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Collapse Load Analysis of Reinforced Concrete Pile Group in Liquefying Soils under Lateral Loading

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Abstract : The ultimate load analysis of RC pile groups has assumed a lot of significance under liquefying soil conditions, especially due to post-earthquake studies of 1964 Niigata, 1995 Kobe and 2001 Bhuj earthquakes. The present study reports the results of numerical simulations on pile groups subjected to monotonically increasing lateral loads under design amounts of pile axial loading. The soil liquefaction has been considered through the non-linear p-y relationship of the soil springs, which can vary along the depth/length of the pile. This variation again is related to the liquefaction potential of the site and the magnitude of the seismic shaking. As the piles in the group can reach their extreme deflections and rotations during increased amounts of lateral loading, a precise modeling of the inelastic behavior of the pile cross-section is done, considering the complete stress-strain behavior of concrete, with and without confinement, and reinforcing steel, including the strain-hardening portion. The possibility of the inelastic buckling of the individual piles is considered in the overall collapse modes. The model is analysed using Riks analysis in finite element software to check the post buckling behavior and plastic collapse of piles. The results confirm the kinds of failure modes predicted by centrifuge test results reported by researchers on pile group, although the pile material used is significantly different from that of the simulation model. The extension of the present work promises an important contribution to the design codes for pile groups in liquefying soils.

Keywords : collapse load analysis, inelastic buckling, liquefaction, pile group
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