ABSTRACT

Pile foundations supported by single or group of piles - curved, straight and batter under frequency dependent vertical harmonic excitation causing coupled mode of vibrations have been analysed. The basic governing wave equations for curved beam - column in a plane has been modified and utilised for analysing the curved pile, straight vertical pile, batter pile along with pile groups. Making suitable assumptions the theoretical analysis has been developed to replace the soil-pile interactions by elastic stiffness and equivalent viscous damping functions for different modes of vibration. Using finite difference method with proper boundary conditions the differential equations have been solved for pile nodal displacements from which the stiffness and damping parameters have been evaluated and utilised to determine the stiffness and damping co-efficients for pile supported footings. With the help of these impedance functions, i.e., stiffness and damping parameters, the foundation vibration response has been predicted. The present method of analysis is unified and generalised and it is capable of analysing curved, straight, batter piles and pile groups.

To establish the validity of the theoretical results a good number of experiments were conducted on model piles made of wood, aluminium alloy and mild steel. Initially curved, straight vertical and batter piles and pile groups were selected for testing under dynamic vertical loads. Uniform dry Ennore sand obtained from Madras, India was used as foundation media. To minimise the distortion effects, 25 mm thermocol was placed inside walls and bottom of the test tank. The dynamic shear wave velocity of soil was determined by ultrasonic wave propagation test. The dynamic vertical harmonic load was applied with the help of vibration exciter. The vertical and horizontal response of pile supported footings have been recorded with the help of electrodynamic vibration pickups and LVDT.

Computer programs have been developed in Fortran IV to work on a high speed computer CYBER 180/840. The theoretical and experimental results are presented through Figures and Tables. Parametric study has been carried out to ascertain the qualitative and quantative influence of various factors like Poisson's ratio of soil ν, mass density ratio ρ_s/ρ_p, dimensionless frequency a_0, shear wave velocity ratio V_s/V_c pile tip relaxaton, pile curvature η, angle of batter α, pile spacing - diameter ratio S/d and number of piles in a group on the stiffness and damping parameters and dynamic response of pile supported footings. Author's theoretical results have been compared with the analytical and experimental values of others and author's experimental results. It is observed that the results are reasonably in good agreement with each other. Conclusions on different aspects of the investigation have been outlined. Typical flow charts of computer programs are furnished. It is expected that the investigation will contribute additional useful information on the dynamics of pile foundations.

The thesis consists of Eight chapters :

1) INTRODUCTION
2) REVIEW OF LITERATURE
3) OBJECT AND SCOPE OF THE STUDY
4) THEORETICAL ANALYSIS
5) EXPERIMENTAL INVESTIGATION
6) THEORETICAL AND EXPERIMENTAL RESULTS
7) COMPARISON OF RESULTS WITH EXISTING DATA
8) SUMMARY AND CONCLUSIONS.

KEY WORDS : Dynamics, Longitudinal-Flexural vibration, Pile foundation, Curved pile, Straight pile, Batter pile, Pile groups, Computer application, Soil-structure interaction, Finite difference, Continuum, Experimental investigation, Model piles, Sand, Mass density, Shear wave velocity, Poisson's ratio.