Tutorial Session 13: LEFM Crack Tip Fields

Mentor Guide K&S Questions:-

1.1 Describe the stress and strain fields near the tip of a linear elastic crack in terms of the stress intensity factor (SIF or K) and the distance from the tip (r).

1.3 Describe the three modes of stress intensity factor (K_I, K_{II}, K_{III})

1.5 State the criterion for brittle facture.

1.6 Deduce how the critical crack size for brittle fracture varies with applied load or the size of the structure.

Numerical/Mathematical Questions:-

1) Read through the derivation of the LEFM fields in Modes I and II in any standard text (e.g. Knott) or on my web site.

2) Use the software of your choice to plot the region around a crack tip which has Mises stress greater than the yield stress of 150 MPa assuming the Mode I K is 50 MPa$\sqrt{m}$. Compare plane strain and plane stress. Which has the larger yield zone? In what direction is yielding most severe (i.e. extends to the greatest distance)?

3) Repeat (2) for the hydrostatic stress.

4) Base on these plots, and assuming that fracture processes are particularly sensitive to the hydrostatic stress, which of plane stress or plane strain conditions is more likely to result in fracture?