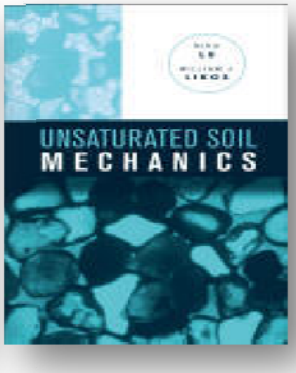
Unsaturated Soil不飽和土壤專題演講

日期：民國 101 年 10月 19 日（星期五）14:00 – 16:30
地點：國立臺灣科技大學(台北市基隆路4段43號)國際大樓IB302
主辦單位：國立臺灣科技大學營建工程系、社團法人中華民國大地工程學會、
協辦單位：國立台灣大學土木工程學系

時間	主題	講者	主持人
14:00-14:50	Using particle image velocimetry for failure prediction in an experimental vertical cut of unsaturated soil	Prof. Ning Lu 陸寧教授 Colorado School of Mines (講者簡歷與演講摘要如附件)	國立台灣科技大學 林宏達教授
14:50-15:00	中場休息		
15:00-15:50	A unified effective stress for variably saturated soils		國立台灣大學 葛宇甯教授
15:50-16:30	Q and A		



陸寧教授為知名教科書
“Unsaturated Soil Mechanics”作者

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Unsaturated Soil 不飽和土壤專題演講 報名回條

報名表請 mail: tgstw999@gmail.com or 傳真: (02)24624038

G#_____, 姓名:_____, 單位:_____

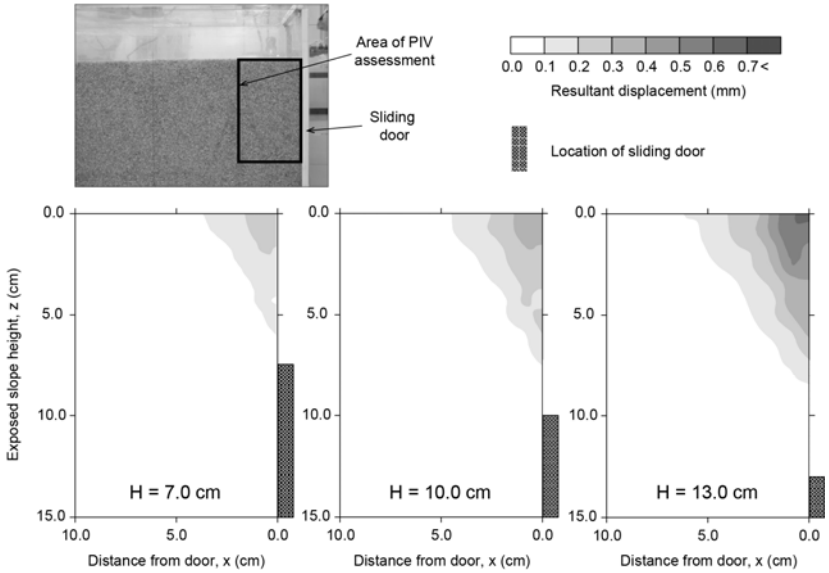
聯絡電話:_____, Email:_____

國立臺灣科技大學校區平面配置圖

Using particle image velocimetry for failure prediction in an experimental vertical cut of unsaturated soil

Ning Lu, Colorado School of Mines, Department of Civil and Environmental Engineering, Golden, CO 80401, USA

Abstract Controlled laboratory experimentation is instrumental in understanding unsaturated slope failure conditions. The critical height of a slope is where the ratio of shear strength to shearing stress along a potential failure plane is lowest. Critical height predictions of a vertical cut are often made using a plane-strain, finite slope analysis assuming a planar failure surface in soils with cohesion. Using a novel suction stress concept, this work extends the vertical cut analysis to cohesionless soils bound by two sidewalls in the third dimension. To test the slope's critical height, we compacted an unsaturated sand to a uniform porosity and moisture content in a laboratory simulator. The simulator had a sliding door that extended the height of the free face until the critical height was reached. Digital photos of the slope's cross section and top-view were taken concurrently. A recently developed particle image velocimetry (PIV) tool designed to detect soil deformation. Results of the PIV analysis from the top-view showed strain localization at a given distance from the sliding door prior to failure. The strain areas along the slope crest coincided with the location of the slope crest post-failure. Angle of the failure plane was then calculated assuming the area of highest strain was incipient motion of the critical failure plane extending to the toe. Strength and soil-water characteristic parameters of the sand were tested for use in the extended vertical cut analysis, along with the failure plane angle. Comparisons of the experimental failure heights to those calculated by predicted method developed in this work showed agreeable results to predicting height of vertical cut failure. This paper lays the groundwork for using the PIV method, along with soil strength and moisture testing, to predict the critical height of a vertical cut of unsaturated soils.

