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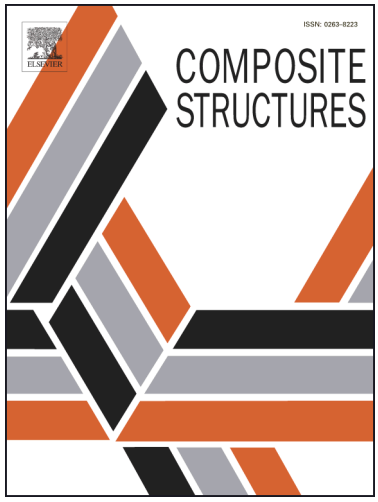

A review of impact testing on marine composite materials: Part IV – Scaling, strain rate and marine-type laminates

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ACCEPTED MANUSCRIPT

A review of impact testing on marine composite materials: Part IV – Scaling, strain rate and marine-type laminates

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Abstract: Although composite materials are now used throughout the marine industry their susceptibility to impact events is still an unresolved problem. The complex nature of the problem in terms of the distinct material and impact event parameters specific to marine applications, damage tolerance and durability has been discussed in parts I, II and III of this review. Here, work addressing marine composite impact scaling and strain-rate effects, and impact studies not explicitly concerning marine applications yet considering laminates typical of the marine industry have been reviewed. Together with parts I, II and III, this paper gives a comprehensive review of 'marine impact on marine composites', providing a valuable resource for the marine industry and research fields.

Keywords: Impact; Marine; Testing; Scaling; Strain Rate

1. Introduction

Laminated fibre-reinforced composite materials are now used in many areas of the marine industry, mainly due to their resistance to the aggressive marine environment, ease of fabrication and potential high specific material properties. However, damage due to low-velocity impacts (LVI) with solid objects is a known potential weakness of these materials. The objective of this review is to bring together the work concerning 'marine impacts on marine composites'. Part I [1] summarised research on the impact on composite materials in general, described in-service 'marine impact' events, made comparisons of composites materials with other material systems, and discussed the complexity of the problem. In Part II [2] impact damage and the effects of both impact event and material parameters on impact behaviour were considered and Part III [3] concerned impact damage tolerance and durability aspects.

The present paper considers the work addressing two aspects which are critical to ensuring that impact testing represents in-service impact behaviour, i.e. scaling and strain-rate effects. Finally, investigations that, whilst not explicitly concerning marine applications, do consider composite materials typical of the marine industry (e.g. glass/reinforced, hand laid-up or infused single skin or sandwich laminates with foam or balsa cores) are described.

2. Scaling

Zhou and G.A.O. Davies [4] state that, '… impact testing of full-scale structural components (prototypes) under various impact conditions is very expensive, and is seldom carried out. Instead, the small coupon tests are conducted in the laboratory, and their data are used for

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