



Numerical Investigation on Pile Group Lateral Deflection under Combined Loading

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Abstract

In practice, Pile foundations mostly consist of a group of piles and usually subjected to a combination of vertical and lateral loads. Specifically, pile groups support a combination of vertical due to superstructure gravity, lateral loads during an earthquake. One of important design criteria under such loading conditions is to control the lateral deflection of the pile group. In this article, using numerical analyses by FLAC3D finite difference software, the lateral deflection of pile group in sandy soils under combined loading have been evaluated and compared with the ultimate lateral deflection of the pile group. The research results indicated that lateral deflection of pile group depends on combination of loading components as well as the type of pile response under lateral loading. The effect of pile spacing and pile geometry on the pile group deflection was also considered.

Keywords: Pile group lateral deflection, combined loading, finite different element, FLAC3D

1. INTRODUCTION

Using pile foundation as the most perfect foundation system, particularly in problematic soils, supporting lateral loads, and controlling excessive settlements has met the interest of many practicing civil engineers. These piles are not only used to support vertical loads, but also lateral loads and combination of vertical and lateral loads. These lateral loads can come from a variety of sources such as wind forces, wave impact, earthquake shaking, liquefaction, and slope failure. Previous research based on pile group under vertical and lateral loading, can be divided in experimental studies such as full-scale and small-scale tests, and numerical analyzing. Using full-scale tests during designing of deep foundations are as one of a major pillar to prove of accuracy operation of pile groups and to confirm of obtained design parametric. Today, use of these tests is fewer due to the huge expenditure of these tests. So, significant data is obtained from small-scale tests as well as centrifuge tests and numerical studies. However, these tests cannot indicate response of pile better than full-scale test because it is not possible to simulate a real attitude of tension in soil, in particular the creature tensions during performance of pile [1]. It has been done varied pile group studies under vertical or lateral loading about influence of distance of piles, loading distribution between piles of group, lateral deflection of the pile group, and number of piles up to now. Poulos (1975), by considering free-head pile found a good agreement between the measured load deflection curve for varied tests of piles in clay and predicted from the theoretical curve [2]. Also poulos (1980), by using a simple method of predicting the load-deflection behaviour of a laterally loaded pile group indicated a good link between the observed and predicted load deflection behaviour of pile group. In addition he suggested that this method is able to providing satisfactory load-deflection for laterally loaded pile group [3]. Karthigeyan (2005), via numerical method indicated that combined loading cause the greater deflection in pile group. Axial loading have significant influence on lateral loading that this depends on type of pile response under lateral loading (such as rigid and flexible) and fixed position of piles [4]. Limkatanyu and his colleagues (2009), via finite element numerical method implied that pile geometric parameters are effective on pile deflection. They studied pile length and diameter for investigating this case. For example they mentioned both lateral strength and stiffness of the pile-soil