TIME-DEPENDENT THERMOELASTIC CREEP BEHAVIOR OF ROTATING DISK MADE OF FUNCTIONALLY GRADED MATERIAL

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Summary. Time-dependent thermoelastic creep behavior of rotating axisymmetric disk made of functionally graded materials (FGM) subjected to a uniform distributed temperature field is investigated. Radially graded ceramic particle reinforced metal matrix composites in which thermomechanical properties of the constituent components obey a power-law distribution is used. A time-dependent expression of the form \( \epsilon_c = B(r) \sigma_c^{m(r)} \) which is the so-called Bailey-Norton law for the material creep constitutive model is considered. Using equations of equilibrium, strain-displacement and stress-strain relations a Navier differential equation for displacement is obtained. Creep strains are involved in the non-homogeneous part of the constitutive differential equation. Using Prandtl-Reuss relation and the Bailey-Norton’s law in conjunction with the constitutive differential equation, a numerical procedure based on the method of successive elastic solution has been developed to obtain history of stresses, displacement and creep strains. Radial, circumferential and effective stress histories as well as creep strains and displacement histories are presented in this paper. It has been found that major redistribution occurs for stresses, strains and displacement of the FGM disk. From the displacement and effective stress histories one can find that the displacement and effective stresses are increasing with time which must be taken into account for the safe design and reliability of FGM rotating disk. At zero time increment our solution approaches the initial thermoelastic stresses which are validated with the existing literature.