

Finite Element Analysis of 2 Piles in Series and Parallel Arrangement Subjected to Lateral Load

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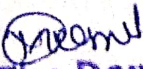
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Abstract. In most cases, the deflection criterion governs the design of pile or pile group subjected to lateral load. In the present study, 2 piles in parallel and 2 piles in series are analyzed for lateral displacement. Program for three dimensional analysis is written in FORTRAN 90. Pile is modelled using 20 node elements and soil is modeled using 8 node elements. 16 node elements are used as interface elements. It is assumed that the pile behaves elastically during the analysis. The soil behaves according to modified Mohr-Coulomb criterion. Sloan and Brooker has suggested the modification in Mohr-Coulomb criterion to overcome the problem of singularities created at vertices in finite element formulation. This modification is adopted in the present study. The effect of pile arrangement, pile diameter, soil modulus, pile spacing and pile length to diameter ratio is investigated. All these parameters influence the lateral displacement at the center of gravity of the pile group considerably.

Key words: Design of pile, Deflection criterion, Mohr-Coulomb criterion, Pile arrangement

INTRODUCTION

Out of various methods to analyze laterally loaded pile or pile group, use of finite element method is more versatile tool. Yegian and Wright (1973) implemented a finite element analysis by adopting plane strain conditions. The soil-pile interface element used was radial. He considered a single pile as well as pile group under the effect of lateral load for nonlinear analysis. Holloway et al. (1982) presented the field test results for an eight-pile group in sand, laterally loaded to failure, under constant axial load, and compared some test results with predictions made using a hybrid numerical model. Pile punching into the surrounding soil was the most likely failure mode, although some yielding of the piles at the cap may have been a contributing factor. Murff and Hamilton (1993) developed an approximate but general 3-D model using the upper bound method. The collapse load can be calculated by this method. The 3-D collapse mechanism was assumed. The influence of thickness of pile cap and inclination of pile was studied by Zaman et al. (1993) when the several forces like axial and shear force, stresses, displacement and bending moments were distributed amongst each pile in a group. Zhang and Small (2000) presented a method to analyze a pile group with an off ground pile cap. It was subjected to vertical and lateral loads. The cap was modelled as a thin plate whereas the pile was modelled as elastic beam. Further, soil was modelled in horizontal layers. Finite element technique was used for the pile and cap whereas finite layer theory was used for the layered soil. Dewaikar et al. (2002) proposed hyperbolic form of nonlinear Winkler springs in respect of cohesionless soil under static loading. The governing equation for beams on elastic foundation was implemented to study response of laterally loaded piles. Ilyas et al. (2004) conducted centrifuge tests on pile and group of piles in kaolin clay. He found that as the number of piles in the group were increased, the efficiency of the pile group was decreased. It also found that within a row of piles, outer piles carry higher load and bending moment as compared to inner piles. Fan and Long (2005) analyzed the laterally


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