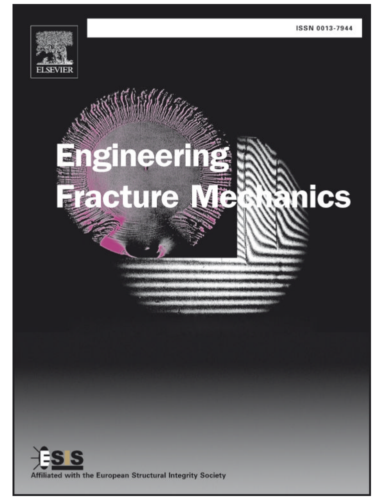

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An analytical solution for double cantilever beam based on elastic-plastic bilinear cohesive law: Analysis for mode I fracture of fibrous composites

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Abstract

The most difficult problem in mode I fracture test for fibrous composites using double cantilever beam (DCB) specimen is to identify crack tip without ambiguity. Consequently to evaluate fracture toughness through compliance method is a tricky matter. This study was conducted to solve this problem by developing an analytical solution for DCB fibrous composite specimen tested for mode I fracture. Cohesive law was employed to model separation constitution of cracking. Based on this analytical solution, the length of fracture process zone (FPZ) can be evaluated. Compliance equations of DCB specimen which take FPZ length into consideration were provided. Therefore, R-curve can be directly obtained by differentiating the compliance with respect to crack length. The model was validated by DCB tests of parallel strand bamboo (PSB), a bamboo-based fibrous composite. Good agreement between the predicted and test load-displacement were achieved. It was found that the R-curve behavior of PSB is similar to that of many other fibrous composites, which undergoes a nonlinear increase stage during FPZ formation and then reaches a constant after FPZ fully developed. Finally, general solutions for common used linear-type cohesive laws are provided.

Key words: cohesive law; cohesive zone model; R-curve; fracture process zone; fibrous composites

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