ASCE Geo-Institute (G-I)
Embankments, Dams, and Slopes (EDS) Committee

Lectures on Offer from the EDS Committee (2020-2021)
Expenses associated with any visiting lecturer will be covered by the G-I

Various Case Histories involving Embankments, Dams, and Slopes
T.D. Stark (University of Illinois at Urbana-Champaign)

This presentation will describe a recent case history involving embankments, dams, and slopes (EDSs), including natural and man-made slopes as well as static and seismic conditions. The lessons learned from these cases histories include the importance of designing for different shear strength conditions, construction activities, foundation conditions, seepage, and slope stability modeling. The case history could include: Oso Washington Landslide, Funado Tailings Dam Failure, Highway Embankment Failure, Hurricane Katrina Floodwall Failures and Court Ruling, Landslides during 1964 Alaskan Earthquake, Elevated Temperatures in Landfills, Slope Movement in San Francisco Housing Development, Landfill Seismic Stability Case, Seismic remediation of Tuttle Creek Dam, Toe excavation and a bedrock landslide, 3D Slope Stability Analyses in Practice, Cutoff Wall for Deep Subway Station, etc.

3D Slope Stability Analyses in Practice
T.D. Stark (University of Illinois at Urbana-Champaign)

This lecture will present an update on the use of three-dimensional (3D) slope stability analyses in geotechnical practice and some of the issues with using 3D analyses. Field case histories will be presented to illustrate the use of a 3D analysis in inverse stability analyses for static and seismic slope failures, modeling complex slope geometries, and accommodating geosynthetic reinforcement anisotropy in factor of safety (FS) calculations. The research shows that 3D analyses are more important for translational than circular slide masses. Recommendations for adjusting 2D values of FS to incorporate 3D side resistance will be presented.

Modified SPT for Drilled Shaft Design in Weak Rocks
T.D. Stark (University of Illinois at Urbana-Champaign)

Standard Penetration Tests (SPTs) have been used to estimate strength parameters of soils and weak rocks when it is difficult to obtain undisturbed samples for laboratory testing. SPTs require 45 cm (18 inches) of penetration which is difficult to impossible to obtain in weak rocks, e.g., shales. As a result, SPT procedures were modified for drilled shaft design where the penetration is less than 45 cm. This new procedure is termed the Modified Standard Penetration Test (MSPT) and uses the penetration rate, not the sum of penetration blowcounts, to estimate undrained strength parameters for drilled shaft design in weak rocks. The penetration rate is the inverse of the linear slope of the penetration depth versus blowcount relationship. An empirical correlation between MSPT penetration rate and laboratory measured unconfined compressive strength was developed for weak Illinois shales and can be used for the design of drilled shafts.

Static and Seismic Strength Parameters for Stability Analyses
T.D. Stark (University of Illinois at Urbana-Champaign)

This presentation will present recent research on drained and undrained shear strengths for static and seismic stability analyses. In particular, Dr. Stark will discuss the application, measurement, empirical correlation, and use of drained peak, fully softened, and residual shear strengths in stability analyses. The presentation will also discuss use of undrained static peak and cyclic strengths, undrained post-peak behavior, and use of undrained residual strengths for seismic slope stability and permanent deformation analyses. The potential for possibility of pre-existing shear surfaces undergoing healing or strength gain with time will be discussed for both drained and undrained stability analyses.

Will it Stay or Will it Go?: Use of LiDAR to Assess Slope Instability

Ben Leshchinsky (Oregon State University)

Light detection and ranging technology, or lidar, is a promising tool for assessing unstable ground due to its resolution, accuracy, and the ability to process away visual obstacles, such as vegetation. In particular, laser scanning has significant utility when applied repeatedly over time, quantifying changes in terrain that may not be easily discernable to the eye. This presentation will touch on some ongoing research that employs lidar for (1) landslide inventorying and landslide susceptibility, and (2) understanding coastal retreat and subsequent landslide progression. A semi-automated approach that uses lidar to recognize geomorphic features and supplement manual landslide inventorying is presented. Thereafter, an approach that uses landslide inventories to leverage region-specific, shallow landslide susceptibility is considered. An ongoing collection of lidar along the Oregon Coastline is used to better capture coastal erosion and its influence on slope instability. The increasing availability of lidar presents us with a unique opportunity to better assess the risk stemming from geohazards, enhance asset management, and understand geomorphic and geologic processes at a more refined level.

1995 and 2005 La Conchita Landslides – Case Histories and Remedial Measures

D.P. Pradel (The Ohio State University)

In the past two decades major landslides devastated the town of La Conchita, California. The January 2005 landslide was a debris flow that killed 10 people, and damaged or destroyed 36 residences. It developed within the south flank of a larger landslide that occurred in March 1995 and destroyed 9 homes. La Conchita is an important case history because the 2005 failure was largely a consequence of decisions taken after the 1995 failure. It shows the importance of good engineering recommendations (including slope winterization) and the central role of owners and government agencies. During the last three decades, the author has made detailed observations of the slopes at La Conchita, performed subsurface and laboratory investigations, and conducted numerical modeling and conventional slope stability analyses whose principal aim was to understand the conditions and failure mechanisms of the 1995 and 2005 slope instabilities. This article discusses the history of the site, and remedial schemes previously proposed to reduce the landslide hazards to the town of La Conchita.

Design of Landslide Stabilizing Piles Based on the Results of Slope Failure Back Analysis

Mihail Popescu (HBK Engineering, Baltimore, MD)

It is generally accepted that shear strength parameters obtained by back analysis of slope failures ensure more reliability than those obtained by laboratory or in-situ testing when used to design remedial measures. In many cases, back analysis is an effective tool, and sometimes the only tool, for investigating the strength features of a soil deposit. The fundamental problem involved is always one of data quality and consequently the back analysis approach must be applied with care and the results interpreted with caution. Procedures to determine the magnitude of both shear strength parameters (c' and □') or the relationship between them by considering the position of the actual slip surface within the failed slope are discussed

Using the concept of limit equilibrium the effect of any remedial measure (drainage, modification of slope geometry, restraining structures) can easily be evaluated by considering the intercepts of the c'-tan □' lines for the failed slope (c0', tan □0') and for the same slope after installing some remedial works (c'nec, tan □'nec), respectively.

This procedure is illustrated to design piles to stabilize landslides taking into account both driving and resisting force acting on each pile in a row as a function of the non-dimensional pile interval ratio B/D. The accurate estimation of the lateral force on pile is an important parameter for the stability analysis because its effects on both the pile-and slope stability are conflicting. That is, safe assumptions for the stability of slope are unsafe assumptions for the pile stability, and vice-versa. Consequently, in order to obtain an economic and safe design it is necessary to avoid excessive safety factors.

Seismic Performance of Retaining Walls with Dirty Backfills

A. Osouli (Southern Illinois University Edwardsville, IL)

There is a desire to use cohesionless backfills in construction of retaining walls. However, field inspections of 20 different bridge sites by Caltrans showed that in 18 cases, the backfill material of bridge abutments contains some level of cohesiveness. In 9 cases, backfill materials with up to 95 kPa cohesion were observed. There is limited information about the seismic deformational response of retaining walls with cohesive backfills. In this seminar, an overview of Newmark sliding block, Richard and Elms, AASHTO and NCHRP studies is provided. Also, more recent experimental and numerical studies on seismic deformational behavior of retaining structures with backfills that has some level of cohesiveness are presented. Finally, it is shown how the fragility analyses can be used for evaluating the probability of damage of these retaining structures as a function of peak ground accelerations.