and reloading conditions. In the second part of this research, the same tactile sensor was used to test the influence of extensive liquefaction on K0. A centrifuge model was subjected to very strong shaking causing extensive liquefaction. Lateral earth pressure was measured before and after liquefaction. It was found that there is a significant reduction on K0 due to extensive liquefaction which explains the increased vulnerability of sandy deposits after liquefaction, as observed by many researchers.