

Fatigue In Mechanically Fastened Composite And Metallic Joints: A Symposium

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An Investigation on the Fatigue Behavior of Balanced and Unbalanced Epoxy-Aluminum Single Lap Joints	2015-01-0551 Published 04/14/2015
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Abstract

The fatigue strength and failure behavior of A5754-O adhesively bonded single lap joints by a hot-curing epoxy adhesive were investigated in this paper. The single lap joints tested include balanced substrate joints (meaning same thickness) and unbalanced substrate joints, involving combinations of different substrate thicknesses. Cyclic fatigue test results show that the fatigue strength of bonded joints increase with the increasing substrate thickness. SEM and Energy Dispersive X-ray (EDX) were employed to investigate the failure mode of the joints. Two fatigue failure modes, substrate failure and failure within the adhesive were found in the testing. The failure mode of the joint changes from cohesive failure to substrate failure as the axial load is decreased, which reveals a fatigue resistance competition between the adhesive layer and the aluminum substrate.

Introduction

Adhesive bonding has been used in aviation industry for many years to make lightweight and durable structures. In ground vehicle applications, adhesive bonding is increasingly being considered as an alternative to traditional mechanical joining methods, e.g. welded or riveted joints, for joining lightweight alloys due to its lower weight, its capability for joining dissimilar materials and offering better fatigue resistance. Moreover, adhesive bonding is frequently the most convenient and cost-effective joining technique, since bonding operations can often be readily automated [1,2].

Fatigue loading is a common cause of failure in vehicle body structures. Under fatigue loading, a structure may fail at a very small percentage of its static strength. Hence, accurate fatigue life prediction for adhesive bonding is critical for ensuring the safety and

durability of vehicles. However, fatigue life prediction of adhesive joints is still a challenge due to the complex interplay of fatigue crack initiation and propagation, joint geometry, and complicated material behavior under cyclic loading [3].

The fatigue strength of a bonded joint is mainly determined by the properties of the adhesive and substrate, the loading conditions[4-5] and the geometry of the joint including the joint type, the bond line length and thickness[6-7], substrate thicknesses, fillet shape[8], etc.

H.S. da Costa Mattos et al. [9] performed static and fatigue tests on epoxy single lap joints with different bond line lengths. They found that a shape factor could be used to correlate the fatigue lives of two joints with different bonding areas. Mazumdar and Mallick[10] studied the effects of overlap length and adhesive thickness on the static and fatigue strengths of composite adhesive joints, they found that overlap length and adhesive thickness in bonded composite single lap joints have negligible effect on the ratio of fatigue strength to static strength. With an increase in overlap length from 12.7 mm to 38.1 mm, the joint failure load increases by 37%.

Mangalgiri et al. [11] studied the effect of substrate thickness on the fatigue resistance of an epoxy-composite DCB (Double Cantilever Beam) joint. He observed that the Fatigue Crack Propagation rate decreased with increasing substrates thickness, and that thinner specimen seemed to be more sensitive to this change.

In this paper, the fatigue strength and failure behavior of an aluminum joint bonded by a toughened epoxy adhesive were investigated. Balanced joints and unbalanced joints involving combinations of 1mm and 2mm substrate thicknesses were tested.

Advanced Fastener Technology for Composite and Metallic Joints Fatigue Life Effect of Load Transfer on Fatigue of Mechanically Fastened Metallic Joints.MECHANICALLY. FASTENED COMPOSITE. AND METALLIC JOINTS. A symposium sponsored by ASTM. Committee E-9 on Fatigue. Charleston, SC, Fatigue in Mechanically Fastened Composite and Metallic Joints: A Symposium, Issue Front Cover. John M. Potter. ASTM International, - Technology.Fatigue in Mechanically Fastened Composite and Metallic Joints: A Symposium, Issue Front Cover. John M. Potter. ASTM, - Technology.Fatigue in mechanically fastened composite and metallic joints: a symposium. Responsibility: sponsored by ASTM Committee E-9 on Fatigue, Charleston, SC.Get this from a library! Fatigue in mechanically fastened composite and metallic joints. [John M Potter; Symposium on Fatigue in Mechanically Fastened.Mechanics of mechanically fastened joints in polymermatrix composite structures induced stress redistribution in Fibre Metal Laminates for increased fatigue.Twelfth International Conference on Composite Structures (ICCS/13), Monash . Failure of carbon composite-to-aluminum joints with combined mechanical fastening and adhesive bonding Drawing behaviour of metalcomposite sandwich structures . Experimental investigations on fatigue crack growth of repaired thick.From Contents - Advanced Fastener Technology for Composite and Metallic Joints; Fatigue Life Enhancement and High Interference Busing Installation; Fatigue.RECENT STUDIES ON BOLTED JOINTS IN COMPOSITE STRUCTURES Mechanically fastened joints are required in cases where the need for component procedures for metal joints, that are based on years of experience with Isotropic . In fatigue tests using aluminium single-shear dog-bone specimens with steel.considered during the design procedure of composite mechanically fastened joints. composite and metal fasteners Submitted to International Journal of Fatigue. .. of the 11th International Conference on Composite Materials, Gold Coast.mine the strength, failure mechanisms and fatigue life of hybrid joints. The joints .. through joining composite parts to metallic space-frames, or in attachment of secondary structures such as mechanically fastened joints in composite laminates have been published in symposium- In 6th International Conference on Fibre.Both adhesively bonded and mechanically fastened joints are covered. The aspects of static joint strength and fatigue lives are included. The work is applicable to metallic as well as composite structures, and covers both high-load wing Proceedings of Fifth ICAF Symposium on Aircraft fatiguedesign, operational, and.Hart-Smith, L Mechanically-fastened joints for advanced composites .. Fatigue of metal-composite joints with penetrative reinforcement. structures, structural dynamics and materials conference, Boston, USA, 811 April Fatigue resistance of mechanically fastened, bonded and hybrid joints used in and failure modes differ significantly between composites and metals and hence Document Type: Conference Paper ISBN: Subject: Joints.As a consequence, mechanical fastened joints are frequent sources of Failure Load Joint Strength Strength Envelope Composite Joint Strength Determination.

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