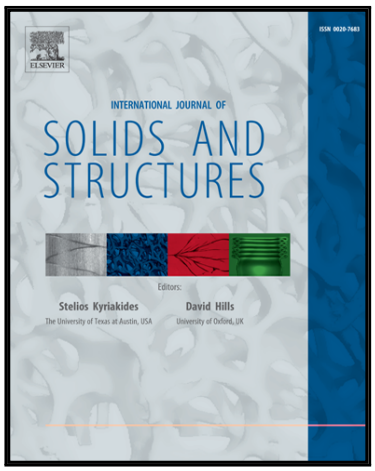

Buckling analysis of variable angle tow composite plates with a through-the-width or an embedded rectangular delamination

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Buckling analysis of variable angle tow composite plates with a through-the-width or an embedded rectangular delamination

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Abstract: Variable angle tow (VAT) composite laminates, in which fibre orientation varies spatially in-plane in a continuous fashion yet is piecewise constant through-thickness, have been made possible by advanced automated fibre placement technology. Such designs have shown considerable potential to improve the performance of lightweight composite structures. In the present study, an analytical model is developed to study the buckling behaviour of VAT composite plates with a through-the-width or an embedded rectangular delamination under compression loadings. The proposed model can accurately capture the global, local and mixed buckling response of delaminated VAT composite plates. Both free and constrained modes are assumed in the delamination buckling analysis. A constrained point approach is employed to analyze the buckling response when contact occurs between delaminated layers. The accuracy and reliability of this proposed delamination buckling model is validated by finite element analysis and with prior results. The influence of delamination size, position and varying fibre orientation angles on the buckling response of delaminated VAT composite plates is studied by numerical examples. It is shown that the buckling loads decrease with an increase of the delamination size. The VAT laminates with an off-midplane delamination may lead to the delamination opening up, which further reduces the buckling loads. Finally, the mechanism of taking advantages of VAT laminates to improve the buckling performance of delaminated composite plates is thoroughly investigated in a parametric study. This study also shows that the residual buckling resistance of the delaminated composite plates can be significantly improved through using the VAT design concept.

Keywords: variable angle tow; delamination; buckling; composites

1 Introduction

Many previous works [1-7] have shown that the buckling and postbuckling load-carrying capacity of composite structures can be significantly increased by using Variable Angle Tow (VAT) laminates. This enhanced performance is mainly attributed to the benign load