Constitutive modelling of unsaturated soils and its practical applications for critical infrastructure

……

Overview

The climate change accompanied by rise in sea levels and an increase in the number of heavy precipitation events combined with prolong drought leading to severe flooding, failure of old and newly formed geotechnical infrastructure (retaining walls, embankments, sub-base for highways) and disruptions to buried utilities (water, communication, electricity supply and underground storage systems) in India and elsewhere in the world. The climate change impact, or otherwise known as "environmental loading" on geotechnical infrastructures in urban areas is an emerging global issue causing serious threats and financial burden on the society. The response of both natural and made-grounds when subjected to drying and wetting is complex problem and it has been proven that the classical geotechnical theories and frameworks do not provide any meaningful solutions. This in large has prompted recent research into unsaturated soils globally.

In technical terms, frequent flooding causes an increase in the degree of saturation and a decrease in the shear strength of soils accompanied by an increase in the pore water pressure, an increase in the stress levels, particularly lateral thrust on retaining and buried structures. Similarly, shrinkage of fine grained soils due to an increase in the temperature may lead to formation of cracks and fissures which could have severe impacts on infrastructures, for example slopes and cutting, particularly if it coincides with extreme flooding events. The above issues are coupled thermo-hydro-mechanical problem, influenced by soil type, stress history, stress level, mineralogy, and soil chemistry.

Accordingly, the primary objectives of the course are as follows:

a) Understanding the existing advanced geotechnical models for predicting saturated soils behaviour
b) Historical development in the modelling of unsaturated soils behaviour
c) Theoretical framework for modelling unsaturated soils behaviour
d) Best laboratory procedures for testing unsaturated soils and quality research outputs
e) Bridging the gap between theory and practice.

Modules	**A: Constitutive modeling of saturated soils (6hrs) : 17th Dec.** *Lecture 1 (3hrs)* Isotropic elastic theory, elasto-plastic theory, state boundary surface, *Lecture 2 (3hrs)* Prediction of plastic strain, anisotropic elastic and elasto-plastic theory and worked examples **B: Unsaturated soils and constitutive modeling (24 hrs) : Dec. 18 – Dec. 21** *Lecture 3 (3 hrs)* Environmental process, suction in unsaturated soils, stress variables, classical

	unsaturated soil mechanics *Lecture 4 (3 hrs)* Two stress state variables, coupled-stress state variables, Loading-collapse yield locus and structure of unsaturated soils *Tutorial 1(3hrs)* Laboratory class involving sample preparation, suction control, suction measurements, soil water characteristic curve *Lecture 5 (3hrs)* Case study based on published work in relation to underground nuclear waste disposal site *Tutorial 2 (3hrs)* Continue with laboratory class involving sample preparation, suction control, suction measurements, soil water characteristic curve *Lecture 6 (3hrs)* Case study based on published work in relation to build-up of stress around buried structures *Tutorial 3 (3hrs)* *Lecture 7 (3hrs)* New research ideas and bridging the gap between theory and practice **Number of participants for the course will be limited to fifty.**
You Should Attend If…	▪ Students at post-graduate or higher level (MSc/MTech/ME/PhD) specialized in geotechnical engineering, soil mechanics, groundwater, water resources, or allied areas ▪ Research scholars or Research scientists from National Laboratories and R&D institutes ▪ Faculty from reputed academic and technical institutions, working/teaching in the domains: geotechnical engineering, water resources, environmental, or similar ▪ Practicing engineers and technical employees from government and private organizations (such as Roads & Buildings R&B, Irrigation Department, CSMRS, etc.), working in relevant area
Fees	The participation fees for taking the course is as follows: ➢ **Participants from abroad: US $400** ➢ **Students: 1500 INR** ➢ **Students from India belonging to the reservation category (SC/ST): 750 INR (Note: Please send a soft copy of your community certificate)** ➢ **Participants from academic institutes, Govt. R&D labs: 9440 INR (Including 18%GST)** ➢ **Industry participants: 11800 INR (Including 18% GST)** The above fee includes all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility. Additional fee needed to be paid for breakfast/lunch/dinner. Accommodation charges are extra. For hotel accommodation nearby IITH campus or in city, please write to coordinator directly. All requests for information and accommodation may be sent to this email id: gianunsat@iith.ac.in

The Faculty

Dr. V. Sivakumar has received a DSc degree from Queens University Belfast for his contributions to Geotechnical research in wide range of subjects, particularly in unsaturated soils. He is also a fellow of Institution of Civil Engineers UK. His research interests include: Performance of compacted fills under extreme weather conditions, constitutive modelling of unsaturated soils, dynamic loading of highway pavement and offshore renewable energy foundations. He has supervised 23 PhD students to completion and currently supervises 6 PhD students and 1 Postdoctoral research assistant. He has published over 100 peer reviewed research papers, including 24 articles in Géotechnique. He is a PI of the project 'Collaborative Research: Green Foundations for Green Energy' funded under the US-Ireland research partnership. VS has been awarded, in conjunction with colleagues, external research income of more than £1.5M, from the RCUK. VS has extensively studied engineering behaviour of compacted soils when subjected to moisture movement, particularly in relation to stress-strain response.

Course Coordinator

Dr B Umashankar
Associate Professor
Department of Civil Engineering
IIT Hyderabad
Phone: 040 2301 6034
E-mail: buma@iith.ac.in