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The Fracture Mechanics in Engineering Materials

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ABSTRACT

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A nonliving material fracture mechanics like for example rock, metals, alloys, composites etc and living example of human skeleton body parts which results at what stress level it will failure or fracture. Further these results are helpful for predicting various analysis sectors. After collision or an accidental incident how the mode shape will change for an object. The energy liberated or absorbed by the specimen or object is calculated as a miniature of fracture testing machine. Usually in izode or charpy test widely used. In dental materials also applicable to these fracture tests.

Keywords : CTOD , Mode 1, Mode 2

I. INTRODUCTION

The principles of linear elastic fracture mechanics (LEFM) were developed in the 1950s by George Irwin (1957). This work was based on previous investigations of Griffith (1920) and Orowan (1944). Irwin (1957) demonstrated that a crack shape in a particular location with respect to the loading geometry had a stress intensity associated with it. The strength of any product is limited by the size of the cracks or defects during processing, production and handling tests for determining K,, values for metals are available from ASTM (198413). Toughness can be measured by either the critical stress intensity factor, Kic, fracture energy, γ_c or critical strain energy release rate, G_c ($G_c = 2\gamma_c$). Note that K,, is measured in units of stress-(distance)ln, e.g., MPa ?rn$^{1/2}$, and yc and G, are measured in energy/unit area, e.g., J/m^2

The large crack techniques can be classified as plate or beam type tests. For example, many large crack techniques use the double cantilever beam (DCB) analysis for determination of fracture toughness. DCB type tests include compact tension (Anderson, 19911, constant moment DCB (Freiman *et al.,* 19731, and the chevron notch short bar tests (Barker, 1983). Large crack beam tests include the single edge or double edge notched beams loaded in either flexure or tension and the chevron notch flexure beam test. Small crack techniques are usually based on flexure.

II. PRINCIPLE OF FRACTURE MECHANICS

The principles of LEFM discussed above can be used in the calculation of strengths for failed materials if the appropriate material constants, *i.e.,* KIc or G_c, have been previously determined. If the stress at failure can be determined, then the value of the effective fracture toughness can be determined through the equation. The value obtained can then be compared to published or independently obtained values for the material so that a determination can be made as to the proper fabrication of the part. The size of the crack relative to the microstructural features, *i.e.,* grain size, glassy phase, pores, *etc.,* is critical to the effective value of the toughness

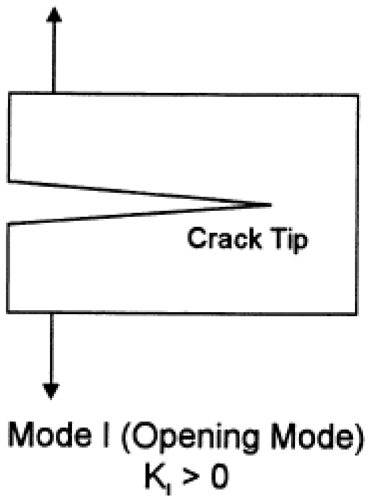
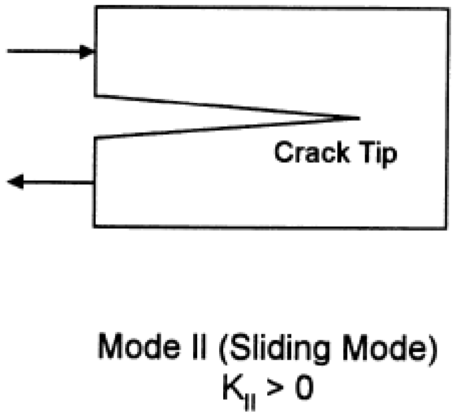


Fig. Sign convention used for determining SIFs in mode I and
mode II.



