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Horizontal Bearing Capacity of Pile in Sand by Neural Networks

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Abstract

In this research the application of the artificial neural network to predict the lateral load capacity of short piles in sand was studied. piles with different diameter and length were considered as rigid and short piles so failure is due to soil governed criteria.Ultimate lateral load capacity was computed with theoretical method and results were compared to neural network predictions based on two criteria: the first one is the best fit line for predicted lateral load capacity (Q_p) and computed lateral load capacity (Q_c), and the second one is the cumulative probability for Q_p/Q_c. Different sensitivity analysis was discussed to identify the most important input parameters.

Keywords: Pile,Lateral load,Neural Network

1. INTRODUCTION

The design of pile foundations and the estimation of static pile capacities based on measured soil properties have improved considerably over the years. However due to inherent soil variability and the disturbance caused by pile installation, there is always an element of uncertainty about the designed capacity. design of axial loaded pile can be done be solving equations of static equilibrium whereas design of lateral loaded piles requires solution of nonlinear differential equations. Poulos and Davis[1] used elastic analysis adopting the Winkler soil model. but such methods are not suitable for the nonlinear soil behavior which can be incorporated in the analysis by considering nonlinear p-y curves as suggested by Matlock and Reese [2].Portugal and Seco e Pinto [3] used the nonlinear p-y curves and finite element method for prediction of the behavior of laterally loaded piles. even though the method is most widely used, due to the variability of soil properties there is uncertainty in such predictions. Other semi-empirical methods used for lateral load capacity of piles are due to Hansen [4], Broms [5] and Meyerhof [6].

The actual bearing capacity of the pile as installed in the field can only be verified by static load tests. However static load test are costly and time-consuming. In certain situations, such as in the offshore environment, the adverse site conditions may render a static load test unmanageable. These practical constraints and cost considerations have given great impetus for research into alternative methods of determining pile capacities. Recently, artificial neural networks (ANNs) have been successfully applied to many application in geotechnical engineering. In particular, neural network were used to predict the static pile capacity. Goh [7] used back propagation neural network (BPNN) to predict the skin friction of pile in clay. Goh [8,9] observed that ultimate load capacity of driven timber, pre-cast concrete and steel piles in cohesionless soils using ANN was found to outperform the methods like engineering News formula, the Hiley formula and the Janbu formula. Chan et al [10] and Teh et al [11] found that the static pile capacity predicted by using neural network have excellent agreement with the same obtained by using the commercially available computer code CAPWAP [12]. Lee and Lee [13] used neural networks to predict the ultimate bearing capacity of piles based on model and in situ pile load test results.Abu-Kiefa [14] used a generalized regression neural network (GRNN), which is a type of probabilistic neural network to predict the pile load capacity considering separately the tip, the shaft and total load capacity of piles driven in cohesionless soils. Nawari et al[15] have used neural network for prediction of axial load capacity of steel H-piles, steel pile and pre-stressed and reinforced concrete piles using both BPNN and GRNN. They also predicted the top settlement of drill shaft due to lateral load based on in situ testing. The two criteria are selected to compare the ANN model with the available theoretical method: the best fit line for predicted load capacity (Q_p) and measured capacity (Q_m),