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Parametric study of generated bending moment in pile groups located in liquefiable soils

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Abstract
An important issue that's the reason of damages and collapses during earthquake is liquefaction of loose and saturated sands. After reduction of soil strength, piles will behave like unsupported columns. So it seems that behavior of these piles and their analysis method isn't clear and suitable. For a better view, a pile group is modeled using FLAC3D software that is connected to each other with a cap. Soil profile has three layers that middle layer is liquefiable and other two layers isn't. In this research generated bending moment in pile group in different values for liquefied layer's thickness and pile length has investigated. Before analysis of model, sensitivity analyses is carried out to achieve accurate results in less computing time.
Keywords: Soil Liquefaction, Pile Groups, Dynamic Analysis, Bending moment.

1. INTRODUCTION

Liquefaction phenomena involve soil deformations caused by monotonic, transient, or repeated disturbance of saturated cohesionless soils under undrained conditions. The generation of excess pore pressure under undrained loading condition is a hallmark of all liquefaction phenomena. The tending for dry cohesionless soils to densify under both static and cyclic loading is well known. When cohesionless soils are saturated, however, rapid loading occurs under undrained conditions, so the tendency for densification causes excess pore pressure to increase and effective stress to decrease [1]. In this position soil behave like liquid and large amount of strain and continuous deformation occurs. Seed defined liquefaction as a state that soil with low or no resistance will had continuous deformation [2].

Determining seismic response of pile foundations that are located in liquefied soil layers is difficult and there are many obscure issues about mechanism and soil-pile interaction. However in recent decades, extensive studies with centrifuge and shaking table have been done in this field and several numerical methods have been proposed. These studies can be divided into local studies, laboratory experiments and numerical models. Local studies are used for identification of failure patterns, settlement and lateral displacement of piles. Laboratory tests are done by centrifuge and shaking table. Numerous experiments had been done in this field that one of the most important researches, is Abdoun and Dobry's studies. They used geotechnical centrifuge and studied bending behavior of pile foundations in laterally spreading soil [3]. Also interior researches had been done by Haeri et al and pore water pressure variation, bending moment and soil-pile interaction under earthquake loads and laterally pressures due to lateral spreading of soil is evaluated [4]. Numerical simulation tools in study of liquefaction are very important, because achievement of desired results in physical models in laboratory simulations isn't possible. Due to computational complexity and time required for two and three dimensional analysis, most of researchers and designers use one-dimensional Winkler model in seismic analysis of pile foundations. In this research, FLAC3D finite difference software is used. Also Finn constitutive model is assigned for liquefiable layer to consider stress-strain behavior of saturated sand layer in undrained condition and effects of soil liquefaction is studied on generated bending moment in the pile group. In this research four concrete pile with circular section modeled and piles attached to each other with a cap. Soil profile contain three layers that middle layer has liquefaction potential and other layers hasn't.