THE OPTIMIZATION OF ANTI-SYMMETRIC LAMINATE

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ABSTRACT

The main objective of this project is to simulate the failure of plates under sinusoidal transverse loading. Based on the simulations, the optimization analysis is performed on the anti symmetric laminates. Higher Order Shear Deformation plate theory is utilized to predict the deformation of the plates. To determine the mode of failure for composite plates, a failure criterion with the existence of coupling terms is employed. The selection of this criterion is made, because of its uniqueness that it includes the coupling terms, which relate the interaction between the longitudinal stress and the transverse stresses. Therefore, it allows the interaction between the fiber properties and the matrix properties in terms of the strength of the material, which other failure criteria have neglected. A program based on a finite element method is utilized to determine the lamina stresses. These stresses are then used in the present failure model to determine the First Ply Failure of the anti symmetric laminates. Finally, the First Ply Failure results for various lay up and ply thickness composite plates are analysed to determine the optimum composite plate based on the best lay up and ply thickness. Firstly, for different lay up of lamina, based on optimization analysis, results are generated to find the best lay up for Carbon Epoxy plates. Secondly, for different ply thickness, for Carbon Epoxy results are generated to find the best ply thickness Carbon Epoxy plates. The results shown that the lay up and ply thickness of (5t,t,t,t) at orientation (0,30,-30,0), (0,45,-45,0), (0,60,-60,0), (0,75,-75,0), (0,90,-90,0) and (t,t,t,3t) at orientation(0,0,0,0) are anti symmetric laminates that could withstand or resistance maximum sinusoidal transverse loading.

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

1.0 Introduction

The main objective of this project is to simulate the failure of plates under sinusoidal transverse loading. Based on the simulations, the optimization analysis is performed on the anti symmetric laminates. This methodology can reduce cost in structural failures. This methodology compared to the experimental method. Then it could increase reliability and predicting the results that can be used to design an optimum composite laminates.

In 1982, Lee has performed the finite element based failure analysis by using his own direct mode determining failure criterion. The major drawback of a three-dimensional failure analysis is the tremendous amount of memory space and calculation time required. Later, improvement on the computational aspects of the three-dimensional formulation is done by other researchers. However, the process is still found complicated to be implemented. This phenomenon leads to the search for more efficient finite element analysis of composite plates. Therefore, two-dimensional plate formulations for composite plates are then developed aggressively. Reddy and Pandey have developed a first ply failure analysis of composite laminates based on first order shear deformation plate theory. The limiting factor of this analysis is the inadequacy of the first order shear deformation theory for thick composite plates. Engblom and Ochoa develop a two dimensional plate analysis to the above, but with increased interpolation in the through thickness direction. Their analysis is carried out to