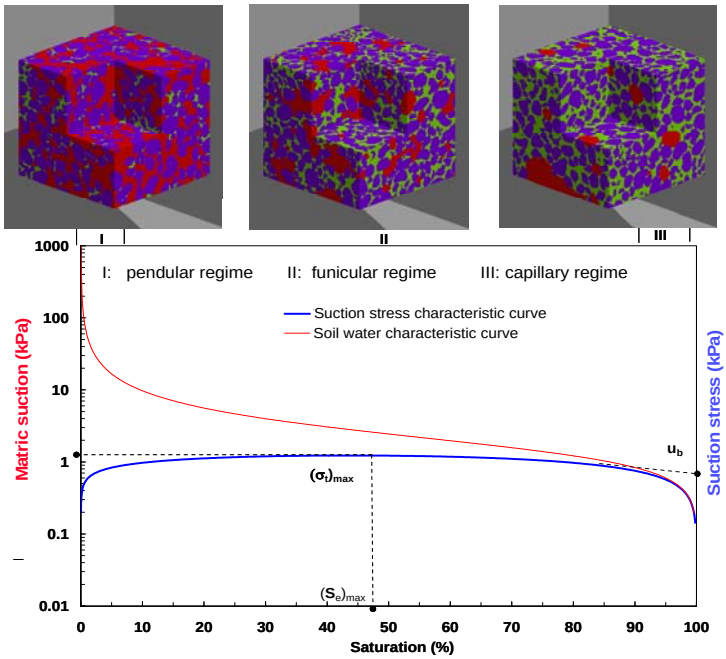


Biographical Sketch Ning Lu is professor of civil and environmental engineering at Colorado School of Mines (CSM) and the director of the joint CSM/USGS Geotechnical Research Laboratory in Golden, CO. He is a recipient of *ASCE 2007 Norman Medal* and the recipient of *ASCE 2010 Croes Medal*, and an elected fellow of *Geological Society of America* and *American Society of Civil Engineers*. His current research focuses on developing a unified coupled hydro-mechanical framework for variably saturated porous media and applying it to rainfall-induced landslide analysis. He is the senior author of widely used textbook *Unsaturated Soil Mechanics* (John Wiley and Sons, 2004) and *Hillslope Hydrology and Stability*, (Cambridge University Press, 2012). He can be reached via ninglu@mines.edu.

A unified effective stress for variably saturated soils

Ning Lu, Colorado School of Mines, Golden, CO 80401, USA, ninglu@mines.edu

Abstract A unified effective stress concept based on the suction stress characteristic curve (SSCC) for variably-saturated soil is discussed. Particle-scale equilibrium analyses are employed to distinguish three types of interparticle forces: (1) active forces transmitted through the soil grains (Terzaghi's); (2) active forces at or near interparticle contacts (physicochemical); and (3) passive, or counterbalancing, forces at or near interparticle contacts (Born's and steric). It is proposed that the second type of forces, which includes physicochemical forces, cementation forces, surface tension, and the force arising from negative pore-water pressure, can be conceptually combined into a macroscopic stress called suction stress. Suction stress is an internal stress that is completely balanced by Born's repulsion and is independent of the external or total stress. Suction stress characteristically depends on degree of saturation, or soil suction, thus paralleling well-established concept of the soil–water characteristic curve in soil physics. The existence and behavior of the SSCC are experimentally validated by considering unsaturated shear strength and volumetric behavior data for a variety of soil types in the literature. The characteristics and practical determination of the SSCC are demonstrated. A closed form equation for predicting the suction stress for all soils is found. A case study of shallow landslide initiation induced by heavy rainfalls in Seattle area illustrates that variation in suction stress can well reconcile the spatial and temporal characteristics of the event. Suction stress provides a potentially simple and practical means to describe the state of stress in unsaturated soil.



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