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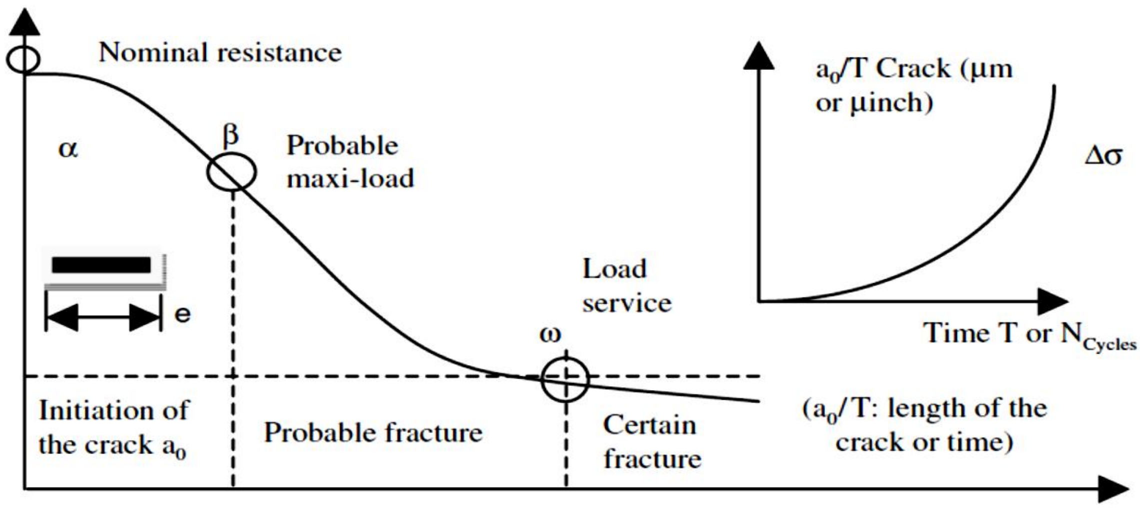


