J. Cent. South Univ. (2016) 23: 1232−1242
DOI: 10.1007/s11771-016-0373-8

Springer

Interaction due to various sources in saturated porous media with incompressible fluid

Rajneesh Kumar[1], Ibrahim A. Abbas[2, 3, 4]

1. Department of Mathematics, Kurukshetra University, Kurukshetra, Haryana, India;
2. Department of Mathematics, Faculty of Science and Arts-Khulais, University of Jeddah, Saudi Arabia;
3. Nonlinear Analysis and Applied Mathematics Research Group (NAAM), Department of Mathematics, King Abdulaziz University, Jeddah, Saudi Arabia;
4. Department of Mathematics, Faculty of Science, Sohag University, Sohag, Egypt

Abstract: The disturbance due to mechanical and thermal sources in saturated porous media with incompressible fluid for two-dimensional axi-symmetric problem is investigated. The Laplace and Hankel transforms techniques are used to investigate the problem. The concentrated source and source over circular region have been taken to show the utility of the approach. The transformed components of displacement, stress and pore pressure are obtained. Numerical inversion techniques are used to obtain the resulting quantities in the physical domain and the effect of porosity is shown on the resulting quantities. All the field quantities are found to be sensitive towards the porosity parameters. It is observed that porosity parameters have both increasing and decreasing effect on the numerical values of the physical quantities. Also the values of the physical quantities are affected by the different boundaries. A special case of interest is also deduced.

Key words: axi-symmetry; incompressible porous medium; pore pressure; Laplace transform; Hankel transform; concentrated source and source over circular region

1 Introduction

The dynamic response due to various sources in a saturated porous media with incompressible fluid are of great interest in geophysics, acoustic, soil and rock mechanics and many earthquake engineering problems.

BIOT [1] derived the basic equations of poroelastisity on the basis of energy principles. PREVOST [2] rederived these equations by use of mixture theory. ZENKIEWICZ et al [3], ZENKIEWICZ and SHIOMI [4] derived the basic equations of poroelasticity by the use of principle of continuum mechanics. GATMIRI and KAMALIAN [5] adopted the later approach because it is more flexible and is based on a set of parameters with a clear physical interpretation to discuss different type of problems. GATMIRI and NGUYEN [6] investigated two-dimensional problem for saturated porous media with incompressible fluid.

GATMIRI and JABBARI [7−8] discussed time domain Green's functions for unsaturated soil for two-dimensional and three-dimensional solutions. GATMIRI and ESLAM [9] discussed the scattering of harmonic waves by a circular cavity in a porous medium by using complex function theory approach. GATMIRI et al [10] also discussed the two-dimensional transient thermo-hydro-mechanical fundamental solution of multiphase porous media in frequency and time domains.

BAI and LI [11] obtained the solutions for cylindrical cavity in saturated thermoporoelastic medium. KAUSHAL et al [12] discussed the response of frequency domain in generalized thermoelasticity with two temperatures. KUMAR et al [13] also discussed elastodynamics of an axisymmetric problem in an anisotropic liquid-saturated porous medium. LIU et al [14] discussed the relaxation effects of a saturated porous media using the two-dimensional generalized thermoelastic theory. SUVOROV and SELVADURAI [15] derived the constitutive equations of thermo-poroelasticity by using eigenstrain-eigenstress approaches. LIU et al [16] presented a model of the equations of a generalized theory with relaxation times for a saturated porous medium and investigated a two-dimensional problem due to time-dependent thermal/mechanical source.

OLIVEIRA et al [17] discussed boundary element formulation of axisymmetric problems for an elastic half space. The influence of the finite initial strains on

Received date: 2015−01−27; **Accepted date:** 2015−05−20
Corresponding author: Rajneesh Kumar, PhD; E-mail: Rajneesh_kuk@rediffmail.com