UNIVERSITI TEKNOLOGI MARA

MULTI- SCALE MODELLING FOR FAILURE ANALYSIS OF VARIOUS COMPOSITE LAMINATES UNDER BIAXIAL LOADING

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of the requirements for the degree of
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AUTHOR'S DECLARATION

I declare that the work in this dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Understanding the failure behaviour of composite laminates and their hybrid counterparts is an important issue in designing a reliable composite structure. Failure analyses have been carried out widely. However, the integration of micro-and macro-mechanics properties for failure analysis of various composite laminates has not been analysed thoroughly. Therefore, this study aims at modelling micro-and macro-scale and failure analysis of Kevlar -Epoxy, Boron-Epoxy, and Glass- Epoxy under Bi-axial tensile load of one hand and the failure analysis of their hybrid counterparts are on the other. For micro-scale modelling (stage 1), Rule of Mixtures and Halpin-Tsai (H-T) equations were employed to determine lamina mechanical properties using MATLAB R2020B. In stage 2, selected lamination schemes of the aforementioned materials are modelled using ANSYS. Using the built-in function and Maximum Stress Theory available in ANSYS, the failure load and failure indexed were determined. Prior to that, numerical validation was carried out to verify the finite element models. Where appropriate, the results of micro-and macro-modelling are compared to past simulated and experimental results. The results showed that the elastic modulus calculated according to H-T equations were close to the experimental values, especially at low reinforcement volume fractions. However, as the volume fraction increased, the experimental and calculated values for elastic properties increased slightly. The simulated failure results showed that the strength of the laminates was very much influenced by the lamination schemes and materials properties. It is also found that Kevlar-Epoxy has better strength than Glass-Epoxy, whereas Kevlar-Epoxy shows lowest strength from Boron- Epoxy. Therefore, it can be concluded that this study has enhanced the knowledge about the interaction of the fiber and matrix properties that influence the failure behaviour of composite laminates under uniaxial tension and Biaxial tensile load.
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