ABSTRACT

The objective of this dissertation has been to develop a simple yet rational and reasonably accurate method of analysis with a view to investigating the dynamic response of footings supported on piles. The theoretical formulations have been developed for straight shaft circular pile embedded in non homogeneous soil and subjected to harmonic vertical excitations or rocking coupled with horizontal vibrations. Three different types of soil deposits having constant shear modulus over depth, parabolic variation of shear modulus with depth and layered soil with soft layer under a stiff layered deposit have been taken into consideration.

In the proposed method of analysis suitable assumptions regarding elastic and viscous-damping functions have been made for evaluating the soil reaction acting on a pile during steady-state harmonic motion. Dynamic pile-soil interaction has been interpreted as frequency dependent complex stiffness or impedance function at the head of the pile for the respective modes of vibration. Hence, the complex soil pressures are expressed category wise, namely, vertical soil reaction for vertical motion of the pile and horizontal soil reaction for coupled horizontal motion of the pile. Accordingly, the equations of motion for various modes of vibrations have been developed. Dynamic direct stiffness method has been utilized for the numerical solution of the equations of motion for various boundary conditions. Computer programmes have been developed for different modes of vibrations to obtain the numerical solutions.

The proposed method has also been extended for the solution of pile groups under different modes of vibration. In these method pile-soil-pile interaction has been approximately accounted for and accordingly modified soil reactions on piles are evaluated for the solutions of the problem.

An extensive study has been made to examine the influence of different soil pile characteristics on dynamic response of pile. A sequentially arranged sets of graphs and tables have been presented to identify the influence of different factors. To check the validity and to assess the accuracy of the proposed theoretical analysis the results of the experimental investigations and analytical solutions of other workers have been compared with the numerical solutions of the proposed method. The proposed method of analysis and the developed computer programmes are quite effective to predict the dynamic response of the pile supported footings for various modes of vibration under different soil conditions and pile properties with a fair degree of accuracy. The results are in good agreement with those of available experimental and analytical investigations.

Keywords: *dynamic response, harmonic excitations, layered soil, viscous-damping, pile-soil interaction, impedance functions, modes of vibration, dynamic direct stiffness method.*