Theoretical and numerical investigation of the mode I delamination of composite laminate with uneven thickness

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Abstract

In this paper, a theoretical analysis model and two simulation methods are applied to characterize the quasi-static and fatigue delamination of composite laminate with uneven thicknesses. The test data of partially reinforced double-cantilever beam (DCB) were used as benchmark to verify the analysis model and simulation, and cohesive zone models (CZMs) and virtual crack closure technique (VCCT) are used in simulation. It's shown that the partially reinforced DCB has a unique double-peak load-displacement relationship, and produces instability development during the delamination. By comparing the results of simulation and experiment, it is found that the simulation based on the exponential CZM can simulate the delamination process of partially reinforced DCB under both quasi-static and fatigue loading; while VCCT method will generate a straight delamination front edge in the area of reinforcement, and lost the micro-damage of the previous loading step between load steps, and result in an incorrect delamination behavior.

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