UNIVERSITI TEKNOLOGI MARA

FAILURE ANALYSIS OF BORON/GLASS HYBRID COMPOSITE LAMINATES WITH VARIOUS CUTOUTS SHAPES AND SIZES UNDER BIAXIAL TENSION

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ABSTRACT

Hybrid composite laminates have recently increasing attention in precision engineering field such as aerospace and automotive industries. Studies for failure behaviour of hybrid laminated composites under uniform biaxial loads have been obtained without considering cutouts. Nevertheless, in practice, the structures are provided with cutouts of various sizes subjected to biaxial tension. This study intends to analyse the failure behaviour of Boron/Glass hybrid composite laminates material with various cutout shapes and sizes under biaxial tension. Initially, failure analysis was performed for laminated composite plate without cutout with lamination sequence of $(\theta_4/0_4/-\theta_4)_s$ where the angle, θ ranges from 0° to 90° using a Finite Element Analysis (FEA) software, ANSYS. The accuracy of the analysis were compared using analytical method using Matlab based on First Order Shear Deformation Theory (FSDT). Then, next stage involved the failure analysis of hybrid laminated composite plate with various cutouts (circle, diamond and square) and sizes. The ply angles of (0/±45/90)s, (0/±45)s and (0/90)s are modelled. These analyses were performed to determine the failure load by employing Maximum stress criterion and Tsai-Wu criterion. The failure curves were plotted and analysed. Results of Matlab code and FEA based ANSYS software, are in close agreement. In overall, it was found that the determined failure load ranges from 50 MPa to 89 MPa and 153 MPa to 289 MPa for composite laminates with cutout under uniaxial and biaxial tension, respectively. The results show that composite laminates with square cutout shapes able to withstand more load before failure by 1.5 times compared to composite laminates with diamond and circle cutout. Besides, composite laminates with cutout of size A_1 were stronger more than 1.3 times compared to composite laminates with cutout of size A_2 and size A_3. Therefore, this work contributes in the understanding of failure behaviour for composite laminates structure with cutout under biaxial tension.

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