Cohesive Crack Equilibrium and Stability

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Cohesive finite elements employing cohesive zone models used to describe material undergoing damage due to various fracture processes at the crack tip have recently attracted considerable attention. Crack growth as described by cohesive zone models requires knowledge concerning crack stability. Unlike the Griffith and Barenblatt fracture theories where crack stability is completely specified in terms of the external loading and the stress state in the body, the use of a cohesive zone model introduces an R-curve for energy dissipation at the crack tip. The notion of crack equilibrium and stability needs to be developed when allowing for the possibility of a finite sized cohesive zone ahead of the crack tip. The concept of crack equilibrium and stability for a conservative system employing cohesive zone model for energy dissipation at the crack tip are developed in the present work. The mathematical conditions that describe conditions of incipient crack propagation and subsequent crack stability are developed within a finite strain framework. The tangential stiffness matrix employing cohesive finite elements that is used to establish the critical state of cohesive crack stability is developed. The stability of crack growth in one-dimensional bar and double cantilever beam crack geometries are studied.

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