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Design of machine Elements
Lab-2

* Calculations: (On the basis of MATLAB code)

Design of Cotter Joint:

Given: $\sigma_{yt} = 380$ N/mm^2 $\tau_{yt} = 190$ N/mm^2

Axial Force = 70×10^3 N

Assuming F.O.S. to be 3.5.

Step-1:

(Rod-Dia)

$$\sigma_t = \frac{\sigma_{yt}}{FOS} = \frac{380}{3.5} = 108.57 \text{ N/mm}^2$$

$$d = \sqrt{\frac{4 \times (P/\sigma_t)}{\pi}} \Rightarrow \boxed{d = 28.6514 \text{ mm}}$$

Step 2:

Thickness of Cotter:

$$t = 0.31 \times d \Rightarrow t = 0.31 \times 28.651$$

$$\boxed{t = 8.88 \text{ mm}}$$

Step-3:

Spigot-End.

$$d2 = 2 * \left(t + \sqrt{(t^2 + (P/\sigma)/\pi} \right)$$

⇒ $d_2 = 16.3851$ mm.

* **Step 4: Socket-End** $d_1 = 2 \times (t + \sqrt{t^2 + 2 \times \left(\frac{\frac{P}{\sigma}}{\pi}\right)})$

$d_1 = 19.737$ mm

* **Step 5: Additional Dimensions:**

$d_3 = 1.5 \times d$, $d_4 = 2.4 \times d$.

$\therefore d_3 = 42.9771$ mm | $d_4 = 68.76$ mm

* **Step-6:** $\sigma = \frac{\sigma_{yt}}{F.O.S.} = \frac{190}{3.5}$

$a = \frac{P}{2 \times \sigma \times d_2} \Rightarrow \frac{70 \times 10^3}{2 \times \sigma \times 16.38} = 39.349$ mm

$a = 39.349$ mm

$c = \frac{P}{2 * \sigma \times (d_4 - d_2)}$

$c = 12.3092$ mm

* **Step-7:**

$b = P / 2 * \sigma * t$

Step 7: $\therefore b = 72.58$ mm

Step 8: $t_1 = 0.4 * d = 12.893$

$\therefore t_1 = 12.8931$ mm

Step 9: $(\sigma_c)_{spigot} = 217.142\ N/mm^2$

$\left(\frac{P}{d_2 * t}\right) = 480.9954.\ N/mm^2$

↳ Spigot - not safe in crushing - test.

$(\tau)_{spigot} = 54.2857\ N/mm^2$

$\frac{P}{2 * a * d_2} = 54.2857.$

↳ Spigot not safe in shear test.

$(\sigma_c)_{socket} = 217.1429\ N/mm^2$

$\frac{P}{(d_4 - d_2) * t} = 150.466.$

↳ Socket safe in crushing test

$(\tau)_{socket} = 54.2857\ N/mm^2.$

$\frac{P}{2 * c * (d_4 - d_2)} = 54.2857\ N/mm^2$

↳ socket - safe in shear test.