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Crack Tunneling in Laminates

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Steady-state tunneling and plane-strain delamination of an H-shape crack are examined for elastic, isotropic multi-layers. Both tunneling and delamination are analysed by employing linear elastic fracture mechanics within a 2D finite element framework. Failure maps are produced to reveal the sensitivity of cracking path to the relative toughness of layer and interface, and to the stiffness mismatch of layers. Closed-form expressions are derived for the critical stress level for steady-state plane-strain delamination. It is shown that the numerical predictions asymptote correctly towards the closed-form expressions for large delamination lengths. A comparison with experimental values taken from the literature shows that the model results are useful in the determination of the residual strength and the fatigue crack growth rate in elastic multilayers.

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