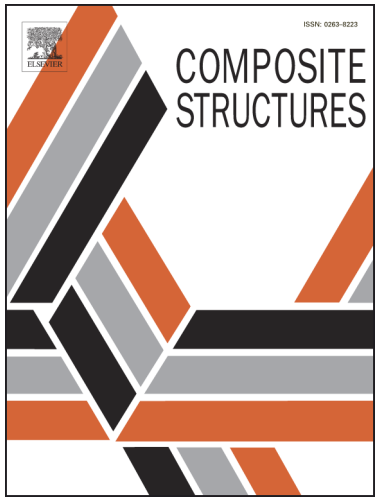

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Effect of thickness and laminate taper on the stiffness, strength and secondary bending of single-lap, single-bolt countersunk composite joints

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Abstract

This paper presents an experimental investigation of single-lap, single-bolt countersunk composite joints. Issues related to design of mechanically fastened joints in composite aircraft fuselage structures are studied, such as the effects of joint thickness, laminate taper (i.e. the positioning of the plies in the taper region) and secondary bending on joint stiffness and strength. It is demonstrated that bearing strength measurement is subject to a scaling effect due to joint thickness and that this needs to be considered in design. Tapered joints display only moderate differences in joint stiffness and bearing strength when compared to similar constant thickness specimens, suggesting that significant weight savings may be achieved. Little or no difference in bearing strength occurs with change in taper type. Three-dimensional digital image correlation is used to measure out-of-plane displacement in all joints tested. It is shown that thin joints experience higher degrees of out-of-plane displacement. This has a direct effect on the final mode of failure in the joint, and explains why thin laminates have a higher tendency to fail in fastener pull-through. It is also demonstrated that taper type has a significant effect on secondary bending and hence the final mode of failure in the joint.

Keywords: Composites, Bolted joints, Thickness and Laminate taper, Secondary bending, Testing, Three-dimensional image correlation (3-D DIC)

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