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Modeling Creep Analysis of Thermally Graded Anisotropic Rotating Composite Disc

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Mathematical modeling for steady-state creep has been done for an anisotropic disc of aluminium-silicon carbide particulate composite rotating at elevated temperatures under a thermal gradient. Creep modeling and analysis has been done using Hill's yield criterion for a disc operating under a parabolic distributed temperature and its comparison is made with the disc operating under uniform temperature throughout the radius. The results are expressed graphically in designer friendly manner for the stress and strain rate distributions under a graded temperature field. It can be seen that the parabolic temperature field has a significant effect on the creep behavior of the anisotropic disc. Thus, the temperature gradient effect should be considered while designing the anisotropic rotating disc.

Keywords: Steady-state creep; anisotropic; temperature gradient; composite.

1. Introduction

The requirement of lightweight, strong and stiff structural components led to the demand of composites in aerospace industries. Discs rotating at an elevated temperature made up of a lightweight aluminium alloy-based composite having a less creep rate may be used, thus diminishing the gross weight of a dynamic system. A number of studies (Ma [1959, 1960], Gupta *et al.* [2003, 2004]) have been done on the rotating discs to analyze the creep deformation which have practical importance in the gas turbine designers. Creep analysis for a circular plate with a circular hole at the center was carried out under uniform stretching at its boundary. It was assumed that the material of the plate was homogeneous and anisotropic. Time-hardening law and successive approximations were used to compute the stresses and strains and were compared with an isotropic case (Bhatnagar *et al.* [1980]). A return mapping