7.2.17 Design of Machine Elements - Lectures 19,20

Stress concentration

Features such as threads, steps, slots, oil grooves
- Locating bearing, transmitting axial loads, etc.
- Connecting shafts to pulley's, gears

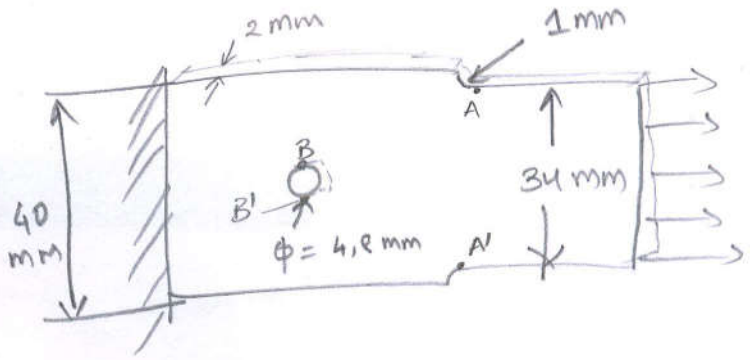
raise stress at that location. Regions where stress raisers are called areas of stress concentration.

Theoretical stress concentration factor K_t or K_{ts} is used to relate actual maximum stress at the discontinuity to the nominal stress. The factors are defined as

$$K_t = \frac{\sigma_{max}}{\sigma_0}, \qquad K_{ts} = \frac{\tau_{max}}{\tau_0}$$

Note:

Effect of stress concentration is usually applied ONLY to brittle materials. For ductile materials stress redistribution occurs and $K_t \to 1$.



A, B } critical
A', B' } locations

For 4 mm hole

$$\sigma_0 = \frac{F}{A} = \frac{F}{(w-d)t} = \frac{10000}{(40-4)_2} = 139 \text{ MPa}$$

For $d/w = 4/40 = 0.1$, is $K_t = 2.7$

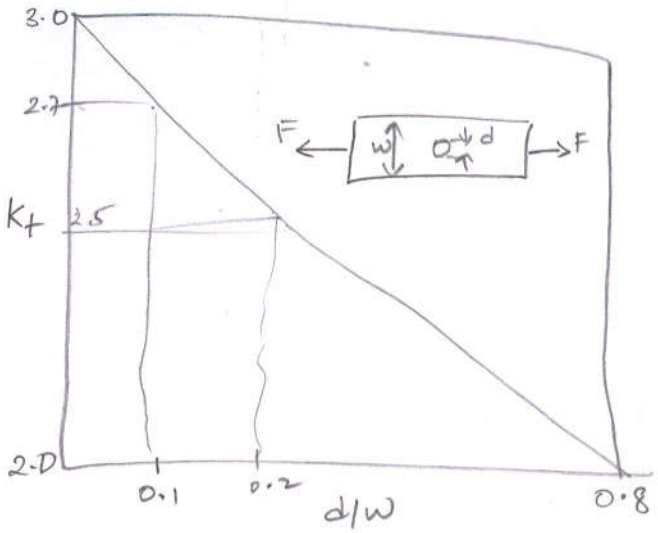
$$\sigma_{max} = K_t \sigma_0 = 2.7\,(139) = 375 \text{ MPa}$$

Similarly for an 8-mm hole

$$\sigma_0 = \frac{F}{A} = 156 \text{ MPa}$$

$$\sigma_{Max} = 2.5 \times \sigma_0$$

$$= 390 \text{ MPa}$$



For the fillet

$$\sigma_0 = \frac{F}{A} = \frac{10000}{(34)2} = 147 \text{ MPa}$$

$D/d = 1.18$, $r/d = 1/34 = 0.026$ then $K_t = 2.5$

$$\sigma_{max} = K_t \sigma_0 = 2.5\ (147) = 368 \text{ MPa}$$