Fig. Simplified illustration of fragile fracture in mechanics

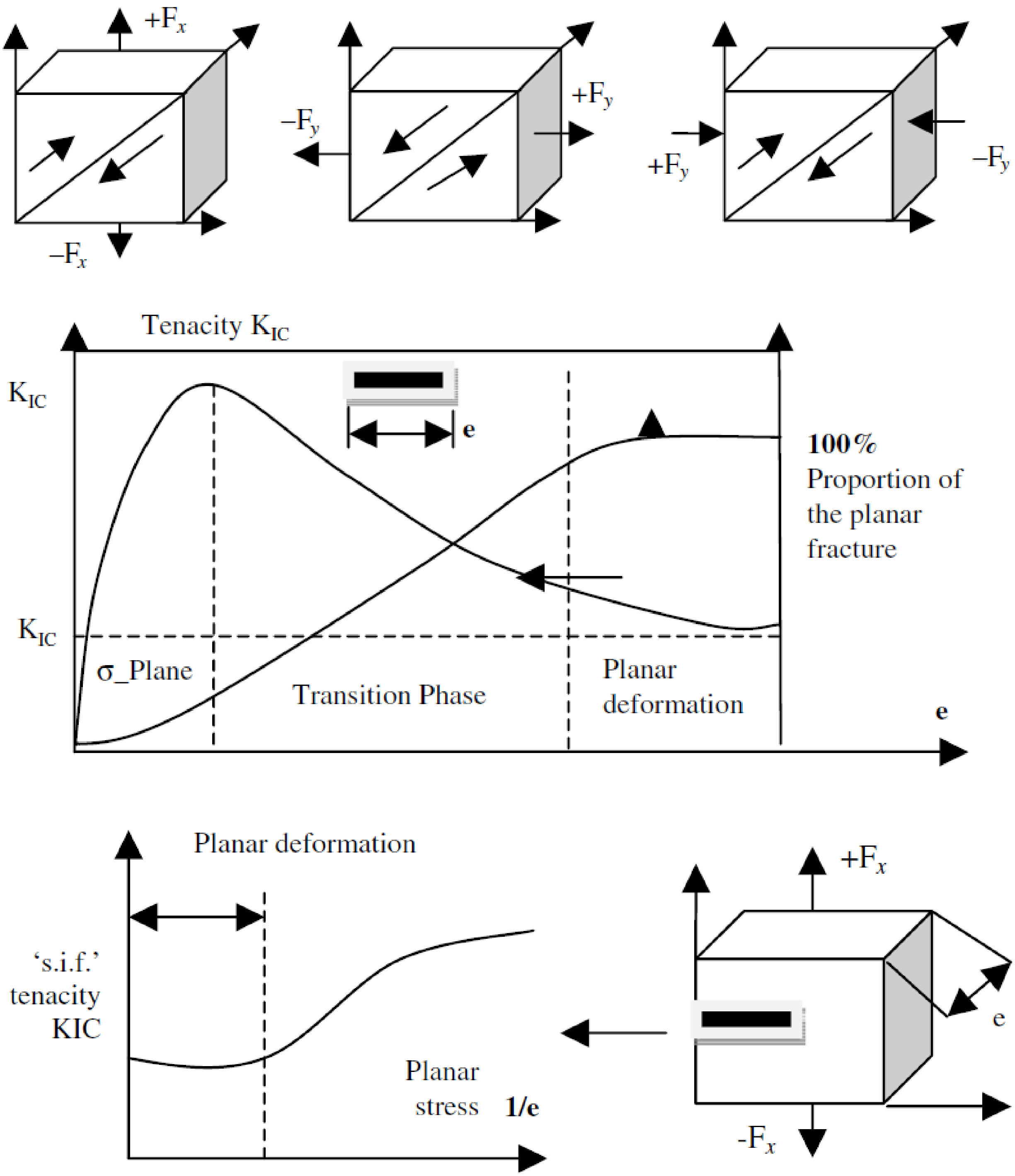


Fig. Simplified illustration of fracture criteria for mechanical plasticity

