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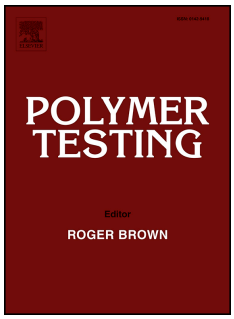

Quasi- static indentation properties of damaged glass/epoxy composite laminates repaired by the application of intra-ply hybrid patches

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Quasi- Static Indentation Properties of Damaged Glass/Epoxy Composite Laminates Repaired By the Application of Intra-Ply Hybrid Patches

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Abstract:

The main objective of this paper is to investigate the effect of intra-ply hybrid patches based on glass and Kevlar woven fabrics on the local bending response of adhesive bonded external patch repairs in damaged glass/epoxy composite laminates. In intra ply hybrid patches glass and Kevlar fibre reinforcements are combined in the same layer. The intention, in using these hybrid patches, is to combine the excellent mechanical properties of glass fiber as a brittle reinforcement with the superior high elongation to failure property of Kevlar fiber as a ductile reinforcement. Five different kinds of plain weave woven fabrics with different ratios between glass and Kevlar fibers (100/0, 75/25, 50/50, 25/75 and 0/100) were used as the external patches. The undamaged virgin specimens were taken as a reference for the comparison of residual mechanical properties. Multiple quasi-static indentation tests were carried out on repaired glass/epoxy specimens, and their ultimate indentation load, stiffness and permanent deformation were estimated. Failure mechanisms of repaired glass/epoxy specimens under indentation loads were investigated using online Acoustic Emission (AE) monitoring technique. The indentation loads required for the occurrence of various failure modes were measured to illustrate the chronology of progression of different damage modes with increasing load and the kinetics of the various damage modes individually defined in real time. The use of different hybrid patches had a significant effect on the local bending response of the repaired glass/epoxy specimens. In practice, specimens repaired with patches including equal volume fraction of glass and Kevlar fibers presented a more favorable indentation response than virgin ones and other repaired specimens by exhibiting balanced mechanical properties (i.e., high deflection to ultimate failure associated with superior patch-parent laminate bond strength).

Keywords: Polymer composites, Adhesive bonded external patch repair, Multiple quasi-static indentation tests, acoustic emission (AE) monitoring, Hybrid patches.

Introduction

The use of fiber reinforced composite laminates in place of conventional metals is becoming progressively more popular in manufacture of high performance structural components. Composite laminates are materials of first choice for numerous structural applications in aerospace, marine and automobile industries, as they have improved specific mechanical properties, show potential for reparability, are scarcely affected by corrosion, longer fatigue life and are more easily tailored to design requirements. Nowadays, composite laminates