Imperial College London

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Venue: SKEM 163
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Time: 16:00

Equivalent state theory for constitutive modelling of silty sand

Synopsis:

A systematic increase of non-plastic fines content, fc, (particle size $\leq 75\mu m$) in the matrix of clean sands may decrease their void ratio, e, but their stress-strain behaviours depend on their relative interaction. To avoid these complexities, clean sand with a fc can be considered as a separate soil to establish critical state soil mechanics (CSSM) framework and then its stress-strain behaviour can be explained to a greater extent via a constitutive model. However, this is not practical as laborious effort is required to define critical state lines, CSLs, for sand with each fc. Therefore, attempts have been made that consider the clean sand behaviour as a reference and then capture the effect of fc by: (1) developing empirical relation; (2) correcting e to an equivalent void ratio, e*, considering relative interaction of fines in the matrix of sand. Concepts of a simplistic model for e* will be discussed, using experimental and DEM data, which may coalesce CSLs for sand with fc to a single equivalent granular critical state line (EG-CSL). The limitation and potential application of e* will be discussed. However, when e* gives the EG-CSL, it develops an equivalent CSSM framework for sand with a range of fc, as long as the soil matrix is dominated by the sand matrix. This EG-CSL only requires CSL for clean sand or sand with a fc. The EG-CSL also allows to modify state parameter, ψ to equivalent granular state parameter, ψ^*. The e* and ψ^* capture the effect of fines in the characteristic features of drained and undrained behaviour. This also allows substitution of e* and ψ^* for e and ψ into state dependent constitutive models (e.g. SANISAND family of models). The 'proof-of-concept' works very well for loose specimens, however predictions slightly deviate for dense specimens, irrespective of fc. An incorporation of fabric evolution improves the model prediction significantly.

Presenter's Bio:

Dr. Rahman is visiting Imperial College and is currently working on "equivalent state theory" for sands with fines. Back in Australia, he is an associate professor in geotechnical engineering at the University of South Australia and leading a geotechnical research group of 3 academics, 2 research associates and 10+ PhD students. He has supervised 7 PhD students to completion and published 120+ peer reviewed articles, including 54 journal contribution. He has a strong interest on fundamental research, but also holds a good track record of translating his theoretical research into a range of industry-funded projects e.g. ARC linkage, Forest and Wood Products Australia, CMA Australia etc. He is an Editor-in-Chief for the journal of *Geotechnical Research*, ICE (UK) and contributed to many other journals as guest/theme editor and EBM. Dr Rahman's visit to ICL is funded by an Endeavour Executive Leadership Award (fellowship) by Australian Government and UniSA, and a cordial support from ICL.
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