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Axisymmetric deformation in transversely isotropic thermoelastic medium using new modified couple stress theory

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Abstract. The present study is concerned with the thermoelastic interactions in a two dimensional axisymmetric problem in transversely isotropic thermoelastic solid using new modified couple stress theory without energy dissipation and with two temperatures. The Laplace and Hankel transforms have been employed to find the general solution to the field equations. Concentrated normal force, normal force over the circular region, concentrated thermal source and thermal source over the circular region have been taken to illustrate the application of the approach. The components of displacements, stress, couple stress and conductive temperature distribution are obtained in the transformed domain. The resulting quantities are obtained in the physical domain by using numerical inversion technique. The effect of two temperature varying by taking different values for the two temperature on the components of normal stress, tangential stress, conductive temperature and couple stress are depicted graphically.

Keywords: transversely isotropic; thermoelastic; Laplace transform; Hankel transform; concentrated and distributed sources; new modified couple stress

1. Introduction

Couple stress theory is an extension to continuum theory that includes the effects of couple stresses, in addition to the classical direct and shear forces per unit area. The classical continuum theories are incapable of predicting the size effects in micro and nanoscales. So, higher order continuum theories have been proposed to account for the size effects. Couple stress theory is such a higher order theory. First mathematical model to examine the materials with couple stresses was presented by Cosserat and Cosserat (1909). This theory could not establish the constitutive relationships. Mindlin and Tierstein (1962) and Koiter (1964) developed initial version of couple stress theory, based on the Cosserat continuum theory (1909). Koiter introduced the constitutive relationships for couple stress theory, involving length scale parameters to predict the size effects. It involves four material constants for isotropic elastic materials which are very difficult to determine (1964). So, modified couple stress theory (M-CST) with one length scale parameter was

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