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Numerical Analysis of Inclined Micropiles Behavior Under Seismic Load

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ABSTRACT

Performing human made that lead to structures damages have occurred due to earthquakes and seismic load. Studying the existing structures and the methods of retrofitting has an important role in earthquake-prone countries. Nowadays, micropiles are commonly used in structures as a practical element to retrofit the seismic behaviors. In this paper, inclined micropiles under the earthquake load were analyzed by finite difference method using FLAC 3D. The approach considers an idealization for micro pile-soil system in three dimension model in order to evaluate logically their behaviors when the earthquake occurs. The micropile is assumed to be linear elastic and the soil is elastoplastic material. The micropile's failure is controlled by the Mohr-Coulomb criterion and all the micropiles were analyzed on the load of earthquake recorded in Tabas, Iran, 1978. The results obtained from the numerical analyses were compared with available other data, indicating a satisfactory agreement. The results show that the inclined micropiles, due to being in the soil, give more hardness to it. So these cause less displacement in comparison with vertical ones. Also the micropile-soil interactions in performance of inclined one were salient.

Keywords: *micropile, inclined micropile, soil improvement, seismic behavior, micropile-soil interaction, finite difference methods.*

1.INTRODUCTION

For using the micropiles in seismic retrofitting or seismic zones we need to know about analysis of the seismic-induced response for the micropiles with inclined elements. In fact , because the stiffness and resistance of vertical micropiles to lateral loading is small, using inclined micropiles is the potential alternative for inertial forces and for making sure about the stability the foundations under seismic loading. But using the micropiles in seismic area has limitation which is for designing the piles , because due to several researches, the function of inclined is not suitable. The inclined piles may be have a big energy on piles or if the inclined of caudles is not symmetric , permauent rotation may develop due to varying stiffness of the pile group in each direction. According to the French recommendation (AFPS) [1] using the inclined piles in seismic areas is forbbidened, but reinforcement of soil can be include inclined elements. The seismic reccomodation (Eurocode EC8) [2]. Indicates that inclined piles shoulden't be use for transmitting lateral loads to the soil, but if these piles are used , they should design bending loading. On the other hand , according to Gazetas and Mylonakis's report [3] curreutly the different observation is recorded which is shown that inclined piles, in certain cases , has a good function for the structure they support and the piles. One of the observation which support it happens in Kobe earthquake. Which one of the few quay-walls that survived the disaster in Kobe harbor was a composite wall which is relying on inclined piles and the near wall supported on vertical piles was totaly devastated. Moreover, centrifuge tests and pseudo- static analysis which is doue by Juran et al [4] showed that pile inclination cause first the decrease on both the pile cap displacement and bending moment at the pile cap connections and second the increase in axial force on piles.

2.Analysis Method

FLAC [5] is a 3-dimensional explicit finite – difference plan in mechanics compalation engineering for simulating the behavior of 3-dmensional soil structures based on rock and the other undergoing plastic flow materials when they reached. Materials are showed by polyhedral elements in a 3-dimensional grid that is modified by the user to fit the shape of object to bemdeled. Each case behaves due to a prescribed linear of nonlinear stress in response to applied forces or boundary restraints. The material can deform at large strain.