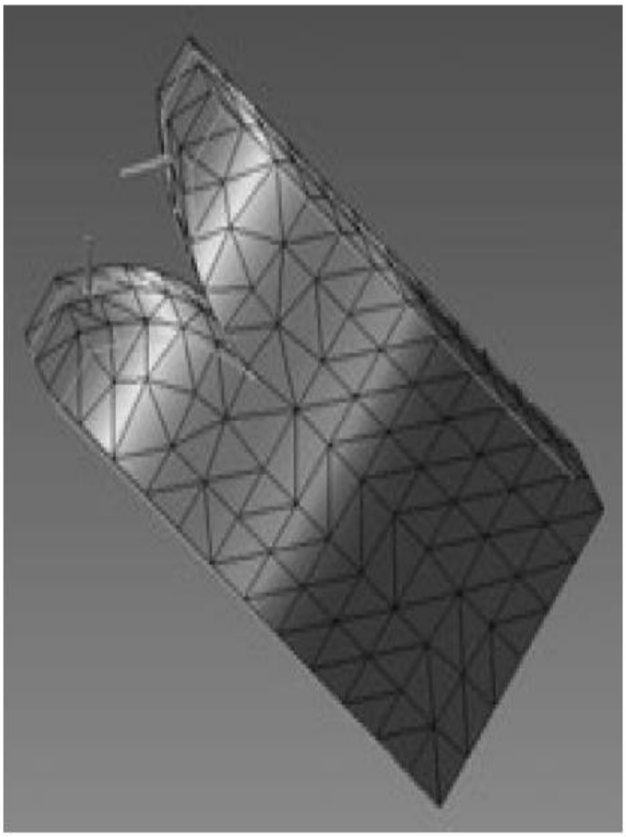


Fig. Mode 1 opening

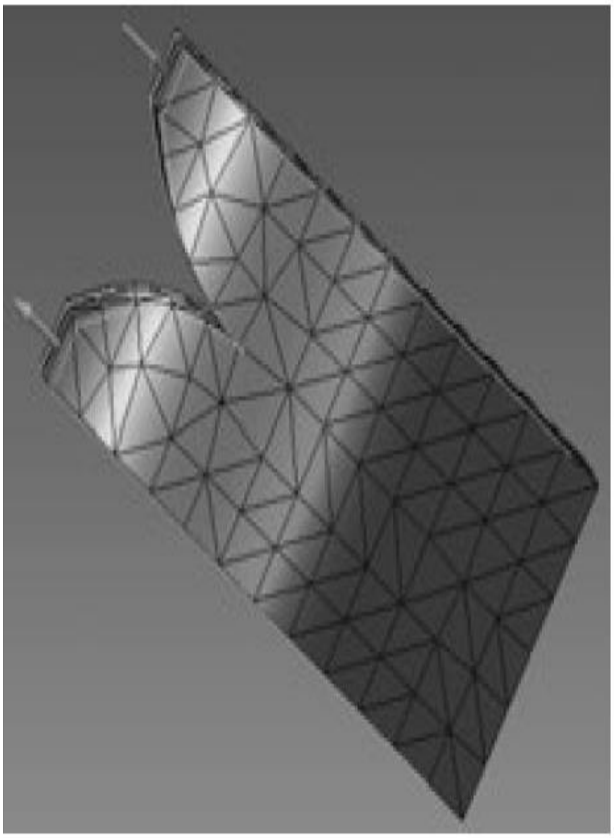


Fig. Mode 2 longitudinal shearing

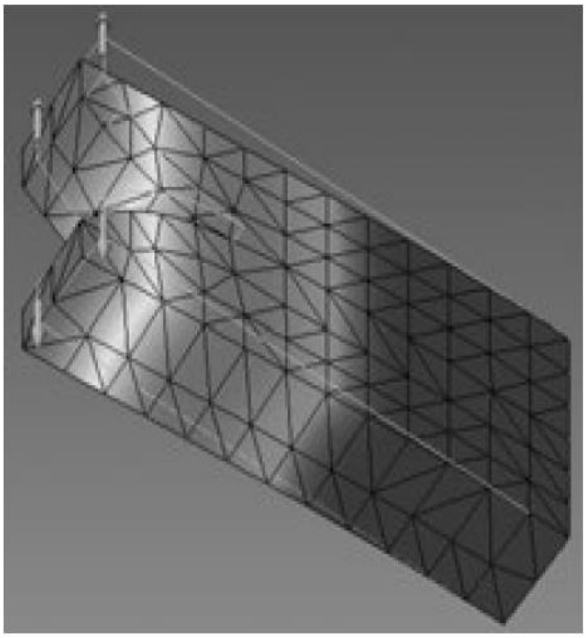
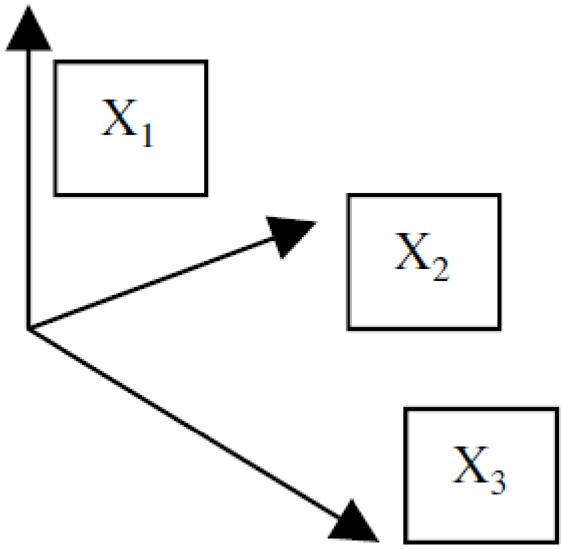


