

T73S02 Tutorial Session #19 (J Estimation) - Homework

Mentor Guide K&S Questions:-

2.3 State how the J parameter may be estimated in terms of K and the reference stress.

5.10 Describe how single and multiple flaws are characterised for assessment purposes.

5.11 Describe in outline the more detailed ρ and V methodologies for incorporating secondary stresses into an R6 fracture assessment.

Describe in outline the various methods for calculating the effective elastic-plastic secondary stress intensity factor, K_J^S . (This was previously a separate question in the MG. It's inclusion in Qu.5.11 appears to be a typo).

5.12 State the special provisions which apply when the combined secondary stresses exceed yield and contain a contribution from welding residual stresses.

5.13 State a selection of useful sources of advice on welding residual stress distributions for common weld geometries.

5.15 Describe in outline the methodology within R6 for assessing displacement controlled loadings which are intermediate in character between primary and pure secondary stresses.

Numerical/Mathematical Questions:-

[1] Using the simpler R6 method, as given in R6 section II.6.3.2, find the greatest possible value for the V factor which defines the effect of secondary plasticity (use equations II.6.2 and note the limit stated in the title of Section II.6.3).

[2] A bar has a rectangular section 20mm by 50mm. An edge crack runs across the whole of the 20mm thickness and is of length 25mm across the longer side, so the crack tip is in the middle of the bar. The bar is load in simple tension, and may be taken as "bending unrestrained" and in plane strain. The lower bound 0.2% proof strength is 150 MPa and the lower bound initiation toughness is 90 MPa√m. Use R6 Option 1 to find the assessed load capacity (at fracture or the initiation of tearing).

[3] The true stress/true strain curve for the material in Qu.[2] is given by,

$$\varepsilon = \frac{\sigma}{E} + 0.002 \left(\frac{\sigma}{\sigma_{0.2}} \right)^8$$

Use the reference stress formula to estimate the elastic-plastic J at the load calculated in Qu.[2]. The reference stress formula is,

$$J_{el-pl} = \left[\frac{E\varepsilon_{ref}}{\sigma_{ref}} + \frac{\sigma_{ref}^3}{2E\sigma_y^2\varepsilon_{ref}} \right] J_{el}$$

where $E = 150\text{GPa}$. Hence find the effective elastic-plastic $K_{eff} = \sqrt{\frac{EJ}{1-\nu^2}}$

Is it worth using R6 Option 2 to seek an alleviation in this case?