SQEP Tutorial Session 17: T73S02 – Homework

Mentor Guide K&S Questions:-

(2.4 - *there is no question 2.4 in the MG*).

2.5 Describe the stress and strain fields near the tip of a crack in a power-law hardening material in terms of J and the distance from the tip (r), assuming small-scale yielding.

2.6 State the criterion for ductile 'fracture' (i.e. crack extension due to overload, which may be stable or unstable).

5.1 Describe the Failure Assessment Diagram (FAD) and define its axes, Lr and Kr. Define the material properties used in their definition. Define 'reference stress'.

5.2 Describe how an R6 assessment using the FAD is equivalent to a J-estimation approach but with an additional check on plastic collapse.

5.3 State the position of the cut-off on the Lr axis and discuss how it varies with material. Discuss why the value of the cut-off can often exceed unity. Define 'flow stress' (as used in R6).

5.4 Describe qualitatively the various methods, of increasing precision, for finding the FAD.

5.5 Describe the two simplest methodologies within R6 for incorporating secondary stresses into a fracture assessment. State typical magnitudes of correction terms/factors, ρ and V. (*Following Amendment 11 there is now only the V method, so confine attention to that*).

5.6 Define the term 'Reserve Factor' and illustrate how it can be estimated.

5.7 Describe how a fracture assessment including stable tearing can be carried out using R6. Illustrate the process by the locus of assessment points on the FAD. Describe how the reserve factors may be found for a stable tearing assessment.

5.8 Describe how an R6 stable tearing assessment can be used to find the limit of tearing stability. Comment on the validity aspects of such an instability assessment. Discuss the potential interaction of ductile tearing and fatigue and how this is treated in R6.

PTO...

Numerical/Mathematical Questions:-

1) Given J = 50 N/mm, $\sigma_0 = 100$ MPa, $\varepsilon_0 = 0.1\%$ and n = 5, use the tabulated HRR parameters to find the following stresses at a distance of 1mm from the crack tip on the x-axis ($\theta = 0$), for both plane stress and plane strain (take care finding σ_z, in plasticity ν is effectively 0.5),

	σ_x	σ_y	σ_z	σ_H	$\overline{\sigma}$
P.Stress					
P.Strain					

Is plane stress or plane strain likely to be more susceptible to fracture?

Is plane stress or plane strain likely to have the larger yield zone?

[Optional: You could repeat the exercise from session 13, plotting the shape of the regions with equal Mises or equal hydrostatic stress. This is messy for PYFM because the angular functions are not in closed form but only tabulated – so I haven't done it. But I believe they would look qualitatively similar in *shape* to the LEFM case – though not in *size*].

2) A material with E = 200 GPa has the stress-strain curve given below. Use R6 Option 2 to find an FAD for this material.

Strain (abs)	Stress MPa
0.001	200
0.002	250
0.003	280
0.004	300
0.005	315
0.0075	345
0.01	365
0.015	395
0.02	415
0.03	440
0.05	470
0.1	500