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Piles in sandy soil: A numerical study and experimental validation

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Abstract

Pile foundations are structural elements, highly recommended as a load transferring system from shallow inadequate soil layers into competent soil strata with high performance. There are several theoretical and numerical approaches available concerning the pile bearing capacity in cohessionless soil, however, there is a need for the development of an accurate and more robust predictive model. In this technical note, the details of experimental work to investigate the pile bearing capacity penetrated in dense sub rounded sand as confirmed by scanning electronic microscopy (SEM) tests with a Dr of 85% is discussed. A testing programme comprised of three types of model piles (steel open-end, steel closed-end and concrete pile). The piles slenderness's ratios (lc/d) are varied from 12, 17 and 25 to simulate the behaviour of both flexible and rigid pile designs. In addition, a novel approach of multi-layered artificial neural networks (ANNs) based on the Levenberg-Marquardt approach (LM) was developed. Finally, the accuracy of the developed ANN model was evaluated using independent test data. The results indicated that the optimised model is highly suited for predicting of the pile-load capacity for the described soil with correlation coefficient, R and root mean square error (RMSE) of 0.97095 and 0.074025 respectively.

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Keywords: Pile foundation; slenderness ratio; artificail neural network; cohessionless soil.

1. Introduction

Pile foundations are slender structural elements underneath superstructures commonly used as load transferring systems at sites encountering inadequate sub-soil layers. Pile bearing capacity and associated settlement at certain applied loads play a key role on the pile foundation design process [1]. Bearing capacity is normally achieved by dividing the ultimate applied load by a certain factor of safety depending on the building serviceability requirements

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