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Influence of the presence of defects on the adhesive layer for the single-lap bonded joint-Part II: Probabilistic Assessment of the critical state

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Abstract

In this paper, we analyse the variation of shear stresses in the adhesive layer, used in a single lap joint, in the presence of variable numbers and positions of defects. The results of the value of maximal shear stresses were used to develop a shear stress probability distribution models in the adhesive of SLJ with presence of one, ten and fifty defects with random position to improve the damage probability. Based on the result found in part-I, a set of theoretical samples was generated and their corresponding histograms using Freedman-Diaconis method. Seven different probability density functions (PDFs) were fitted to these histograms. In each case, a Kolmogorov-Smirnov test was used to evaluate the quality of fit. Finally, after substituting the values of estimated parameters for each distribution, a set of fully defined PDFs have been proposed for the shear stress in the adhesive layer of SLJ in the presence of artificial defects with random positions. This PDF has been used to introduce a new criterion included critical shear stress but also distribution parameters of damage.

Keywords: probability, defect bonding, single lap joint, Kolmogorov-Smirnov test

Introduction

Adhesive joints encounter in-service defects that may have an impact on the joint strength. Any manufacturing process will inevitably introduce some defects in the end product. It is almost impossible to produce a defect-free joint, even under stringent controls. Entrapped air, foreign bodies, grease or dirt created is bonds in the joint. No load can be transferred through areas that are disbanded. Consequently, load has to be transferred through alternative neighboring paths, increasing the stress in these areas. It is important to know how these defects could affect the strength of the bonded component [1].

Several researchers studied the sticking phenomenon and invest more time analyzing the processes by the determination of influencing factors on its durability during use by experimental, analytical and numerical methods. Karachalios et al [1] studied the strength of single lap joints with artificial defects. In their studies two different adhesives, one strong and ductile and the other weak and brittle, and three different types of steel were used. Rectangular and circular artificial defects located in the middle of the overlap, with increasing size, were studied. They showed that when a