INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title: ANALYSIS OF GLARE LAMINATES UNDER LOW VELOCITY IMPACT

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Thesis Submitted to the Department/ Center : Department of Mechanical Engineering

Date of completion of Thesis Viva-Voce Exam : 27/12/2023

Key words for description of Thesis Work : Low velocity impact, Oblique impact, GLARE, Delamination, Finite element analysis

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SHORT ABSTRACT

Superior impact properties of glass aluminium reinforced epoxy (GLARE) have led to their usage in impact prone structures such as aircraft fuselage, wings and cargo panels. However, these advanced laminated structures are also susceptible to impact induced damages, especially under low velocity impact (LVI) where the damages are sub-surface and barely visible. Finite element analysis (FEA) enables a more in-depth study of the complex nature of the response and damages due to arbitrary LVIs. This dissertation thus presents the FEA of GLARE under LVI, evaluating the response of the target and the associated damage due to LVI. A complete 3D finite element (FE) formulation has been developed using 3D layered solid elements to evaluate the contact impact response of GLARE subjected to arbitrary (normal and oblique) LVIs. A transient dynamic FE code has been developed incorporating the Newmark-β method and implementing suitable normal and tangential contact models for accurate determination of the contact responses and the associated interfacial delamination damages. An important aspect of the present FE modelling is the incorporation of an adjustable contact stiffness based on the impactor to plate mass ratio which is critical for accurate evaluation of the contact response and correctly predicting the associated damages. Influence of important parameters like properties and geometry of the GLARE laminate and the impactor along with the trajectory of the impact on the contact impact response and the delamination damages have been investigated. Results from the present work show that besides the size and geometry of the impactor, the trajectory of the impactor relative to the target and the coefficient of friction between them also significantly influence the contact response as well as the evolution of delamination at the interfaces. Further, for multiple impacts, the interval between the successive impacts greatly influences the magnitude of contact force as well as delamination at the fibre-metal interfaces. The presence of discontinuities in the form of cut-outs or open holes (due to functional requirements) in the GLARE laminate significantly influences how delamination grows around these locations due to increased stress concentrations under impact loads. Results from the analysis of LVI show that the pitch of the cut-outs and their size and shape has significant influence on the evolution of delamination, especially at the metal/composite interfaces.