Fig. Mode 3 transverse shearing



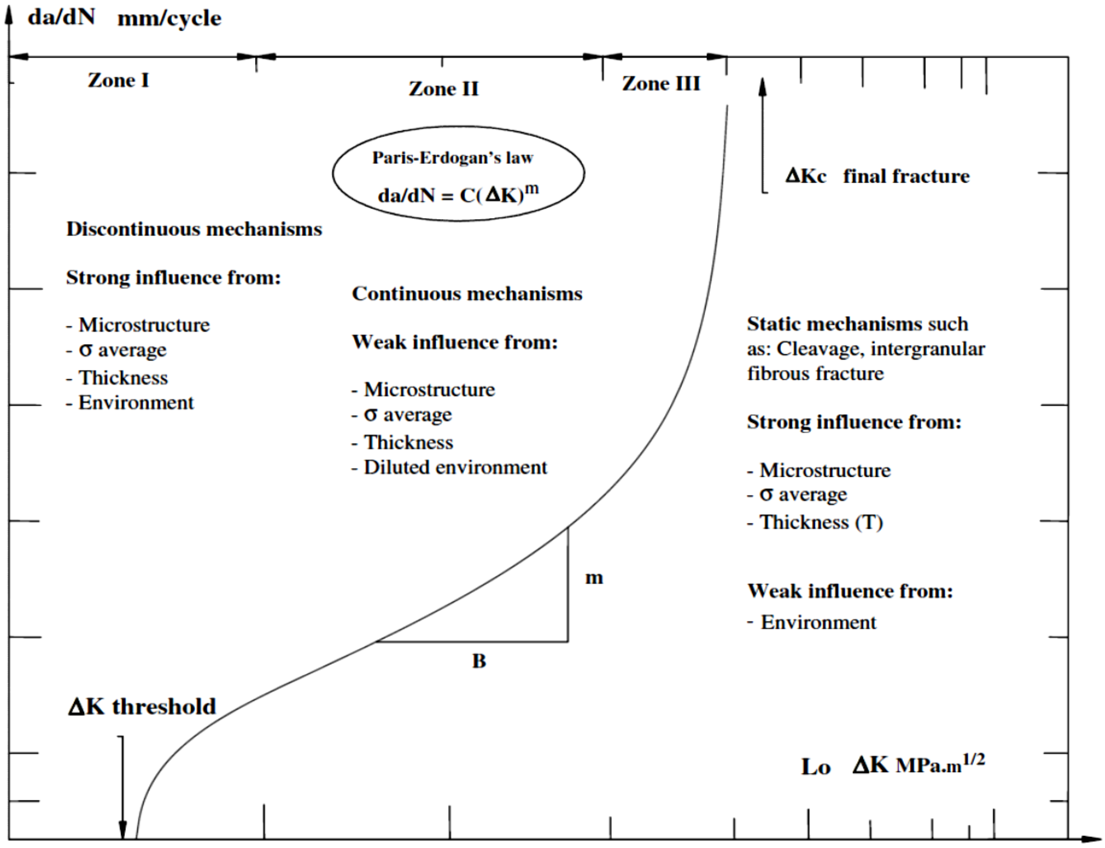
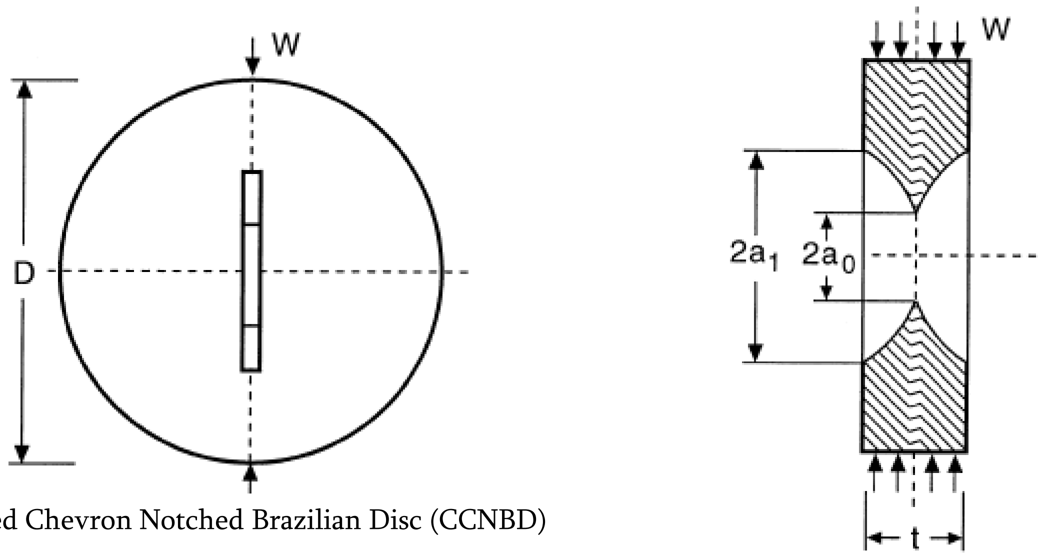


FIG. Illustration of the propagation rate da/dN in function of the s.i.f.



