UNIVERSITI TEKNOLOGI MARA

PERFORMANCE OF PFA-CEMENT-SAND STABILIZED COLUMN IN SOFT SOIL

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ABSTRACT

Renewable and eco-friendly development are vital concepts to be considered for ground improvement methods in construction practices. One of the method to achieve this is by implementing usage of waste material in construction. Therefore, the main objective of this research is to use Pulverized Fuel Ash (PFA) in stabilized column by studying the impact of this waste material against strength parameters of the stabilized column. small shear box (SSB) and big shear box (BSB) tests were conducted to determine shear strength parameters while unconfined compression test (UCT) are carried out to determine unconfined compressive strength (q_u). Results have shown that by using PFA, strength parameters can be improved while for q_u, the highest value recorded is close to the concrete grade 20 (G20). Plate load test was conducted on PFA-cement-sand column. 6 steel-tanks with dimension of 800 mm x 800 mm x 1500 mm containing soft soil collected from Klang Valley, Selangor are prepared. The columns (included sand and cement columns) are then installed and left for 28 days for curing process before plate-load test is conducted. Results for allowable load capacity (q_a) of PFA-cement-sand column recorded almost 4 times higher load capacity at 3.37 kN compared to cement column (0.95 kN) and sand column (0.29 kN). Numerical analysis with PLAXIS software is then conducted to calibrate with the experimental test results. Further tests are conducted using PLAXIS to analyse the effect of various column dimension on q_a. Data from laboratory test and PLAXIS analysis is then used to train the Artificial Neural Network (ANN) to predict q_a and strength parameters. The ANN trained for this study provides a high value of regression, where $R > 0.92$ which indicates high level of accuracy. In conclusion, the PFA-cement-sand column has proved that the strength parameters of column can be increased by using PFA and can provide better solution compared to other stabilized columns such as cement and sand column. In fact, this column can produce a high q_u, similar to concrete even though it uses low percentage of cement and without any crushed stone. In addition to that, the ANN model trained in this study will assist in designing stabilized column by predicting the strength parameters and allowable load capacity based on various input parameters without any calculation.

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CHAPTER ONE
INTRODUCTION

1.1 INTRODUCTION

This chapter explains the background of the research, describes the objective based on the research problem and defends the significance of the research in developing a new technique in ground improvement engineering. This research introduces Pulverized Fuel Ash (PFA) as one of the alternative material in stabilizing and improving the geotechnical parameters of sand and cement columns. Typical disadvantages of these stabilized columns are limited compression and shear strengths provided, lower bearing capacity, bulging problem especially sand column and high cost. Therefore, this research is conducted to design the optimum proportion of PFA-cement-sand column, to determine the allowable load capacity based on hanging column with various diameters and lengths using PLAXIS and design a new system using Artificial Neural Network (ANN) by MatLAB to calculate the shear strength parameters, unconfined compressive strength and allowable load capacity of PFA-cement-sand column. In this section, the importance of conducting this study will be highlighted and the research questions related to this field will be drawn.

1.2 BACKGROUND OF STUDY

In Malaysia, it is impossible to ignore the development in weak-soil area due to limited availability of location and its obligation to meet human needs for protection and development of the country in order to compete economically and to maintain international reputation. Nowadays, construction industries in Malaysia must deal with the rising number of population densities with consequences of depletion of good land availability for construction site. Therefore, this situation has forced the industry to carry out land reclamation, development of unattended land area and dealing with land area which contains soft soil (weak-soil area) (Brenkert and Beauchamp, 2012). Weak soil like alluvial clayey ubiquitous in Malaysia makes up 70% of the 5,000 km coastline of the country and in between 20 to 40 m in thickness of the soil (Gobbett and Hutchison, 1973). In construction, this type of soil is considered as problematic soil