

NUMERICAL ANALYSIS OF THE RESPONSE OF PILE-RAFT SYSTEMS CONSIDERING THE APPLICATION OF CEMENT AND POLYPROPYLENE FIBER TREATMENT

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Abstract

Long-term performance of civil engineering projects mainly depends on the strength of underground layers. When the underground soil layers are problematic or have low bearing capacity and strength against the applied loads, application of soil stabilization methods can be effective. In this study, performance of pile-raft systems using stabilized/reinforced soil under foundation is investigated. For validation, the obtained numerical results were compared with the existing results from analytical and numerical analyses. Using the experimental data available in the literature, the variations of stiffness and strength parameters were simulated by three-dimensional finite element method and then foundation response was evaluated for each case. According to the obtained results, depending on the pile-raft configuration, different strategies of stabilization with cement, reinforcement with polypropylene fibers, or a combination of cement stabilization and fiber reinforcement can be employed to reduce the differential and maximum settlements of foundation and to improve the overall performance. In general, even though reinforcement with fibers has a positive influence on the tensile and shear strength of soil, the effect of cement stabilization on the design parameters of the foundation is more pronounced. Finally, an implementation of cost analysis of stabilization project was proposed to be conducted based on the applied materials and improvement/cost ratio.

Keywords: Cement stabilization; Pile-raft system; Polypropylene fiber; Settlement; Three-dimensional finite element method.