Numerical Evaluation of Lateral Bearing Capacity of Piles in Cement-Treated Soils

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Abstract : Soft soil is used in many of civil engineering projects like coastal, marine and road projects. Because of low shear strength and stiffness of soft soils, large settlement and low bearing capacity will occur under superstructure loads. This will make the civil engineering activities more difficult and costlier. In the case of soft soils, improvement is a suitable method to increase the shear strength and stiffness for engineering purposes. In recent years, the artificial cementation of soil by cement and lime has been extensively used for soft soil improvement. Cement stabilization is a well-established technique for improving soft soils. Artificial cementation increases the shear strength and hardness of the natural soils. On the other hand, in soft soils, the use of piles to transfer loads to the depths of ground is usual. By using cement treated soil around the piles, high bearing capacity and low settlement in piles can be achieved. In the present study, lateral bearing capacity of short piles in cemented soils is investigated by numerical approach. For this purpose, three dimensional (3D) finite difference software, FLAC 3D is used. Cement treated soil has a strain hardening-softening behavior, because of breaking of bonds between cement agent and soil particle. To simulate such behavior, strain hardening-softening soil constitutive model is used for cement treated soft soil. Additionally, conventional elastic-plastic Mohr Coulomb constitutive model and linear elastic model are used for stress-strain behavior of natural soils and pile. To determine the parameters of constitutive models and also for verification of numerical model, the results of available triaxial laboratory tests on and insitu loading of piles in cement treated soft soil are used. Different parameters are considered in parametric study to determine the effective parameters on the bearing of the piles on cemented treated soils. In the present paper, the effect of various length and height of the artificial cemented area, different diameter and length of the pile and the properties of the materials are studied. Also, the effect of choosing a constitutive model for cemented treated soils in the bearing capacity of the pile is investigated.

Keywords : bearing capacity, cement-treated soils, FLAC 3D, pile

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