The Geo-Institute Technical Committees will be live streaming the Computational Geotechnics Technical Committee December 7 at 2 PM EST. The topics include:

“Fragility Analysis of Cantilever Retaining Walls Based on Different Earthquake Ground Motions and Failure Case Histories,” Siavash Zamiran, PhD, PE., M.ASCE

In this investigation, the seismic response of retaining walls constructed with cohesive and cohesionless backfill materials was studied. Fully dynamic analysis based on the finite difference method was used to evaluate the performance of retaining walls during different earthquake events. The analysis response was verified by the experimental study conducted on a retaining wall system with cohesive backfill material in the literature. The effects of cohesion and free-field peak ground acceleration (PGA) on seismic earth thrust, the point of action of earth thrust, and maximum wall moment during the earthquake were compared with analytical and experimental solutions. The motion characteristics of the retaining wall during the earthquake were also considered. The relative displacement of the walls with various backfill cohesion, under different ground motions, and free-field PGAs were investigated. Current analytical and empirical correlations developed based on Newmark sliding block method for estimating retaining wall movement during earthquakes were compared with the numerical approach. Based on the developed model, fragility analyses were conducted to determine the probability of damage to the retaining walls during an earthquake event. Multiple earthquake ground motions were used to investigate the fragility response of the retaining walls. To evaluate the fragility of the studied model, a specific failure criterion was chosen for retaining walls. The failure criterion was selected based on different case histories of retaining wall failures and damages. It is demonstrated to what extent a small amount of cohesion in backfill material can influence the displacement of a retaining wall and the probability of damage in seismic conditions. According to the findings, practical correlations were presented for conducting the seismic design of retaining walls.

“Application of Numerical Techniques to Evaluate Retaining Walls and Slope Failure in North Texas,” Yasser Abdelhamid, PhD, PE, M.ASCE

In this presentation, results of forensic investigations of two different cases of retaining wall and slope failures in north Texas are presented. Subsurface investigations that included soil borings, geophysical profiles, and proper laboratory testing were performed. Inclinometers and piezometers were installed to monitor ground surface movement and groundwater elevations. Light Detection and Ranging (LiDAR) surveys were also performed to obtain accurate grades of the site. The stability of the walls and the slopes was evaluated using analytical and numerical methods. The global stability of the walls and the slopes was analyzed using limit equilibrium and finite element methods. Factors contributing to failures include, but are not limited to, failure to consider all modes of failure during design, improper soil parameters assumptions or improper determination of soil parameters, and not taking into consideration the reduction of shear strength of highly plastic clays due to cyclic wetting and drying of the soil.
A meaningful numerical simulation of a geosystem is dependent on many factors; the model assumptions, element type and size, constitutive models, contact behavior, and modeling techniques. The commercially available software are competing to be user friendly with formulations (e.g., Embedded truss elements to simulate anchors) and constitutive models (elastic perfectly plastic to simulate soils). The lack of understanding on how such formulations work and how such simplified constitutive models capture the behavior will generate “results”, however, such results are far from being reliable.

In this presentation, two of the factors that are of significance to generating a model that will capture the right mechanics of the problem and will have a significant effect on the results will be discussed through the application to a braced excavation simulation. The results from parallel simulations of a braced excavation will be discussed. The comparison will be carried on models with elastic perfectly plastic soil model and with elastoplastic soil model. The comparison will demonstrate that the assumption of linear elastic perfectly plastic behavior of the soil will not capture the anticipated response of the excavation, and on the other hand the use of the appropriate soil model with the representative parameters, will demonstrate the adequacy of the model to capture the problem mechanics and the anticipated soil response. In addition, the presentation will address the parameters selections for the elastoplastic model that will be used on the demonstration.

The second factor is the ability of the contact assumption between the soil and the supporting structure to accurately reflect the appropriate load transfer mechanism to address the structural response of the structural elements.

The objective is to demonstrate that understanding of the problem mechanics and the anticipated soil response is essential during the model setup to get reliable results that will accurately capture the modeled system response.