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Experimental study into compression after impact strength of laminates with conventional and nonconventional ply orientations

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Abstract

The quest for impact damage tolerant laminates by tailoring stacking sequences has led to nonconventional laminates whose ply sequences are not limited to 0, ±45 and 90°. Departing from the hypothesis that compression after impact (CAI) strength is impaired by the presence of delaminations, a ply sequence was defined by selecting the mismatch angles between plies so as to maintain a central sublaminate with no, or small, delaminations. An experimental test campaign was devoted to validate this hypothesis. To that purpose, baseline and blocked-ply laminates were included in the study. Specimens were tested under low velocity impact followed by compression according to ASTM standards. Delaminations were identified with Ultrasonic C-Scan. The results show delamination locations being successfully predetermined by controlling the mismatch angle, as well as the ensuing improvement in compressive strength retention after impact.

Keywords: Nonconventional laminate, B. Delamination, B. Impact behaviour, B. Damage tolerance

1. Introduction

Composite laminates have high specific stiffness and strength, good corrosion resistance, long fatigue life, and design flexibility for tailoring multidirectional properties to suit specific applications. However, they exhibit poor damage resistance under Low Velocity Impact (LVI), and low Compression After Impact (CAI) residual strength. Studies [1–6] show that LVI causes matrix cracks, delamination and eventually fibre breakage for higher impact energies. Delamination is considered to be the most critical as it divide an impacted laminate into sublaminates, and

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