Lecture 18

Griffith Energy-Balance:

- A crack will propagate when the rise in elastic strain energy is equal to

$$\sigma_c = \sqrt{\frac{2E\gamma_s}{\pi a}}$$

σ_c ↓ Critical stress for crack propagation.

Fracture Toughness: resistance of material to propagate a crack.

- measured by stress intensity factor.

$$K_{I/II} = Y\sigma\sqrt{\pi a} \quad MPa\sqrt{m}$$

- Mode I: Crack Opening mode
- Mode II: Forward Shear mode
- Mode III: Parallel Shear mode.

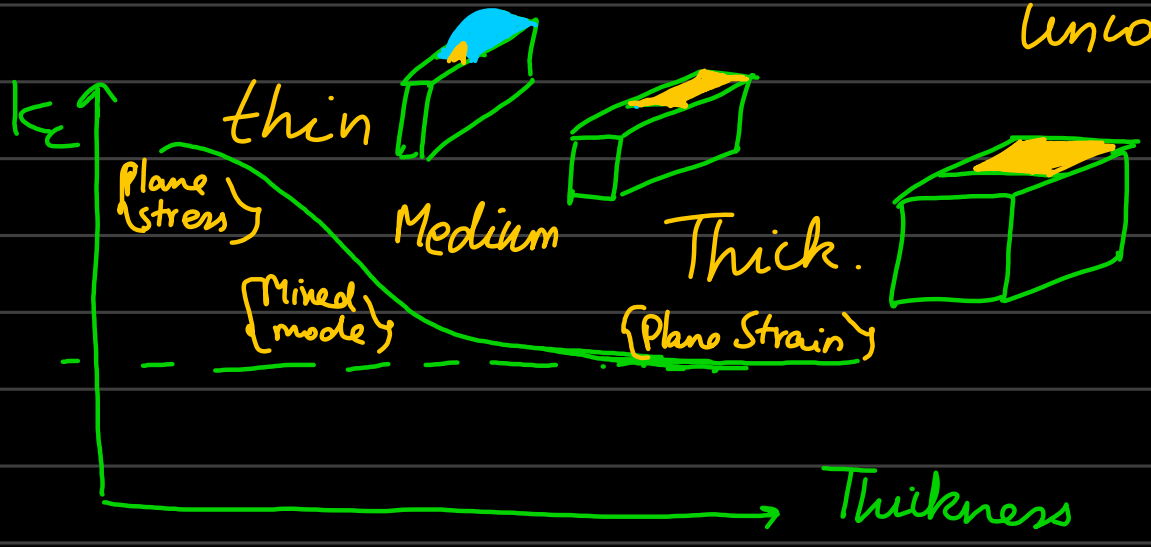
Y = Geometric factor ; σ = applied stress.
a = crack size

* Maximum Normal Stress Criterion:
{Rankine / Coulomb criterion}

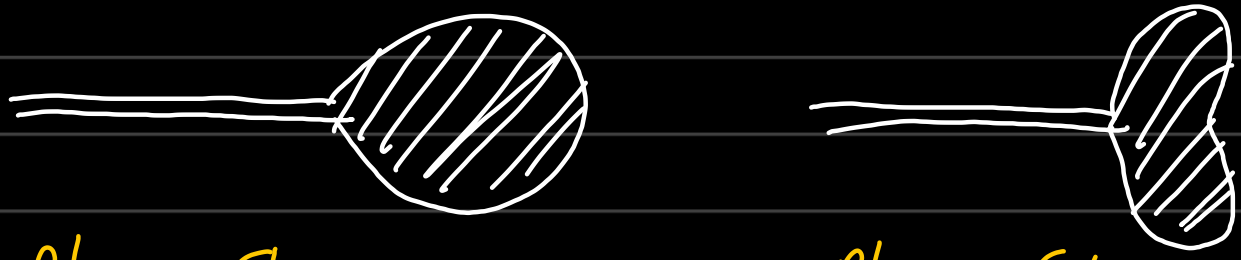
$\sigma > UTS \rightarrow$ fracture

* When $K_I < K_{Ic} \rightarrow$ crack is stable

When $K_I > K_{Ic} \rightarrow$ crack grows uncontrollably.



Plastic zone in front of crack:



Plane Stress

Plane Strain.

$$\sigma_c = \frac{K_{Ic}}{Y\sqrt{\pi a}} \qquad a_c = \frac{1}{\pi}\left(\frac{K_{Ic}}{\sigma Y}\right)^2$$

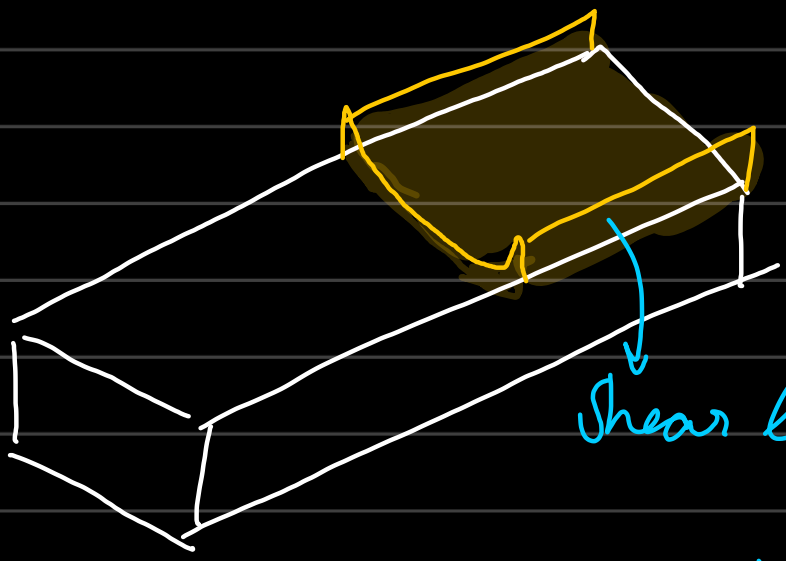
K_{Ic}: material property

σ_c: critical stress

a_c: critical flaw size

Plane Strain:

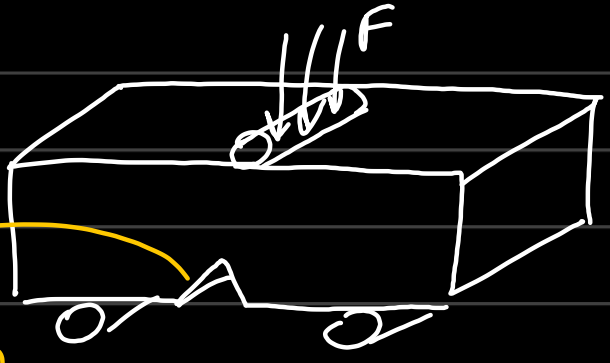
- predominately brittle fracture
- triaxial state of stress.



Shear lips:

$$B \geq 2.5\left(\frac{K_{Ic}}{\sigma_y}\right)^2$$

Three-point bend test:



pre-crack notch

{to maintain triaxiality}