

The Southwest Mechanics Lecture Series

at

Texas A&M University

THEORY OF CRACK FRONT WAVES

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A crack front wave is a disturbance of the edge of a propagating crack, which remains localised about the edge as it propagates. Because it is confined to the vicinity of the edge, a crack front wave propagates without attenuation, unless some local mechanism for dissipation is present. The theory underlying crack front waves will be presented. It is more general than any presented previously. First, the presence of a non-singular term in the stress field near the unperturbed crack edge is shown to introduce dispersion, which becomes negligible as frequency tends to infinity; the previously-published work that neglected this term and predicted that the crack front wave is non-dispersive thus has only asymptotic validity, in the limit of high frequency. In addition, the present analysis is conducted for a crack which propagates through a medium that is viscoelastic rather than elastic; again, the previous elastic result is recovered as frequency tends to infinity. Explicit results have been obtained in the case that the frequency of the disturbance is high: the leading-order term is the one previously found for elasticity, while the first correction term yields both dispersion and attenuation, proportional to (frequency)⁻¹. The virtue of the asymptotic analysis is that it is applicable to any isotropic viscoelastic medium: the properties of the medium enter only through two-term expansions (for high frequency) of the (complex) phase speeds of longitudinal and shear waves.