2D deformation in initially stressed thermoelastic half-space with voids

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Abstract. The present investigation is to study the plane problem in initially stressed thermoelastic half-space with voids due to thermal source. Lord-Shulman (Lord and Shulman 1967) theory of thermoelasticity with one relaxation time has been used to investigate the problem. A particular type of thermal source has been taken as an application of the approach. Finite element technique has been used to solve the problem. The components of displacement, stress, temperature change and volume fraction field are computed numerically. The resulting quantities are depicted graphically for different values of initial stress parameter. The relaxation time and the initial stress parameter have a significant effect on all distributions.

Keywords: thermoelastic half-space; voids; initially stressed; thermal sources finite element

1. Introduction

Biot (1956) introduced the theory of coupled thermoelasticity to overcome the first shortcoming in the classical uncoupled theory of thermoelasticity where it predicts two phenomena not compatible with physical observations. The theory of couple thermoelasticity was extended by Lord and Shulman (1967) and Green and Lindsay (1972) by including the thermal relaxation time in constitutive relations. In the decade of the 1990's Green and Naghdi (1991, 1992, 1993) proposed three new thermoelastic theories based on an entropy equality rather than the usual entropy inequality. During the second half of twentieth century, non-isothermal problems of the theory of elasticity become increasingly important. This is due to their many applications in widely diverse fields. First, the high velocities of modern aircraft give rise to aerodynamic heating, which produces intense thermal stresses that reduce the strength of the aircraft structure. Second, in the nuclear field, the extremely high temperature and temperature gradients originating inside nuclear reactors influence their design and operations.

The linear theory of elastic materials with voids is one of the generalization of the classical

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