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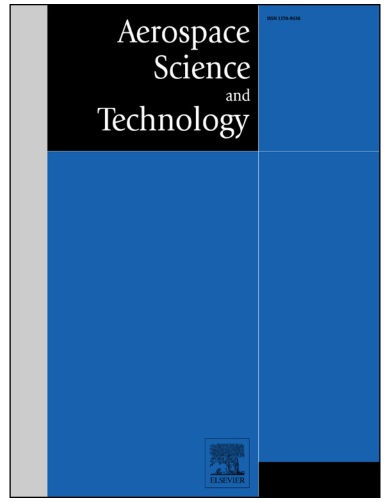

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Numerical analysis of the effect of the presence, number and shape of bonding defect on the shear stresses distribution in an adhesive layer for the single-lap bonded joint; Part1

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Abstract

The objective of this study was to analyze by three-dimensional finite element method, the effect of the position, number and shape of the bonding defect on the shear stress distribution in the adhesive layer used to joint two aluminum 2024-T3 plates. Numerical analysis allowed us to deduce that the bonding defect presence has a negative effect on the value of the shear stresses in the adhesive layer and therefore the durability of the assembly. Whatever the size of the defect, the maximum stresses are always localized at the adhesive edge. If the overlap length is important, the effect of defect on joint strength is less.

Keywords: adhesive, single lap joints, defect distribution, shear stress, finite element method

Introduction

Adhesively bonded joints are increasingly being used in the aerospace and automotive industries as the use of adhesive bonding rather than mechanical fasteners offers potential reductions of weight and cost [1, 2]. In the design of mechanical structures which contain adhesively bonded joints, the knowledge of the mechanical characteristics of these joints is essential. To determine the physical nature of stress distribution in adhesively bonded joints, many authors have tried to give a better estimate on the amount of stress developed in the adhesive layer, under different loading conditions. For a safe design, a complete knowledge of stress distribution at critical points becomes crucial.

Several analytical works have been carried out to understand the behavior of adhesively bonded joints [3–5]. A detailed literature survey on major analytical models for adhesively bonded single lap joints has been provided by da Silva *et al.* [6]. They have further done a comparative study on different analytical models to comprehend the accuracy and time requirements for different cases [7]. However, obtaining an exact solution becomes difficult if the joint geometry is complex or if there is a large amount of factors to be considered is large. Though stresses can be measured by conducting mechanical tests, they become expensive in terms of cost and time while considering all the involved parameters. These limitations can be overcome using numerical methods like Finite Element Analysis (FEA). It is convenient to study the influence of a change in different parameters on the behavior of a bonded joint using FEA. This reduces the number of tests to be performed during prototyping and also helps in reducing the time and cost involved during the process [8].

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