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Syed, M.A.J., Muhammad Nazri, M.J.A.

Optimization of Composite Fuselage Frame Layup for Energy Absorption under Crash Loading
(2024) *Journal of Advanced Research in Applied Mechanics*, 122 (1), pp. 111-129.

DOI: 10.37934/aram.122.1.111129

Department of Mechanical and Aerospace Engineering, Kulliyyah of Engineering, International Islamic University Malaysia, Gombak, Kuala Lumpur, 53100, Malaysia

Abstract
Considerable research has been carried out on aircraft fuselage design, with a particular focus on frames due to their role in energy absorption during crash impacts. While metallic alloys have traditionally been used for frame construction, the growing popularity of composites has led to a shift towards their utilization. However, the research specifically targeting composites for fuselage frames is limited in scope. This study aims to bridge this gap by conducting a comprehensive analysis using LS-DYNA software. The composites investigated in this analysis include Standard Carbon Fiber, Graphite AS-3501-6 Fiber, E Glass Fiber, and Kevlar Fiber. Parameters such as deformation, energy absorption, maximum normal stresses, and shear stresses are compared against Aluminum Al 7075-T6, a commonly employed metallic alloy. Furthermore, an optimization process is performed, focusing on the laminate orientation of standard carbon fibre, to determine the most favourable orientation for each parameter studied. The results highlight that employing Standard Carbon Fiber, with laminates having 90° ply such as quasi-isotropic, cross-ply and unidirectional 90° laminates lead to superior outcomes in terms of energy absorption and deformation for the fuselage frame under crash loading.

Author Keywords
CFRP; Composite Laminates; Drop Test; FEA; Fuselage Frame; GFRP; LS-DYNA

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Correspondence Address
Syed M.A.J.; Department of Mechanical and Aerospace Engineering, Gombak, Malaysia; email: jaffar@iium.edu.my

Publisher: Semarak Ilmu Publishing

ISSN: 22897895
Language of Original Document: English
Abbreviated Source Title: J. Adv. Res. Appl. Mech.
2-s2.0-85201666727
Document Type: Article
Publication Stage: Final
Source: Scopus