Imperial College London

A Generalized Framework for Static and Dynamic Analysis of Laterally Loaded Piles

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Venue: SKEM 207
Date: 26th Sep 2019 (Thursday)
Time: ~~15:00~~ 16:00

Synopsis:

Soil structure interaction is an integral part of geotechnical engineering practice, and has applications in analysis and design of foundations, retaining structures, tunnels, excavations, and other geo-structures. A soil structure interaction analysis framework is developed using the variational principles of mechanics for analysis of pile foundations subjected to lateral loads. The pile is modeled as a Timoshenko beam and the surrounding soil as a continuum. The framework is also applicable to offshore wind turbine monopile foundations and is general enough to take into account both dynamic and static analysis. The differential equations governing the pile deflection and soil displacements in different soil layers are obtained using energy principles and calculus of variations. Dynamic and static pile responses like deflection, bending moment, and pile head impedances can be obtained as part of the solution. The analysis also incorporates soil nonlinearity and produces quite accurate nonlinear pile response. Further, the framework incorporates different beam theories like the Euler-Bernoulli and rigid beam theories by progressive simplifications from the Timoshenko beam theory so that short stubby piles and monopiles as well as long slender piles can be modeled using the same framework. Thus, the framework gives the opportunity to investigate the appropriateness of the different beam theories for analysis of different types of soil. At the same time, it is shown analytically that the p-y curves are explicit functions of pile diameter because of which different p-y curves are required to analyze different sized piles and monopiles. The framework produces results that are as accurate as those produced by three-dimensional finite element analysis but is computationally one order of magnitude faster. Further, the framework is easy to use, without requiring any meshing or numerical domain generation as inputs are given through a simple text file, and can be easily adopted in practice.

Presenter's Bio:

Dr. DIPANJAN BASU is an Associate Professor in the Department of Civil and Environmental Engineering at the University of Waterloo (Canada). Prior to his current appointment, Dr. Basu was a faculty member at the University of Connecticut (U.S.A.). He obtained his doctoral degree from Purdue University (U.S.A). Dr. Basu's interests lie in Energy Geotechnics, Soil Structure Interaction, Sustainability and Resilience Quantification, and Numerical Analysis. Dr. Basu is a member of Tau Beta Pi, and is a recipient of the Telford Premium Award (U.K.), Fugro Fellowship (U.S.A.), ExCEEd Teaching Fellowship (U.S.A.), and Prof. S. Neogi Award (India). He is the chair of the ISSMGE and ASCE-GI technical committees on Sustainability in Geotechnical Engineering. Dr. Basu served as an Associate Editor of the ASCE Journal of Geotechnical and Geoenvironmental Engineering.