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A Review on Generalized Thermoelastic Interaction in a Fiber-Reinforced Anisotropic Medium

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The present study deals with the review on the development of the theory of generalized thermoelasticity in a fiber-reinforced anisotropic medium. The basic equations are applied in context of Lord and Shulman[12] theory, Green–Lindsay[13] and Green and Naghdi[18] theory of generalized thermoelasticity are reviewed. Analytical and numerical methods in literature are also reviewed.

KEYWORDS: Lord-Shulman Theory, Green–Lindsay Theory, Green and Naghdi Theory, Finite Element Method, Normal Mode, Fiber-Reinforced.

CONTENTS

1. INTRODUCTION

Fibre-reinforced composites are used in a variety of structures due to their low weight and high strength. Fibre-reinforced composites are widely used in engineering structures. Materials such as resins reinforced by strong aligned fibres exhibit highly anisotropic elastic behaviour in the sense that their elastic moduli for extension in the fibre direction are frequently of the order of 50 or more times greater than their elastic moduli in transverse extension or in shear. Fibre-reinforced materials have many applications in aerospace and automotive fields, as well as in sailboats, and notably in modern bicycles and motorcycles, where its high strength-to-weight ratio is of importance. Improved manufacturing techniques are reducing the costs and time to manufacture, making it increasingly common in small consumer goods as well, such as laptops, tripods, fishing rods, paintball equipment, archery equipment, racquet frames, stringed instrument bodies, classical guitar strings. The analysis of stress and deformation of fiber-reinforced composite materials has been an important subject of solid mechanics for last three decades. Spencer,[1] Pipkin[2] and Rogers[3,4] did pioneer works on the subject. A continuum model is used to explain the mechanical properties of such materials. Fibres are assumed an inherent material property, rather than some form of inclusion in such models.[1] In the case of an elastic solid reinforced by a series of parallel fibres it is usual to assume transverse isotropy. In the linear case, the associated constitutive relations, relating infinitesimal stress and strain components, have five material constants. The mechanical behavior of many fibre-reinforced composite materials is adequately modelled by the theory of linear elasticity for transversely isotropic materials, with the preferred direction coinciding with the fibre direction. In such composites the fibres are usually arranged in parallel straight lines. However, other configurations are used. An example is that of circumferential reinforcement, for which the fibres are arranged in concentric circles, giving strength and stiffness in the tangential (or hoop) direction. The theory of strongly anisotropic materials has been extensively discussed in the literature, Belfield et al.[5] studied the stress in elastic plates reinforced by fibres lying in concentric circles. Hashin and Rosen[6] gave the elastic moduli for fibre-reinforced materials. Verma[7] discussed the problem of magnetoelastic shear waves in self-reinforced bodies. Chattopadhyay and Choudhury[8] investigated the propagation, reflection and transmission of magnetoelastic shear waves in a self–reinforced media. Chattopadhyay and Choudhury[9] studied the propagation of magnetoelastic shear waves in an infinite self-reinforced plate. Chattopadhyay and Michel[10] studied a model for spherical SH-wave propagation in self-reinforced linearly elastic media.

The generalized theories of thermoelasticity, which admit the finite speed of thermal signal, have been the center of interest of active research during last three decades. These theories remove the paradox of infinite speed of heat

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