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Interactive analysis of a building fame resting on pile foundation

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Abstract. The study deals with the physical modeling of a typical single storeyed building frame resting on pile foundation and embedded in cohesive soil mass using the finite element based software SAP-IV. Two groups of piles comprising two and three piles, with series and parallel arrangement thereof, are considered. The slab provided at top and bottom of the frame along with the pile cap is idealized as four noded and two dimensional thin shell elements. The beams and columns of the frame, and piles are modeled using two noded one dimensional beam-column element. The soil is modeled using closely spaced discrete linear springs. A parametric study is carried out to investigate the effect of various parameters of the pile foundation, such as spacing in a group and number of piles in a group, on the response of superstructure. The response considered includes the displacement at the top of the frame and bending moment in columns. The soil-structure interaction effect is found to increase the displacement in the range of 38 -133% and to increase the absolute maximum positive and negative moments in the column in the range of 2-12% and 2-11%. The effect of the soil- structure interaction is observed to be significant for the type of foundation and soil considered in this study. The results obtained are compared further with those of Chore *et al*. (2010), wherein different idealizations were used for modeling the superstructure frame and sub-structure elements (foundation). While fair agreement is observed in the results in either study, the trend of the results obtained in both studies is also same.

Keywords: soil-structure interaction; pile groups; pile spacing; top displacement; bending moment

1. Introduction

Framed structures are normally analyzed with their bases considered to be either completely rigid or hinged. However, their foundation resting on deformable soils also undergoes deformation depending on the relative rigidities of the foundation, superstructure and soil. Interactive analysis is, therefore, necessary for accurate assessment of the response of the superstructure. Numerous interactive analyses (Chameski 1956, Morris 1966, Lee and Brown 1972, King and Chandrasekaran 1974, Buragohain *et al*. 1977) have been reported in many studies in the 1960-70's and a few in recent studies (Shriniwasraghavan and Sankaran 1983, Subbarao *et al*. 1985, Deshmukh and Karmarkar 1991, Viladkar *et al*. 1991, Noorzaei *et al*. 1991, Dasgupta *et al*. 1998, Mandal *et al*. 1999). While most of the above mentioned studies dealt with the quantification of the effect of interaction of frames with isolated footings, or combined footings, or

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