Residual Stresses in Stainless Steel Fiber-Reinforced Aluminium Matrix Composite Plates with Central Square Hole

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ABSTRACT: In this paper, a study on residual stresses in a stainless steel metal-fiber reinforced aluminium metal-matrix flat plate with a central square hole has been conducted. In the solution, a finite element method with two dimensional isoparametric rectangular nine node-elements has been employed. In the calculation of the residual stresses in the plate under uniform in-plane loads, Newton-Raphson method (initial stress method) has been used. After a steel-aluminium composite plate has been manufactured by upsetting under certain pressure and at certain temperture, some experiments have been carried out through the tensile testing machine in order to obtain mechanical properties and yield strength. Results show that a central hole or cut-out in a plate causes the residual stresses in a considerable quantity particularly near itself, which increases strength of the plate. It is also seen that the hole geometry and the orientation angle have affected residual stresses. Solutions are shown in graphical forms and in illustrations.

KEY WORDS: metal fiber-metal matrix plates, Newton-Raphson method, finite element method, residual stress.

INTRODUCTION

COMPOSITE MATERIALS ARE those formed by combining more than one bonded material, each with different structural properties. Since composite materials have the ability to tailor many properties, such as a high ratio of stiffness to weight, strength, thermal properties, corrosion resistance, wear resistance, fatigue life, they have been extensively used in many structural applications. Therefore, many manufacturing techniques have been developed. The aim is usually to obtain stronger, stiffer materials with lower density.

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