CHAPTER I

INTRODUCTION

1.1 General

For the last thirty years, several methods of analysis have been employed for predicting the settlement of single pile and pile groups. Usually, the soil domain has been considered as an elastic material. For the cases where there is fluid-saturated in the medium, this assumption is not entirely accurate. Moreover, natural soil profiles are normally layered in character with different properties and thickness. In the past, a number of researchers considered a soil medium as a homogeneous poroelastic half-space which behaves according to Biot's theory of poroelasticity. However, due to the properties of natural soil profiles, the representation of the supporting medium should be considered as a multi-layered poroelastic half-space.

This thesis presents the problem of a vertically loaded pile group embedded in a multi-layered poroelastic medium. The piles-poroelastic medium is decomposed into a group of one-dimensional fictitious elastic bodies and an extended multi-layered poroelastic half-space. Each layer of the extended half-space is governed by Biot's theory of poroelasticity. Axial displacement of the piles is assumed in the form of an exponential series with a set of arbitrary coefficients. The total potential energy of the system in Laplace transform space, consisting of the strain energy of the piles and the medium, and the potential energy of the applied load, can be expressed in terms of these arbitrary coefficients. The minimization of the total potential energy of the system yields a set of linear simultaneous equations for determination of the unknown coefficients. The quasi-static response in time domain is finally obtained by using an appropriate numerical Laplace inversion scheme.

1.2 Objectives of Present Study

The objectives of this thesis are the followings:

1. To develop a computer program for solving the problem of vertical load transfer from a pile group to a multi-layered poroelastic medium.

2. To study the effect of various governing parameters, i.e., poroelastic material properties, moduli of elastic pile, configurations of pile group, length of pile and number of piles, on the quasi-static response of a vertically loaded pile group in a multi-layered poroelastic medium.

1.3 Scopes of Present Study

Variational formulation is derived in Laplace domain to formulate the total potential energy functional of the system. A minimization of the total potential energy is used to determine the arbitrary constants associated with the pile displacement. A computer program for solving this problem has been developed to investigate the influences of various parameters.

1.4 Basic Assumptions

The interaction between a vertically loaded pile group and a multi-layered poroelastic half-space considered in this study is based on the following assumptions:

1. The external load is applied vertically through the centroid of the pile group.
2. The piles-poroelastic medium system is decomposed into an extended poroelastic medium and a number of fictitious piles.
3. Each layer of the multi-layered medium is considered as a homogeneous poroelastic material and behaves according to Biot's theory of poroelasticity (Biot 1941).
4. Each pile in the group behaves as a one-dimensional elastic continuum. The deformation distribution of the pile is assumed in the form of exponential function with a number of arbitrary coefficients.

5. Each pile is perfectly bonded to the medium and the contact surface is fully permeable.
6. The pile cap is rigid and is not in contact with the ground.