Wednesday, 3/15/2017

9:45–11:15 a.m.

Tunneling Methods, Modeling and Effects 2

Chairs: Alec Marshall, University of Nottingham; Elizabeth Dwyer, WSP/Parsons Brinckerhoff

Silvertown Tunnel, London, England–A Case Study Applying BIM Principles to the Geotechnical Process

Gary Morin, and Roger Chandler, Keynetix; Scott L. Deaton, Dataforensics; Roger Chandler, Simon Miles, Atkins Ltd.

While the use of Building Information Modeling (BIM) and Digital Engineering has grown massively in recent years, often being pushed by state initiatives, too frequently it appears to start from the ground up, with the geology and subsurface data being ignored. This paper presents an overview of BIM for Geotechnical Engineers together with a case study for the Silvertown Tunnel in London, England, which highlights how the core BIM principles, Collaboration, Process, Whole Life and 3D Digital Data can be used and applied to geotechnical process, and how incorporating geotechnical data within the wider BIM benefits the collaborating partners.

Evaluation of Construction Effectiveness for Shield Tunneling in Complex Ground based on FCE and AHP

Mengbo Liu, and Shaoming Liao, Tongji University; Jichao Li, China State Construction Engineering Corp.

Shield tunneling in complex ground is more difficult than that in homogeneous formation and its construction effectiveness has significant impact on the duration and cost of project. Therefore, a reasonable evaluation of construction effectiveness for shield tunneling is necessary. This paper developed an evaluation model based on Fuzzy Comprehensive Evaluation (FCE) and Analytic Hierarchy Process (AHP). Construction effectiveness was divided into four grades including Extremely Low, Low, High, and Extremely High. Considering eight critical factors, the AHP structure was established hierarchically to determine these factors' importance weights. Membership functions were derived based on statistical analysis of samples and applied to construct fuzzy decision matrix acquiring the final ranking. A case study was illustrated to demonstrate the feasibility of the proposed model. The model can provide a crucial basis for the analysis on construction difficulty of shield tunneling in complex ground.

Pipeline Response to Ground Deformations Induced by Tunneling

Evangelia Ieronymaki, Manhattan College; Andrew J. Whittle, Massachusetts Institute of Technology

This paper introduces a simplified analytical methodology for estimating bending moments and axial loads on buried pipelines due to ground movements caused by tunneling in soft soil. The method combines Winkler models for describing the pipe-soil interaction, with closed-form analytical solutions that use cavity shape-mode parameters for estimating the tunnel-induced free-field ground deformations. Analytical approximations for the vertical and horizontal Winkler spring stiffness coefficients are interpreted from three-dimensional numerical analyses. The proposed methodology is then applied to predict the deformations on an instrumented gas-main in London Clay that was monitored during the construction of tunnels for the Crossrail project at a greenfield site in Hyde Park

London. The results show very good agreement between the measured and the predicted strains on the pipe.

Centrifuge Modeling of Tunnelling Beneath Axially Loaded Displacement and Non-displacement Piles in Sand

Andrea Franza, and Alec M. Marshall, University of Nottingham

Tunnelling under piled structures is becoming more common in urban areas. However, there is limited guidance available for the prediction of settlements and the loss of bearing capacity of existing piles due to tunnel excavation. This paper aims to provide an improved understanding of the response to tunnelling of axially loaded displacement and non-displacement piles. Data are provided from a series of geotechnical centrifuge tests of tunnel excavation beneath single piles in dry silica sand. The tests evaluate induced settlements of the piles at varying levels of initial safety factor (i.e. the ratio between initial bearing capacity and applied load). Furthermore, a previously published analytical approach, based on cavity expansion theory, is used to investigate the variation of the residual safety factor at constant pile load with tunnel volume loss. The outcomes of both centrifuge and analytical investigations illustrate the importance of pile installation method and initial safety factor and improve understanding of tunnel-pile interaction mechanisms.