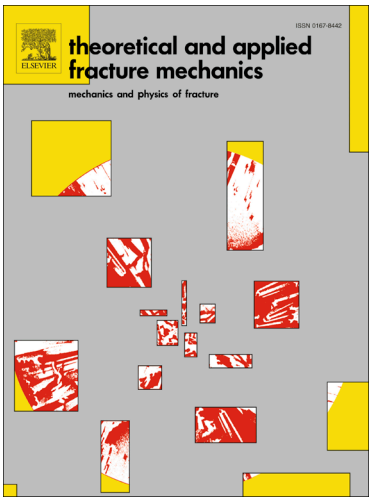

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ON THE ANALYSIS OF BONDED STEP LAP JOINTS

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SUMMARY

This paper discusses the stress and strain states in adhesively bonded step lap joints from the perspective of the strain energy density solutions determined via the elastic and elastic-plastic solutions obtained using the computer code A4EI, which as outlined in the US Defence Departments Composite Materials Handbook CMH-17-3G is the industry standard for designing adhesively bonded joints. Whereas it has previously been shown that the load carrying capacity of an adhesively bonded double lap joint could be estimated using the strain energy density associated with the elastic solution and the critical value of the adhesive strain energy density, the present paper reveals that this approach also yields a reasonable first approximation to give the load carrying capacity bonded step lap joints.

Keywords: Bonded step lap joints, strain energy density, residual strength, composite adherend failure

1 INTRODUCTION

Bonded step lap joints are used in a number of aircraft, viz: the F-15 horizontal stabilator, the F/A-18 wing, Beech Starship and the Lear Fan [1]. However, whilst the US Defence Departments Composite Materials Handbook CMH-17-3G [1] discusses the design and static strength of bonded joints at length there is little guidance on the growth of disbonds and their effect on operational aircraft. Indeed, the primary recommendation contained in CMH-17-3G is for a no growth design, both for damage in bonded joints and also for delamination and impact damage in composite structures, that is validated via a single full scale fatigue test to two lifetimes. The durability of bonded joints is discussed in Section 10.6 of CMH-17-3G. Here attention is primarily focused on one of the lessons learnt in the PABST program [2], namely how to determine the maximum load bearing capacity of a bonded joint, and on the associated computer code A4EI [3]. (This code is a continuation of the work reported in [5-7].) Section 10 of CMH-17-3G also discusses the use of A4EI for the design of bonded repairs to damaged composite structure.