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Sandwich T-joint structures with and without cutout under shear and in-plane bending loads

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Abstract

This paper presents an investigation into the failure behaviour of composite sandwich T-joint structures under a combined shear and in-plane bending loads. The T-joint structure FE model was created and experiment was conducted. The FE model was validated by using the test data for the purpose of design improvement. Experimental and FE results showed that the T-joint structure without a cutout failed due to web panel buckling and high tensile stress in the off-fibre direction of the outer ply of the web panel. The T-joint with a circular cutout in the web panel near the joint region has a similar failure mode with the failure load reduced by 31%. In this case, both buckling and stress concentration occurred near the cutout edge. The current conventional T-joint design was proved to be very effective despite of its complex manufacture. Alternative designs for lower cost manufacturing were proposed and evaluated. One of the options proved to be an improved design to compete with the conventional one in terms of structural strength and manufacturing cost.

Key words: *Composite sandwich T-Joint, Failure mode, Web buckling, Manufacturing cost*

1. Introduction

Airframe consists of an assembly of structural components connected to form a load transmission path. The connection or joints are potentially the weakest points and affect the overall structural efficiency. Examples of airframe assemblies include the skin-to-rib and skin-to-spar joints. In previous research, numerical and experimental studies have been conducted to determine the failure modes of both composite laminate and composite sandwich T-joint structures (Yap *et al*., 2002; Kesavan *et al*., 2006; Blake *et al*., 2001; Vijayaraju *et al*., 2004; Kumari and Sinha, 2002; Shenoi and Violette, 1990; Theotokoglou, 1999; Theotokoglou, 1997; Theotokoglou and Moan, 1996; Turaga and Sun, 2000; Zhou *et al*., 2008). The effect of the presence of a cutout in sandwich panels and reinforcement around the cutout edges has also been the focus of many studies (De Boos *et al*., 2007; Guo *et al*., 2008; Guo *et al*., 2009). In the conventional sandwich T-joint design, one of the manufacturing features is the base core drop-off and the merging of the upper and lower composite faces into a monolithic laminate at the joint region. This manufacturing process is effective

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