Announcing the Final Examination of Moataz Soliman for the degree of Doctor of Philosophy

Time & Location: July 6, 2020 at 8:00 AM in Virtual Defense
https://us02web.zoom.us/j/84934476948?pwd=SHhWZUJweUFuUDRIRGdGYUVmSWRkQT09
Title: Numerical Analysis on the Geotechnical Mechanism and Stability of Sinkholes in Central Florida

Sinkholes are a common geohazard in karst areas that can threaten human life loss and create significant damage to infrastructure. Approximately 18% of the United States falls into karst area where overburden soils are underlain by soluble carbonate rocks. In Florida, sinkhole-related insurance claims between 2006 and the third quarter of 2010 amounted to $1.4 billion according to the Florida Office of Insurance Regulation. Intensive research methods are needed in order to detect and predict sinkhole activity. Numerical investigations can play an important role in studying the stability against sinkholes as well as understanding the failure mechanism under varied subsurface conditions. In this study, the geomechanical behavior of sinkholes due to subsurface cavity and its expansion was numerically investigated by Plaxis 2D finite element (FE) software. The study investigated the effects of embedded clay layers on the failure mechanism of cover-collapse sinkholes. Selected sinkhole case histories (including Winter Park sinkhole) from different locations in Florida are also presented. Soil profiles and parameter values were determined using subsurface exploration data and published correlations in the geotechnical literature. Appropriate constitutive models were employed in the numerical simulations to reproduce the soil behavior that can account for small strain stiffness, soil nonlinearity, recent stress history effects, and large-strain asymptotic behavior. The constitutive models that were adopted in this study were elastoplastic models (Hardening Soil Small Strain model) and critical state models (hypoplasticity models) for sands and clays. Induced stress paths due to an underground cavity were investigated and compared versus the soil yielding conditions. Ground settlements, distortions and influence zones due to an evolving subsurface cavity in the numerical environment were computed and compared versus the damage criteria of infrastructure in engineering practice. Based on a series of FE simulations, site-specific stability charts of selected sinkhole sites in Florida were developed using shear strength reduction techniques. The aim of this chart is to be used as a preliminary check of the sinkhole stability in the study domain, i.e. central Florida, at similar subsurface conditions.

Major: Civil Engineering

Educational Career:
Bachelor's of Civil Engineering, BS, 2013, Cairo University
Master's of Civil Engineering, MS, 2016, Cairo University

Committee in Charge:
Boo Hyun Nam, Chair, Civil, Environmental and Construction Engineering
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Approved for distribution by Boo Hyun Nam, Committee Chair, on July 6, 2020.

The public is welcome to attend.