A STUDY ON AXIAL PERFORMANCE OF HELICAL PILES ON RESIDUAL SOILS

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Denser/harder soil layers often found under very shallow depths in Sri Lanka. In such circumstances, helical piles offer an economical alternative to traditional foundation types such as pad footings, rafts or piles while providing required support to the structure. Main objective of this study was to check whether the existing empirical relationships given in literature can still be used under Sri Lankan subsoil conditions to approximate pile capacities or to determine installation torque needed in attaining necessary design loads with little error.

In this study, axial performance of helical piles were evaluated through in-situ static load tests, theoretical studies, numerical modelling, and empirical relationships. Terzhaghi (1943) general bearing capacity equation was used to evaluate bearing capacity at each helix level theoretically. Numerical modelling was done using Plaxis2D software and findings from Hoyt et al. (1989) and Perko (2009) were used to calculate pile capacities from empirical relationships. In-situ tests provide the actual capacity of helical piles. Based on static pile load test results, suitability of using empirical factors (K_t) given in literature to determine axial pile capacities or to find installation torque needed in achieving design loads is checked. In this study, 19 static load tests were conducted and suitable values for K_t will be suggested under Sri Lankan subsoil conditions if values given in literature does not provide accurate estimations. Diameter method is proposed as the failure criterion in determining ultimate pile capacity from in situ tests and numerical models. Load transfer mechanism of helical piles were also examined to determine the validity of theoretical capacity evaluation.

Based on the results for axial capacities, suitable values for K_t are suggested for tested soil conditions and pile types under compression and tension loads. Results show K_t tend to be higher under compression and around or below values given in literature under tensile loads for tested soil types. Under compressive loads numerical models tend to provide accurate estimations whereas capacities evaluated using existing empirical factors proved close to actual capacity under tensile loads. Based on displacement contours from numerical models, a cylindrical shear failure profile between helices along with bearing failure of lead helix in the direction of loading was observed.

Keywords: helical piles; axial performance; capacity correlations; numerical modelling

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