

T73S02 Session 21 Homework – Constraint Effect of Fracture

Mentor Guide K&S Questions:-

5.23 Describe physically the influence of constraint on fracture behaviour. Define the T-stress and the Q-stress, and when they apply. Define the constraint parameter β . Describe the effect of positive and negative constraint on the effective fracture toughness in the cleavage and ductile regimes. . Discuss the effect of out-of-plane constraint and how this is treated in R6.

5.25 Describe in broad outline the aims of the local approaches to fracture, the range of models available, and how they are used in practice.

Numerical/Mathematical Questions:-

Consider our old friend the edge cracked plate (ECP), bending unrestrained. Assume a plate width of 64mm and a remotely applied stress of 150 MPa. The material has a 0.2% proof strength of 300 MPa and a toughness, obtained from a fully constrained valid specimen, of $100 \text{ MPa}\sqrt{\text{m}}$.

(a) Find the critical (initiation) crack depth assuming that the ECP is fully constrained.

(b) Find the critical (initiation) crack depth assuming that the ECP is not fully constrained but instead has $\beta = -1$ and that Equations (4a,b) of the notes to session 21 apply with $\alpha = m = 1$.

NB: I doubt that an ECP has such a low constraint as -1, but never mind. It's just an example.