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Numerical Simulation of Footing on Reinforced Loose Sand

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Abstract : Earthquake leads to adverse effects on buildings resting on soft soils. Mitigating the response of shallow foundations on soft soil with different methods reduces settlement and provides foundation stability. Few methods such as the rocking foundation (used in Performance-based design), deep foundation, prefabricated drain, grouting, and Vibro-compaction are used to control the pore pressure and enhance the strength of the loose soils. One of the problems with these methods is that the settlement is uncontrollable, leading to differential settlement of the footings, further leading to the collapse of buildings. The present study investigates the utility of geosynthetics as a potential improvement of the subsoil to reduce the earthquake-induced settlement of structures. A steel moment-resisting frame building resting on loose liquefiable dry soil, subjected to Uttarkashi 1991 and Chamba 1995 earthquakes, is used for the soil-structure interaction (SSI) analysis. The continuum model can simultaneously simulate structure, soil, interfaces, and geogrids in the OpenSees framework. Soil is modeled with PressureDependentMultiYield (PDMY) material models with Quad element that provides stress-strain at gauss points and is calibrated to predict the behavior of Ganga sand. The model analyzed with a tied degree of freedom contact reveals that the system responses align with the shake table experimental results. An attempt is made to study the responses of footing structure and geosynthetics with unreinforced and reinforced bases with varying parameters. The result shows that geogrid reinforces shallow foundation effectively reduces the settlement by 60%.

Keywords : settlement, shallow foundation, SSI, continuum FEM
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