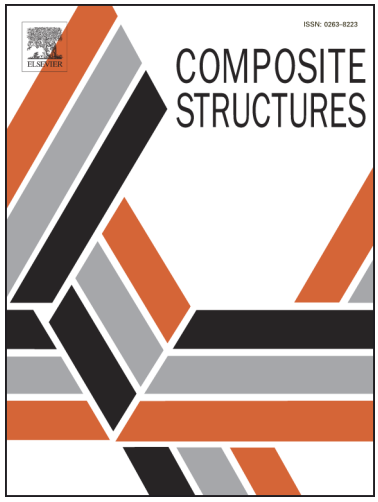

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Asymptotic analysis of thermoelastic response in functionally graded thin plate subjected to a transient thermal shock

Y. Z. Wang[1,*], D. Liu[1], Q. Wang[1], J. Z. Zhou[2]

[1]*Department of Energy and Power Engineering, Jiangsu University, Zhenjiang 212013, P. R. China*

[2]*Department of Mechanical Engineering, Jiangsu University, Zhenjiang 212013, P. R. China*

***Corresponding author: wyz3701320@ujs.edu.cn**

Abstract: This paper is concerned with the thermoelastic response of a functionally graded thin plate with an analytical approach. The governing equations are derived in the context of the Lord and Shulman theory (L-S theory), where the material properties of the thin plate are assumed to be graded along the lengthwise direction according to a power law distribution. An asymptotic approach based on the layer method and the Laplace transform technique is presented to deal with these nonlinear governing equations, and then the closed-form solutions of displacement, temperature and stresses, induced by a sudden temperature rise at the boundary, are derived. The propagation of each wave, as well as the distributions of each physical field, are plotted and discussed. The comparison is also conducted to evaluate the effect of characteristic parameter, including the thermal relaxation time and the power law index, on thermoelastic response.

***Keywords*:** Generalized thermoelasticity; Functionally graded plate; Asymptotic solutions; Lord-Shulman theory; Thermal shock

1 Introduction

In recent years, the functionally graded materials (FGMs), designed to withstand elevated temperature and severe thermal gradient, are widely used in some engineering practices [1]. The analysis of thermoelastic response, especially the prediction of thermal stresses generated in some severe circumstances, is very important to evaluate the lives of FGMs and has received considerate attention. Many researches on the thermoelastic behavior of FGMs have done in the context of the conventional coupled theory of thermoelasticity [2-6]. The conventional coupled theory proposed by Biot [7], however, predicts an infinite speed of heat propagation, which contradicts physical facts and limits the applicability of the results to the