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Adhesive Bonded Joints Characterization and Crack Propagation in Composite Materials under Cyclic Impact Fatigue and Constant Amplitude Fatigue Loadings

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Abstract : The Colombian aeronautical industry has stimulated research in the mechanical behavior of materials under different loading conditions aircrafts are generally exposed during its operation. The Calima T-90 is the first military aircraft built in the country, used for primary flight training of Colombian Air Force Pilots, therefore, it may be exposed to adverse operating situations such as hard landings which cause impact loads on the aircraft that might produce the impact fatigue phenomenon. The Calima T-90 structure is mainly manufactured by composites materials generating assemblies and subassemblies of different components of it. The main method of bonding these components is by using adhesive joints. Each type of adhesive bond must be studied on its own since its performance depends on the conditions of the manufacturing process and operating characteristics. This study aims to characterize the typical adhesive joints of the aircraft under usual loads. To this purpose, the evaluation of the effect of adhesive thickness on the mechanical performance of the joint under quasi-static loading conditions, constant amplitude fatigue and cyclic impact fatigue using single lap-joint specimens will be performed. Additionally, using a double cantilever beam specimen, the influence of the thickness of the adhesive on the crack growth rate for mode I delamination failure, as a function of the critical energy release rate will be determined. Finally, an analysis of the fracture surface of the test specimens considering the mechanical interaction between the substrate (composite) and the adhesive, provide insights into the magnitude of the damage, the type of failure mechanism that occurs and its correlation with the way crack propagates under the proposed loading conditions.

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