Tuesday 3/14/2017

1:15–2:45 p.m.

Rigid Walls and Non-gravity Walls

Chairs: Elizabeth Dwyer, WSP–Parsons Brinckerhoff; Anne Lemnitzer, University of California, Irvine

Use of Lightweight Fill for Landslide Repair:Media Vía Stabilization Project, Cuenca, Molleturo Roadway, Ecuador

Carlos M. Sevilla, Thiele Geotech Inc.

This paper describes the construction of a 13-m-high tieback-supported retaining wall to repair the Media Vía slope failure on the Cuenca-Molleturo Roadway in Ecuador. Construction of the reinforced concrete wall supported with 30-m-long tiebacks had to be modified during construction due to a conceptual error in the original design. During wall construction to a height of approximately 7 m, distress fissures appeared on the lower wall panels. The authors, working for the general contractor, designed and obtained the approval for the installation of lightweight fill paired with steel beam reinforcement as replacement for the design included in the contract documents. The wall was successfully completed in 2003 and shows no signs of further distress. An effort to document wall behavior under seismic loading was considered since reference points were previously installed to document permanent displacements.

Observed Deformation Characteristics and Internal Force of Pile-Anchor Retaining Excavation: A Case Study

Jicheng Shu and Dingwen Zhang, Southeast University

A case study on the observed deflections and internal forces of pile-anchor retaining excavation in Jinan city of China is reported in details. Based on field measured data, the ground surface settlement, deflection of wall, axial anchoring forces, and the deformation of surround pipeline are investigated. The results indicates that the combining application of concrete piles, jet grouting columns and anchors support system can effectively control excavation-induced surface ground settlements. The field maximum lateral wall deflections are between 0.02 percent and 0.19 percent of the excavation depth due to the difficult site conditions. The axial forces in the upper layer of anchors increased gradually during the excavation, but those of the lower layer of anchors first decreased slightly and then tended to stabilize during the excavation process.

Robust Geotechnical Design of Retaining Wall Subjected to Earthquake Load

Parishad Rahbari Nadarajah Ravichandran, and C. Hsein Juang, Clemson University

A robust geotechnical design methodology for design of cantilever retaining wall subjected to earthquake is presented in this paper. Initial geotechnical designs were performed considering possible variations in backfill soil properties and earthquake loading parameters to establish upper and lower limits for the design variables. Then, dynamic finite element simulations were conducted on models for selected design cases to obtain the wall tip deflection-time histories. Considering the maximum wall tip deflection as the response of concern, a response surface was developed to establish a relationship between the response and the variables (random and design). Finally, a design optimization was conducted considering cost and robustness as the objectives. The standard deviation of the response and volume of wall were considered as the measure of robustness and cost, respectively. The

optimization yielded a set of preferred designs known as Pareto front, and the optimal final design was then selected using knee point concept.

Investigation of Active Soil Pressures on Retaining Walls using Finite Element Analysis
George Saad, Shadi Najjar, and Nader Nasreddine, American University of Beirut
For retaining systems involving rigid walls, the soil-structure-interaction between the side soil and the wall affects the response of the system. The relationship between lateral earth pressure and wall displacement at any given depth is expected to be complex and affected by the height of the wall, the relative density of the backfill, the non-linearity of the soil response, and the type of wall movement. The objective of this paper is to investigate the static soil-structure interaction between rigid walls and sand backfill using finite element analyses for active states of loading. Numerical results indicate that (1) active conditions are mobilized at different wall displacements along the height of the wall and not at a fixed displacement as assumed in the literature, (2) the gradual mobilization of active earth pressure (starting from the at-rest pressure) at any given depth could be expressed as a function of the distortion of the wall using a simplified trilinear model, and (3) the use of a non-linear constitutive soil model is required in lieu of the more common elastic-perfectly plastic model where numerical instabilities were observed in the solution of the soil-structure interaction.

Sheet Pile Interlocks and Ring Beam Installation Effects on the Performance of Urban Cofferdams
Andres F. Uribe-Henao and Luis G. Arboleda-Monsalve, California State University, Long Beach
Urban cofferdams are made of steel sheet piles that are structural sections with interlocking systems used to build a continuous wall. These systems are constructed by driving sheet piles, assembling subsequent sheet pile sections, and installing ring beam bracings as the excavation proceeds. The interlock connections between sheet pile sections tend to have a natural slack which leads to additional deflections of the support system. It is only after some deformation that the natural slack of the interlocks and sheet pile-to-steel ring beam connections close their gaps and the bracing system is fully engaged. These features on urban cofferdam behavior are presented parametrically in three-dimensional numerical analyses. Large differences on the computed lateral wall deformations are presented when ignoring these installation effects. Disregarding these pre-excavation construction effects conceal the fundamental reason for the resulting ground deformations in the construction of urban cofferdams and deep excavations.

Practical Robust Geotechnical Design of Supported Excavations: A Case History of Excavation in Taiwan
Sara Khoshnevisan, and Hsein Juang, Clemson University; Lei Wang, University of Montana
Uncertainty in soil parameters and variation in surcharge loading applied to the ground surface often make engineers overdesign for safety, which may lead to a cost inefficient design. In order to get a design, which is safe, insensitive to the uncertainties, and also cost efficient, the concept of robust geotechnical design (RGD) is adopted. In RGD methodology, robustness and cost are the main objectives to be optimized, while satisfying the safety requirement, by only adjusting the design parameters without reducing the existing uncertainties. In this paper, the aim is to develop an efficient and practical RGD for a design of a deep excavation supported by soldier pile anchor tieback system, using a single spreadsheet in Microsoft Excel. However, the analysis of complex supported excavation using numerical software such as Deepex 2015 within the RGD framework is computationally challenging. To make this RGD approach efficient and practical, the response surface procedure is adopted. In the design

optimization, the signal-to-noise ratio (SNR) is taken as the robustness measure. The optimization between cost and robustness is performed in a single spreadsheet in Microsoft Excel using Solver. To locate the best compromise between these objectives, the minimum distance approach (MD) is adopted which can be implemented easily in a spreadsheet. Finally, the results are compared to the original design constructed in Taiwan.