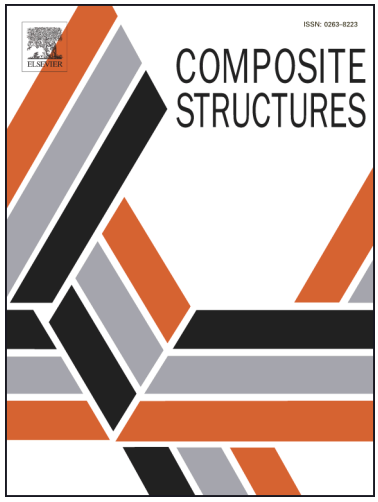

Experimental and numerical crushing analysis of circular CFRP tubes under axial impact loading

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Experimental and numerical crushing analysis of circular CFRP tubes under axial impact loading

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Abstract

In this paper, a prospective simulation method for composite crushing under axial crash loading is presented. To this end carbon fibre-reinforced plastic (CFRP) circular crash tubes are investigated in drop tower tests. Flat specimen tests are performed to determine calibration parameters and are used for efficient re-parameterization of a transversally isotropic material card used in finite element (FE) simulation. An existing material card for CFRP based on basic tension and compression tests is used as a starting point and only a small set of material parameters is numerically reasonable adjusted to account for crushing. Once calibrated by means of flat specimens the material model is able to cover a variety of different composite layups and specimen geometries, e.g. tube specimens. Therefore, numerical simulation of drop tower testing is carried out and results show good agreement between numerical and experimental results. In addition to these tests, it can be shown that the presented approach is leading to equally good results when the material and geometry of the specimens are changed to a glass fibre-reinforced plastic (GFRP) tube structure.

Keywords

CFRP, axial crash loading, crushing, finite element analysis, energy absorption

1. Introduction

Due to the challenging task of emission constraints or fuel consumption reduction targets, materials with high weight-specific mechanical properties are forging ahead in automotive lightweight design. Today, many ideas exist to incorporate fibre-reinforced plastics (FRP) into the Body-in-White to certain amount. For example in [1] potential weight saving with use of FRP is specified to 50-60% in comparison to traditional steel construction.

In addition to high values of specific stiffness and specific strength FRP show excellent values of specific energy absorption (SEA) [2]. Therefore, FRP may be