DYNAMIC ANALYSIS OF PILED RAFT SYSTEM ON SAND USING THREE DIMENTIONAL FINITE ELEMENT METHOD

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Piled raft foundations provide an economical foundation option for circumstances where the performance of the raft does not satisfy the design requirements. A piled raft is a hybrid foundation in which the piles are usually used as settlement reducers and applied loads from superstructure are transferred by both piles and raft. Generally, in piled raft system, which indicates a complex mechanism rather than the pile group, the main problem is prediction of system's settlement regarding to load distribution between raft and pile group.

Many researchers (i.e. Fraser and Wardle, 1976; Poulos and Davis, 1980) made efforts to clarify the complex mechanism of the piled raft system under static loading conditions. Also, Randolph (1994) introduced piled raft system as differential settlement reducer by placing several piles around the center of a raft. On the other hand, Sommer et al. (1991) implemented more piles near the edges of the raft for high rise building of ‘‘Messes Turm’’ in Germany. Horikoshi and Randolph (1996) have investigated the mechanism of the piled raft system with centrifuge modeling tests.

Moreover, in earthquake condition, the mechanism of piled raft system is more complex rather than static condition. For this aim, in present study, the piled raft system on sandy layer is analyzed using three dimensional finite elements modeling to compare its static and dynamic bearing behavior i.e. Dynamic Load Factor or named DLF). ABAQUS software was utilized for modeling of a piled raft system with nine concrete circular piles (3×3 pile group). Elastic modulus, friction angle and shear wave velocity of the soil are assumed to be equal 63 MPa, 39 degree and 200 meter per second respectively. The Mohr-Coulomb criterion was used for modeling of the soil. Piles diameter and cap's thickness are both assumed to be equal to 0.5 meter. Also, in a parametric analysis, three values for spacing ratio (S/D=3, 5 and 8) and three values for length ratio (L/D= 16, 30 and 40) were chosen in order to study the roles of these parameters on dynamic response of the system. The length of piles was considered to be equal 8, 15 and 20 meter. Rayleigh damping and viscose elements were considered for energy loss in the soil and boundary conditions of the model respectively. Four values of static pressures (q=500, 1000, 1500 and 2000 KPa), which is applied uniformly on the capsurface, were considered. Also, five earthquake records (including Trinidad, Friuli, Hollister, Sakaria and Northridge earthquakes),which is applied on the bottom of the model,were used for dynamic loading of the system.

A typical result of the carried out analyses is shown in Figure1 to compare the load-settlement response of the system under static and dynamic conditions. As seen, considering static load of 500 KPa, the dynamic load factor (DLF) of piled raft system was obtained about 3.14 and 5.55 for Holister and Trinidad earthquakes respectively. And, also, considering static load of 2000 KPa, DLF was obtained about 1.13 and 3.45 for the mentioned earthquakes respectively. The obtained results indicate that DLF is decreased with increasing of the static loads for all implemented earthquakes. On the other hand, DLF is increased with increasing of ground motion intensity.

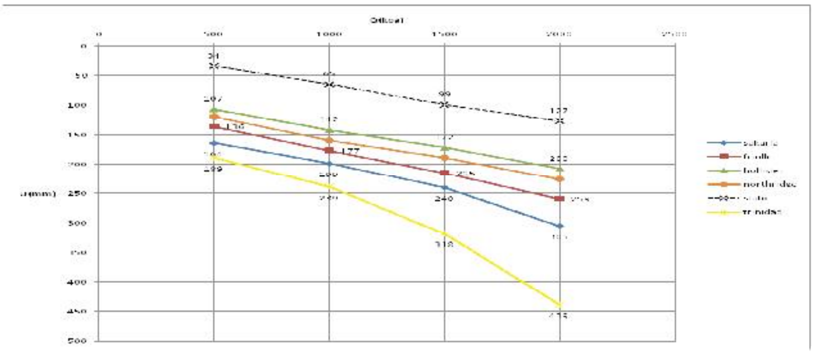

Figure 1. Load-settlement behaviour of piled raft system under static and dynamic loading conditions

Also, based on the results obtained from dynamics analysis with Trinidad earthquake record, the effects of S/D and L/D on piled raft settlement is shown in Figure 2. As seen the settlement is increased with increase of S/D and it is decreased with increase of L/D.

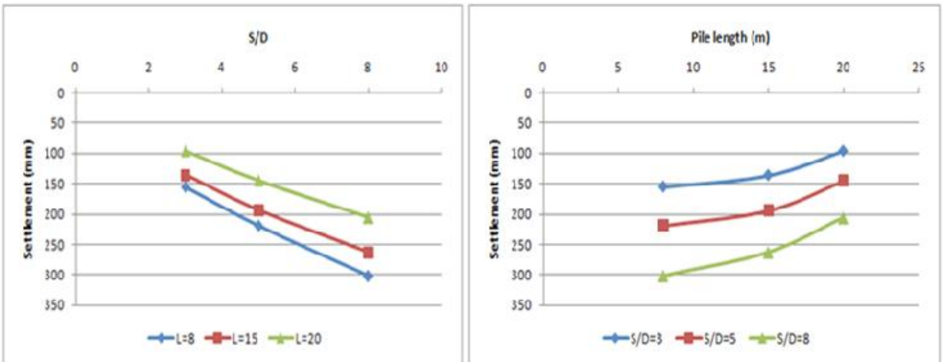

Figure 2. Effect of pile length and S/D on piled raft settlement under both static loads and Trinidad earthquake

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