Coupled Systems Mechanics, *Vol. 13, No. 1 (2024) 21-41*
https://doi.org/10.12989/csm.2024.13.1.021

Interactions in transversely isotropic new modified couple stress solid due to Hall current, rotation, inclined load with energy dissipation

Parveen Lata[a] and Harpreet Kaur*

Department of Basic and Applied Sciences, Punjabi University, Patiala, Punjab, India

(Received August 22, 2023, Revised October 9, 2023, Accepted October 10, 2023)

Abstract. This paper is concerned with the disturbances in a transversely isotropic new modified couple stress homogeneous thermoelastic rotating medium under the combined influence of Hall currents, magnetic fields, and mechanical sources represented by inclined loads. The application of Laplace and Fourier transform techniques are used for the derivation of analytical expressions for various physical quantities. As an application, the bounding surface is subjected to uniformly and linearly distributed force (mechanical force). Present model contains length scale parameters that can capture the size effects. Numerical inversion techniques has been used to provide insights into the system's behavior in the physical domain. The graphical representation of numerical simulated results has been presented to emphasize the impact of rotation and inclined line loads on the system, enhancing our understanding of the studied phenomena. Further research can extend this study to investigate additional complexities and real-world applications.

Keywords: Hall current; inclined load; new modified couple stress; rotation; transversely isotropic

1. Introduction

A macro-scale analysis of materials can be made with the help of classical continuum mechanics theory, which ignores the microstructure size-dependency. For a more complete continuum theory, new deformation measures are needed. This implies that couple stresses must also be introduced into such a theory. Firstly, Voigt (1887) proposed the asymmetric theory of elasticity, and afterward in 1909, a couple stress theory was presented by Cosserat and Cosserat (1909), but examiners deemed the theory not important due to its failure to establishing the constitutive relations. Mindlin (1963) introduced a standard couple stress theory for isotropic materials with constitutive relation

$$\sigma_{ij} = \lambda e_{kk}\delta_{ij} + 2G\varepsilon_{ij}$$
$$m_{ij} = 4l^2 G\chi_{ij} \text{ where } \chi_{ij} = \omega_{i,j}$$
$$e_{ij} = \frac{1}{2}\left(u_{i,j} + u_{j,i}\right)$$

*Corresponding author, Ph.D. Scholar, E-mail: mehrokpreet93@gmail.com
[a]Professor, E-mail: parveenlata@pbi.ac.in

http://www.techno-press.org/?journal=csm&subpage=8 ISSN: 2234-2184 (Print), 2234-2192 (Online)

Zenkour, A. and Abbas, I.A. (2014), “Nonlinear transient thermal stress analysis of temperature-dependent hollow cylinders using a finite element mode”, *Int. J. Struct. Stab. Dyn.*, **14**(6), 1450025. https://doi.org/10.1142/S0219455414500254.

CC