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محاضرة سلوك ميكانيكي / ثالث ايلول

Fracture mechanics :-

المحاضرة (19)

- Linear elastic Fracture mechanics :-

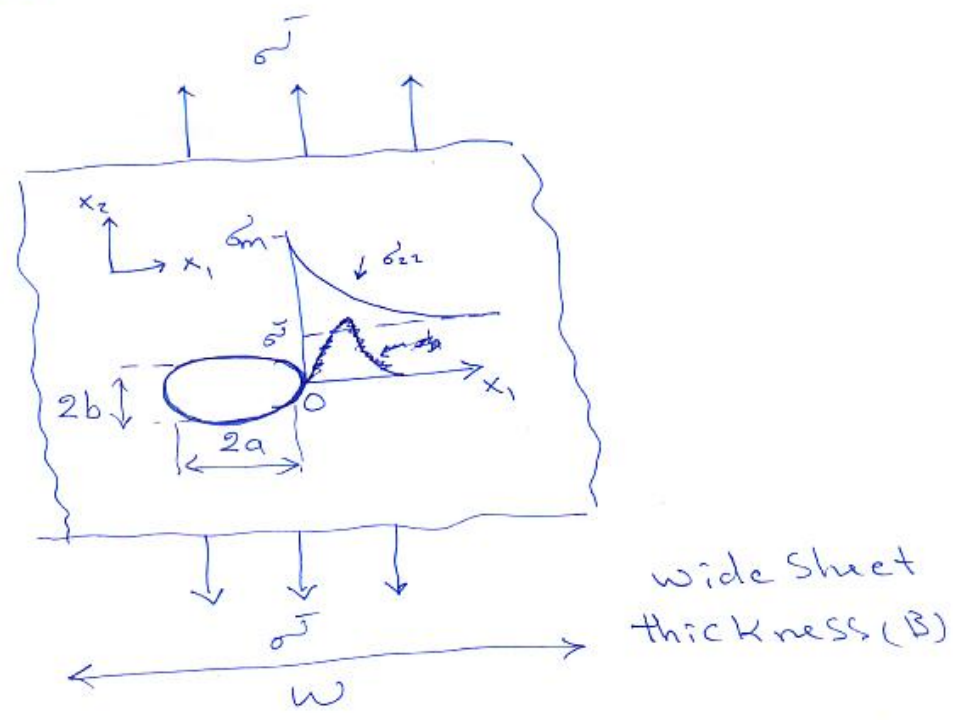
Brittle Solids Fracture because the Applied stress is

Amplified by minute cracks (of order 1 μm in size)

which occur naturally as a result of fabrication,

Solidification, Fatigue damage. These cracks are termed

Griffith cracks -



Consider an elliptical through thickness crack in an elastic sheet subject to a stress $\bar{\sigma}$ in the x_2 direction causes a stress distribution along Ox_1 .

(Wide or infinite sheet means $w \gg 2a$).

$\bar{\sigma} = \frac{F}{wB}$; σ_{22} is amplified from $\bar{\sigma}$ to σ_m at both tips of the crack where σ_m is max. value. σ_{22} falls to $\bar{\sigma}$ as x_1 increases (x_1 distance from the crack).

~~Max stress~~ The maximum stress Amplification (MSA) will occur at the crack surface ($x_1 = 0$) \rightarrow

$$MSA = \frac{\sigma_m}{\bar{\sigma}} = \left(1 + \frac{2a}{b}\right) \text{ For central crack.}$$

For a circle ($a = b$) \rightarrow ~~The max. stress~~ $MSA = 3$;

For a thin crack ($\frac{a}{b} = 500$); $MSA \approx 10^3$;

~~For central cracks;~~

For low applied stress, the stress at the crack tip approach the theoretical strength of the solid (interatomic bonds reach to their breaking point).

These conditions occur only in materials that is unable to relieve the stress concentration by plastic flow or other mechanisms of crack blunting such as diamond and

In most of Eng. materials such as polymers, failure is inhibited by energy absorbing processes around the crack tip (Crack will spread only if the total energy of the system is lowered).