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Elastic Fields of Double Branched and Kalthoff-Winkler Cracks in a Half-Plane

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ABSTRACT

Edge cracking represents one of the most prominent damage modes in engineering practice and hence receives immense attention from academic societies. When branched cracks or multiple cracks are present at the edge, their propagation may be affected by the interaction between the cracks. In this talk, we may cover the elasticity of a cracked half-plane with two typical scenarios: a double branched crack with two rays emanating from one point on the edge and two edge cracks spaced by a certain distance (Kalthoff–Winkler cracks). By adopting the combination of the Schwartz-Christoffel conformal mapping and the Muskhelishvili theory with fractional function series, we supplied a general way to solve the elasticity problem of cracks with complicated geometries, for both branched cracks and Kalthoff–Winkler cracks under typical loading conditions including far-field uniform tensile stress and concentrated loads along either the tangential or the normal direction of the free surface. The theory is validated by comparing the finite-element results in terms of stress intensity factors (SIFs), stress fields, and crack opening displacement (COD). The shielding effect for Kalthoff–Winkler cracks of length a is revealed: the SIF K_I decays with their space d, $K_I = K_I^0 + K_I^1 \exp(-a/d)$, where K_I^0 and K_I^1 are two coefficients. When d approaches infinity, K_I converges to the SIF of a single edge crack [1].

KEYWORDS

Edge branched crack; Kalthoff-Winkler crack; stress intensity factors; crack opening displacement; conformal mapping

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