APL765: Fracture Mechanics

Minor Test I

August 29, 2016 Time 1 hr Maximum Marks 20

1. **Theoretical Cohesive Strength** [6]

A stress-displacement equation for a solid is given as:

$$\sigma = A\, x\, e^{-Bx}$$

where x is the increase in bond length over the equilibrium value, A and B are constants.

(a) Make a schematic sketch of σ *vs.* x and mark the equilibrium location and the theoretical cohesive strength σ_c. Give the dimesions of constants A and B.

(b) Derive an expression for the theoretical cohesive strength σ_c in terms of constants A and B.

(c) Derive an expression for the theoretical cohesive strength σ_c in terms of Young's modulus E, equilibrium bond length a_0 and the surface energy γ. Compare your result to the critical stress obtained by Griffith.

2. **Griffith and Obreimoff** [4]

Show schematically the relevant energy plots for the Griffith's (1921) and Obreimoff's (1930) experiments. Comment on the similarilty and differences of the two situtaions. Indicate the material of choice for both the workers and why they selected it.

3. ***G***

(a) Show schematically the change in strain energy during crack growth for a linear elastic material tested under (i) constant load and (ii) constant displacement. [6]

(b) Derive expression for G for constant load and constant displacement in terms of compliance.

(c) Comment on whether "strain energy release rate' is a suitable expression for G.

4. ***DCB*** [4]

(a) Derive an expression for the energy release rate of a DCB specimen.

(b) Comment on the stability of crack growth in a DCB specimen tested under load control or displacement control.

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Examinations are formidable even to the best prepared, for the greatest fool may ask more than the wisest man can answer. Charles Caleb Colton