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Thermo-magnetic analysis of thick-walled spherical pressure vessels made of functionally graded materials. (English) Zbl 1416.74037

AMM, Appl. Math. Mech., Engl. Ed. 40, No. 6, 751-766 (2019).

Summary: This study presents an analytical solution of thermal and mechanical displacements, strains, and stresses for a thick-walled rotating spherical pressure vessel made of functionally graded materials (FGMs). The pressure vessel is subject to axisymmetric mechanical and thermal loadings within a uniform magnetic field. The material properties of the FGM are considered as the power-law distribution along the thickness. Navier's equation, which is a second-order ordinary differential equation, is derived from the mechanical equilibrium equation with the consideration of the thermal stresses and the Lorentz force resulting from the magnetic field. The distributions of the displacement, strains, and stresses are determined by the exact solution to Navier's equation. Numerical results clarify the influence of the thermal loading, magnetic field, non-homogeneity constant, internal pressure, and angular velocity on the magneto-thermo-elastic response of the functionally graded spherical vessel. It is observed that these parameters have remarkable effects on the distributions of radial displacement, radial and circumferential strains, and radial and circumferential stresses.

MSC:

74H10	Analytic approximation of solutions (perturbation methods, asymptotic methods, series, etc.) of dynamical problems in solid mechanics	Cited in **1** Document
74F05	Thermal effects in solid mechanics	
74F15	Electromagnetic effects in solid mechanics	
74E30	Composite and mixture properties	

Keywords:

analytical solution; magnetic field; thermal loading; rotating thick-walled spherical pressure vessel; functionally graded material (FGM)

Full Text: DOI

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