A study of static capacity estimation methods for bored piles in residual soils

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Failure of a structurally sound pile can be due to two reasons: (i) shear failure of the soil surrounding the pile and; (ii) excessive settlement of the foundation, i.e. more than an allowable limit. Therefore, the task of the foundation designer is to find out an economical pile to carry the working load with a low probability of shear failure while keeping the resulting settlement to within allowable limits. In designing a single pile against shear failure, it is customary to estimate the maximum load that can be applied to a pile without causing shear failure, generally referred to as the ultimate carrying capacity. In practice the ultimate carrying capacity is estimated using the static bearing capacity methods and then sometimes, verified by subsequent pile load tests.

In this study to estimate the skin frictional resistance of bored plies, three empirical correlations, namely, Meyerhof empirical correlation (Bowles 1996), the ICTAD guidelines, and the method proposed by Poulos and Davis (Poulos and Davis 1980) are used. Measured pile capacities considered in this paper consist of data collected from a series of tests on bored cast-in-place concrete piles in which dynamic pile load testing was carried out according to ASTM D4945. Added advantage of the dynamic load testing using PDA is that both the skin frictional resistance and the end bearing resistance are estimated separately. It should be mentioned here that the PDA measures the mobilized resistance against the movement of the pile during the application of the hammer blow. Even though none the piles tested had reached failure, the skin friction mobilized may be closed to the ultimate skin friction resistance due to the small displacement required for full mobilization of skin friction. However, due to the large displacement needed for mobilization of ultimate end bearing capacity, it could be concluded that the measured end bearing resistance is a lower bound to the ultimate end bearing capacity.

All of the piles tested in the test program are drilled using bentonite slurry and they are resting on bedrock. It is clear from the above data that the skin frictional resistance is significant in end bearing bored piles in residual soils. It is also evident that Poulos & Davis method under predicts the ultimate skin frictional resistance of bored piles in residual soils. In practice it is assumed that the net ultimate end bearing capacity of bedrock is 5 N/mm^2 and it is seen from the above data that the assumption is a conservative one for rock with high RQD and Unconfined Compression Strength.

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