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Soil-Structure interaction in piled-raft foundation compound system

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Abstract
Soil-structure interaction refers to the interaction between a structure, its foundation and the subsoil. As the term soil-structure interaction covers a broad field, the work presented in this paper will be restricted to the analysis of raft or piled-raft foundations under static load. Piled-raft is composite structures which are comprised of three elements: the piles, raft and supporting soil. Loads applied to the raft are transferred to the soil through the piles. Therefore, it is necessary to take into account the interaction among the three elements. Four different types of interaction have to be considered in the analysis. In this paper, the interaction mechanism for piled-raft foundations is discussed and the use of the finite layer technique to compute the interaction factors is presented.

Keywords: interaction, piled-raft, finite layer, pile, raft, soil supporting

۱. Introduction

Methods for the analysis of soil-structure interaction have been developed over many years. Lee and brown (۱۹۷۲) developed an analysis by treating the structure, foundation and soil system as an integral unit. The soil was treated as a Winkler or linear elastic model. The method was applied to the analysis of a multi-bay frame. Results have shown that the maximum moment in the foundation decrease with increasing flexibility of the foundation. Fraser and Wardle (۱۹۷۵) used the finite element method to analyze a two bay portal frame on a layered cross-anisotropic elastic continuum in which the frame was modeled by beam elements, the raft by plate elements and the soil surface by surface elements. The elastic continuum was assumed to consist of a number of horizontal layers of uniform thickness with infinite lateral extent. It was found that the differential displacements depend on the stiffness of the structural frame and cross-anisotropy of the soil has significant effects on the interaction. Brown (۱۹۷۵) showed that for structures on strip footings, the differential displacements in the raft were dependent on the relative stiffness of the structure.

Zhao and Cao (۱۹۸۵) used the substructure method to analyze a twelve story frame structure with two basements founded on soft clay. The structure, raft and the soil were analyzed as a whole system. Results have shown that a variation in the stiffness of the structure, raft or soil would cause a redistribution of the force in the system. As the superstructure contributes additional stiffness to the raft, bending moment in the raft was reduced which led to forces being transferred to the superstructure and resulted in increasing the bending moment in the structure. Yao and Zhang (۱۹۸۵) have shown that relative