Cracked Chevron Notched Brazilian Disc (CCNBD)

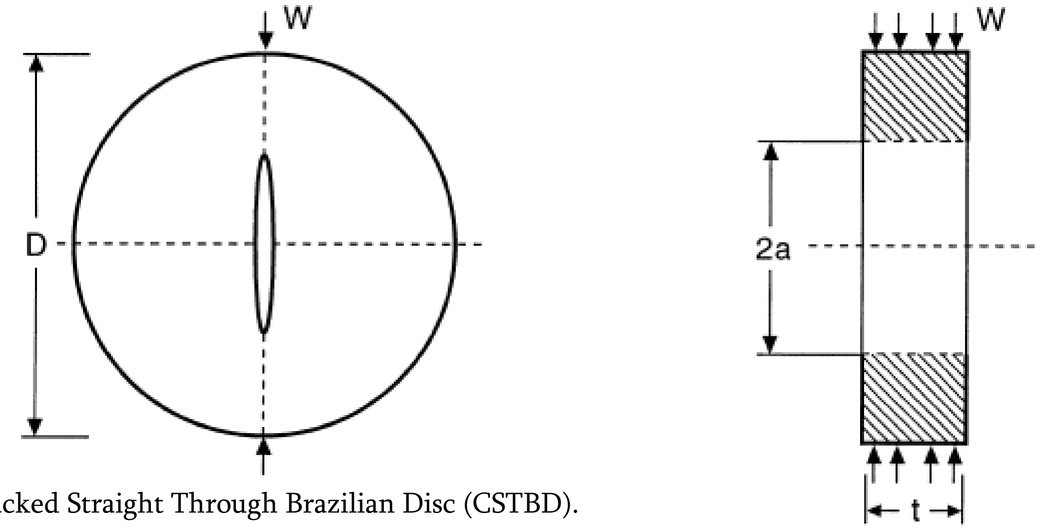


Fig. Cracked Straight Through Brazilian Disc (CSTBD).

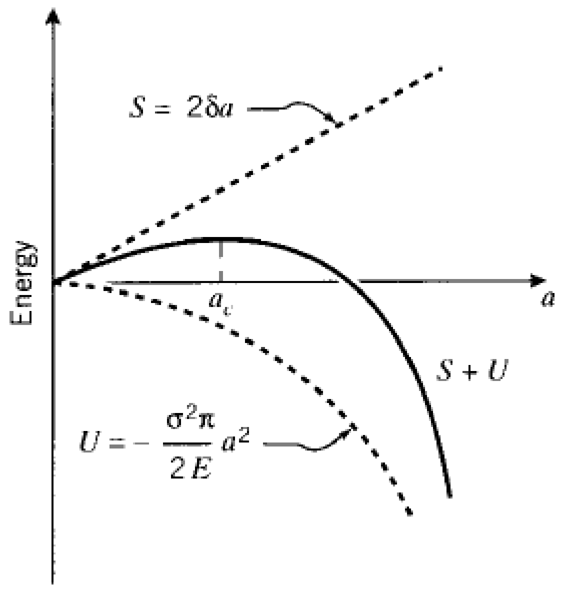


Fig. The fracture energy balance.

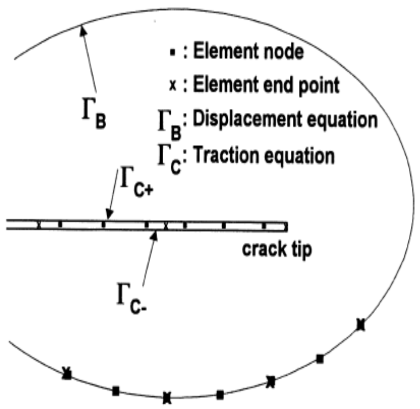


Fig. Geometry of a two-dimensional cracked domain

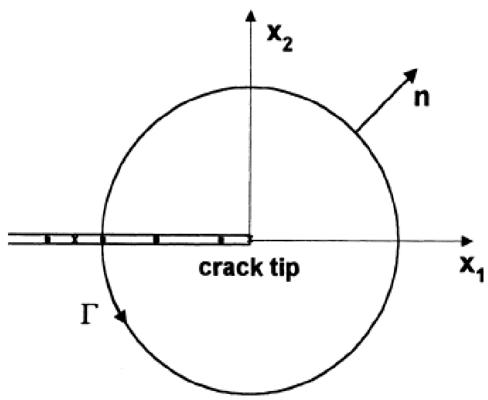


Fig. Contour path of J-integral.

III. CONCLUSION

1. In general no one material will fail by single loading
2. The material will fail or fracture by combination of two or more loading type
3. It may be from tensile+compressive, tensile+shear, compressive+shear, tensile+compressive+shear etc.
4. Mode 1 or mode 2 or mode 3 are fracture types
5. Mode shapes are obtained
6. Repeated loaded called fatigue failure in materials

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