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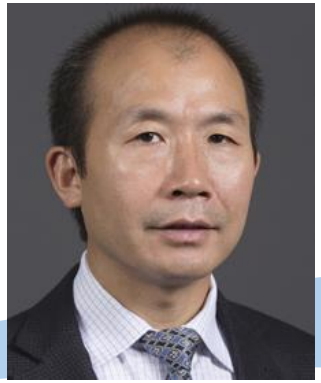

Xiong Zhang

Dr. Xiong Zhang is the James A. Heidman Professor in the Department of Civil, Architectural, and Environmental Engineering at the Missouri University of Science and Technology. He received his Ph.D. degree in Civil Engineering from Texas A&M University. Before he joined in the Missouri S&T, he worked at the University of Alaska Fairbanks and University of Cincinnati for 10 years. Dr. Zhang has been teaching and conducting research in the field of geotechnical engineering since 1992. His studies focus on development of advanced laboratory techniques to rapidly characterize geomaterials, constitutive modeling coupled hydro-mechanical behavior of unsaturated soils, numerical modeling of climate-soil-structure interaction, slope stability analysis, soil stabilization and ground improvement, and frozen ground engineering. He recently received the 2016 Intnl Innovation Award in Unsaturated Soil Mechanics from TC106 Committee on Unsaturated Soils within the ISSMGE. Dr. Zhang is currently serving as editorial board member of Canadian Geotechnical Journal, Associate Editor for ASCE Journal of Cold Region Engineering. He also serves as a chair of ASCE GI Shallow Foundation Committee and committee member of several nationwide technical committees such as ASCE GI Committee on Design of Residential Structures on Expansive Soil Standards, ASCE GI Pavement Committee, TRB AFP60 Committee on Engineering Behavior of Unsaturated Soils, and TRB AFS20 Committee on Soil and Rock Instrumentation.

Calibration of BBM Parameters using the Modified State Surface Approach

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The Barcelona Basic Model (BBM) developed by Alonso et al. (1990) is the first and the most widely used elasto-plastic model for unsaturated soils. The BBM successfully explained many key features of unsaturated soils and received extensive acceptance. However, there is lack of a well-established method for selecting parameter values for the BBM from laboratory tests, although a variety of methods have been recently developed for calibrating model parameters for the BBM. Concerns still exist on the correctness and robustness of such parameter value selection procedures. The above statements were evidenced by a recent benchmark exercise on selection of parameter values for the BBM organized within a "Marie Curie" Research Training Network on "Mechanics of Unsaturated Soils for Engineering" (MUSE). Experienced constitutive modelers from 7 prestigious teams in unsaturated soils were provided with the same experimental results on an unsaturated soil to calibrate the parameter values in the BBM. Theoretically, the calibrated parameters from different teams are expected to be the same or at least very close. However, the selected parameter values by the 7 teams are surprisingly widely different.

This paper first discussed the limitations in the existing methods to calibrate the parameter values in the BBM. A surface approach was then proposed to calibrate the parameter values for the BBM. The approach takes advantage of the close-form solution of the BBM, which is derived based upon a newly proposed Modified State Surface Approach to study the unsaturated soils. The same experimental data, used in the MUSE benchmark exercise, were reanalyzed using the proposed approach to calibrate parameters for the BBM. The results were compared with those in the MUSE benchmark exercise from which the simplicity, effectiveness, and robustness of the proposed method were evaluated.