UNIVERSITI TEKNOLOGI MARA

SIMULATION OF IMPACT RESPONSES ON CARBON FIBRE COMPOSITE LAMINATES

NURHAZWANI SHAHIRAH BINTI ABD JAMIL

MSc

September 2021

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.

Name of Student	:	Nurhazwani Shahirah bt Abd Jamil
Student I.D. No.	:	2020544993
Programme	:	Master of Science (Mechanical Engineering) – EM703
Faculty	:	College of Engineering
Dissertation Title	:	Simulation of Impact Responses on Carbon Fibre Composite Laminates
Signature of Student	:	……..
Date	:	2 September 2021

ABSTRACT

Composites are widely used in structural applications due to their excellent mechanical performance. Despite having good mechanical properties, the composite is not exempted from damage due to low-velocity impact. Since low-velocity impact damage is undetectable and may scale down the stiffness of the composite laminates as well as the structure's strength, the behavior of composite laminate after being impacted by low-velocity impact is investigated. The effects of low-velocity impact and the effects of layup sequences on carbon fibre reinforced epoxy (CFRE) composite plates were investigated numerically using FEA software, ABAQUS/Explicit. Four main layup sequences have been analyzed: CFL1 $[0/90]_8$, CFL2 $[0/90/\pm 45/\pm 45/0/90]_S$, CFL3 $[0/90/0/90/\pm 45/\pm 45]_S$, and CFL4 $[0/90/\pm 45/0/90/\pm 45]_S$ and they were tested with four different impact energies: 4 J, 8 J, 12 J, and 16 J. The analysis reveals that the high impact energy leads to the larger maximum value of contact force and energy absorbed by the composite laminates. It is also apparent that there is an increment in the impact damage resistance of the quasi-isotropic laminates when the percentage of fibre orientated in the +45°/-45° direction is added to the layup sequence than the conventional fibres orientated in the 0°/90° direction only. The lowest impact resistance was obtained in the case of composite with 0°/90° ply orientation, which discloses the energy absorption and the ply orientation have a great influence over the impact behavior of the composite laminates.

ACKNOWLEDGEMENT

First and foremost, praises and thanks to ALLAH S.W.T, for His showers of blessings throughout this beautiful journey that I am able to begin and completed my studies and my dissertation research successfully. Million thanks to the Ministry of Defence, Malaysia for financing through the Higher Education Scheme for endorsing my study at Universiti Teknologi MARA, Shah Alam.

I would like to express my deep and sincere gratitude to my project dissertation supervisor, Dr. Bibi Intan Suraya binti Murat and Dr. Ahmad Sufian bin Abdullah for giving me the opportunity to do research and always give valuable support in this research. Their dynamism, vision, sincerity, and motivation have deeply inspired me. Special thanks to EM703 program coordinator Dr Mohd Hafiz Bin Mohd Noh for guiding us students in our Master's studies. His supports are indispensable to us which helps alert us on key milestone on our timeline and smoothen our journey with any enrolment issues with university.

Saving the best for last is my undying gratitude to my parents, my parents in-law and siblings as they are the driving force which helps me paved way on my Master's studies. With their unconditional love, they support me on an emotional level and I am thankful for everything that they have done for me so far. To the most precious persons in my life, my sons, Muhammad Shahmi and Muhammad Fazwan, both of you are my strength, spirit and courage. Only because for both of you, I chose this path and opportunity to make our future brighter and more meaningful. Thanks for the supports that you gave me all this time. Your loves and affections make me more confident and resilient to face any challenges in the future.

This thesis is the culmination of all that have helped and supported me and I am very grateful to that. I dedicated this piece of victory to all of you. Thank you.

TABLE OF CONTENT