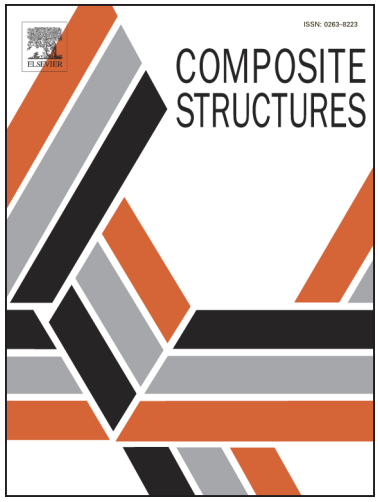

letter

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Numerical Modelling of Hybrid Elastomeric Composite Panels Subjected to Blast Loadings

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Abstract: Designing lightweight composite panels that can resist extreme impulsive loadings is of great interest for defence and infrastructure protective applications. In this work, a finite element model is developed to understand the deformation and failure mechanisms of a multilayered elastomer / fibre-reinforced polymer (FRP) composite panel under blast. Fibre (E-glass fibre) and matrix (vinylester resin) damage and degradation of individual unidirectional composite laminas are modelled using the Hashin failure model. The delamination between composite laminates is captured by three-dimensional bilinear cohesive elements. A thin elastomer (polyurea) layer is applied to the back face of the panel to reduce damage to the composite laminates. The predicted deformation histories, evolutions of fibre/matrix damage patterns, and inter-lamina delamination are captured and compared between monolithic and hybrid elastomer/composite panels. The model reveals the important role of the elastomer layer in improving panel performance by effectively mitigating the transmitted impulse to the back face of the panel and reducing delamination, while maintaining overall stiffness.

Keywords: composite panel; blast loading; elastomer; numerical modelling.

1. Introduction

The design of new smart and lightweight materials and structures for energy-absorbing purposes is complex, requiring the structure to be able to withstand and mitigate blast loadings whilst still being light in weight. Composite and multilayer sandwich structures, inspired by biological materials and composed of multiscale micro-/nano-materials and lightweight cellular structures, offer various advantages due to their unmatched mechanical performance over traditional engineering materials [1-11]. Recently, fibre reinforced polymer (FRP) composite materials and cellular polymer foams have been utilised to replace metals in sandwich architectures. Because they have strength comparable to high-strength steels, yet