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Fracture Criterious for Bridged Crack: from Macro to Nanoscale

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A multi-scale bridged crack model for the evaluation of fracture and strength parameters of interfaces with cracks is proposed. We suppose that distributed nonlinear bonds link the crack surfaces in some zones starting from the crack tips. The sizes of these zones are not assumed to be small as compared to the crack length on every bridging level. The system of singular integral-differential equations is derived for normal and shear bond stresses evaluation. Two fracture criterions of quasistatic crack growth are considered. The first condition in the both criterions is the same: it is the condition of the bond limit stretching or strain at the trailing edge of the bridge zone. Two types of the second condition of fracture is considered: a) the force condition which is the condition for the critical stress intensity factor and b) the proposed energetic condition based on the equality of the values of the strain energy release rate and the energy dissipation by the bonds at the crack limit state. The regimes of the bridged zone and the crack tip equilibrium and growth are analyzed for the both types of these criterions. The application of this model and the comparison the criterions for different problems from macro to nanoscale of the interface cracks are presented. It is noted that the most differences between the results from the force and energetic fracture conditions are observed for the cracks of micro and nano sizes.

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