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Performance-based design of extended pile shafts subjected to cyclic loading

Abstract

Seismic performance of bridge and marine structures supported by extended pile-shafts principally depends on the curvature demand in critical regions of the pile below ground level. The equivalent fixed-based cantilever model is commonly used to assess the local curvature ductility demand of a yielding pile-shaft at any inelastic displacement level. In this approach, adequate prior knowledge of several parameters including depth of fixity, plastic-hinge depth and equivalent plastic-hinge length is essential for proper estimation of ductility capacity. The present study aims to propose analytical formulations by using concepts of strain wedge method based on nonlinear behavior of soil-pile system to assess the key parameters of the equivalent cantilever model. In addition, a set of dimensionless design charts is produced based on an analytical approach covering a range of practical values of soil and pile properties. The ability of the developed model in assessing the curvature ductility demand of the bridge system is validated against several published full-scale tests on RC shafts in clay and sand. Finally, a general cyclic BNWF model is developed to account for the important features of soil-pile interaction problem including lateral load characteristics, soil cave-in, soil-pile side shear, gap formation, and strength and stiffness hardening/degradation.

About the Speaker

Dr. El Naggar is a Distinguished University Professor of Western University, Canada. He is Editor-In-Chief of Soil Dynamics and Earthquake Engineering and past Associate Editor of the Canadian Geotechnical Journal. He published more than 500 technical papers/book chapters on foundations, soil-structure interaction and geotechnical earthquake engineering; and consulted on major projects worldwide. Dr. El Naggar attracted more than \$20M of research funding and graduated more than 100 PhD and Master students. He received numerous awards including: Geosynthetics, Stermac, Meyerhof, Canadian Geotechnical Colloquium Speaker, Western University Distinguished Professorship, Faculty Scholar Award, Outstanding Teaching, and Research Excellence Awards as well as the 2015 Ontario Professional Engineers Medal for Engineering Research & Development. He is an elected Fellow of Canadian Academy of Engineers, Engineering Institute of Canada and the American Society for Civil Engineers.

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