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Dynamic Bridging Mechanisms of Through-Thickness Reinforced Composite Laminates in Mixed Mode Delamination

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Abstract

Delamination resistance of composite laminates can be improved with through-thickness reinforcement such as Z-pinning. This paper characterises the bridging response of individual carbon fibre/BMI Z-pins in mixed mode delamination at high loading rate using a split Hopkinson bar system. The unstable failure process in quasi-static tests, was also captured with high sampling rate instruments to obtain the complete bridging response. The energy dissipation of the Z-pins were analysed, and it was found that the efficacy of Z-pinning in resisting delamination growth decreased with an increase in mixed mode ratio, with a transition from pull-out to pin rupture occurring. The Z-pin efficacy decreased with loading rate for all mode mix ratios, due to the changing in failure surface with loading rate and rate-dependent frictional sliding.

Keywords: A. Fracture toughness; B. Failure; C. Delamination; D. 3-Dimensional reinforcement

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