

A static pile load test (SPLT) can be considered the best choice to determine the pile foundation bearing capacity (BC). However, interpretation methods of SPLT give different results for the ultimate BC value (Q_u), and the test takes a long time. For the preliminary design of piles, the Standard Penetration Test (SPT) based design methods can be used. Still, the predictions of SPT methods provided a significant difference in the resulting values compared to the actual value computed based SPLT. Therefore, the main objective of this research is to evaluate these methods and propose a modified framework to estimate the BC based on SPT results. The suggested framework requires determining the failure zone of the piles by using the finite element method (FEM) and finding the best method to determine the appropriate factors for the soil in Nasseriyah

The research considered 22 piles in different areas of the city of Nasseriyah in southern Iraq and included data analysis using fifteen methods to interpret the loads resulting from the SPLT. Then the value of the ultimate bearing capacity (BC) of the pile was predicted by applying seven direct methods of SPT. Three criteria have been used to evaluate direct SPT methods: best fit line, mean, standard deviation and log distribution curve. Also, the FEM has been used for single piles to analyze the behavior of the pile subjected to vertical load and produce the pile load-settlement (Q-S) curve. The method of analysis using the FEM offered possibilities to determine the depths of failure of the piles, which provided the opportunity to determine the limits of failure for each pile. Then, an equation was proposed to calculate the BC of the pile. In addition, FEM was applied to a group of piles as a case study. Finally, a reliability analysis was performed to update the resistance factors used in load resistance factors design (LRFD), utilizing both measured

ultimate bearing capacity and predicted ultimate bearing capacity depending on SPT

It was concluded that some methods of interpretation, such as Shen and Buttler, did not give a clear visualization of the failure curve of the piles and others such as Chin-Kondner and Decourt could be used to complete the failure curve of the piles. It was also found that the Chin-Kondner method gave the highest Q_u while the Buttler method provided the lowest load. With respect to SPT direct methods, they provided a high BC of piles while the proposed equation with modified factors gave Q_u with a coefficient of variation (COV) value of 10% for twelve piles and 33.3% for the other ten piles as evaluated by three criteria

Concern to the effective zone limits of piles computed by FEM, it was concluded that the limits of the effective zone of the piles for clay (8.4B above the base of the pile and 6.46B below the base) with the dispersion 2.3% and 1.4% for above and below the end pile, respectively. The effective zone of piles in sand (4B above the base and 3.65B below the base) with the dispersion of 0.43% and 0.4% for above and down the end pile, respectively. The proposed SPT-based design method in this research was also verified for a case of group piles that showed a good agreement with FEM. Finally, the resistance factor for piles based on the proposed equation gave a value of 0.43, which can be used in the LRFD method