ABSTRACT

A LABORATORY STUDY FOR A SINGLE PILE SUBJECTED TO VERTICAL AND HORIZONTAL FORCES

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ABSTRACT

In fact, the pile foundation usually carries the applied load as combined from axial and lateral load at the same time. Many previous studies dealt only with the effect of pure lateral load in the analysis of pile foundation. While few studies covered the behavior of piles under combination load. These few studies were usually done out of the laboratory. They generally used another technique like finite element or analytical methods. Therefore, this issue needs more laboratory studies for assessing the performance of pile foundation under different load combinations.

Consequently, the main objectives of this study are to model a single pile in a laboratory when subjected to different load combinations, and with different slenderness ratios, pile materials, pile cross sectional areas, and finally with three relative soil densities. The applied axial load is divided into six stages (i.e. 0%, 20%, 40%, 60%, 80% and 100% from the allowable pile capacity). While the lateral load is divided into five stages (i.e. 20%, 40%, 60%, 80% and 100% of the lateral load). In addition, the other parameters taken into account are the pile slenderness ratio (i.e. 25, 30, 35, 40 and 45), pile materials (i.e. aluminum and steel), pile cross-section (i.e. square and circle) and soil relative densities (i.e. 30%, 50% and 70%). In this study, the soil is prepared using raining technique, while the loads are applied directly on the tip of the piles.

Based on the results, it can be seen that in most cases the lateral deformation of the pile under pure lateral load was larger compared with a case that included combined loads for different soil densities. The reduction in the displacement reaches for example to 57%, while in specific cases like L/D=45 (in case of aluminum pole), the axial load increases the lateral pile displacement and this value reaches to about 42%. This means that the application of axial load clearly affects the lateral pile performance.

In addition, the lateral capacity of a square pile section is more than that of circular pile section for different soil densities and different materials. The increase of pile capacities reacts to 47% for L/D=25 and 58% for L/D=45. It can also be seen that the increase of axial loads produces lead to excess in the amounts of bending moment in most cases.

Finally, this study develops the p-y relationship for both the pile displacement and lateral soil opposition. The pile displacement and the soil behavior appears as nonlinear in all cases which is usually close to the actual performance and can be used directly for the analysis and design of pile foundation.