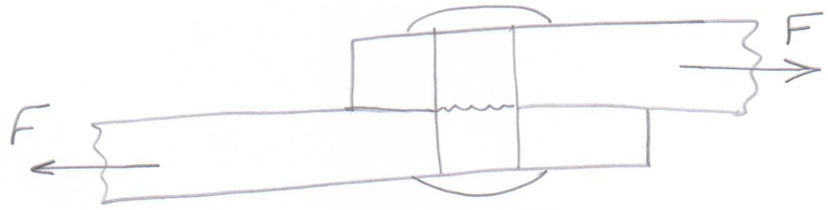
shear stress

* direct shear

* single shear

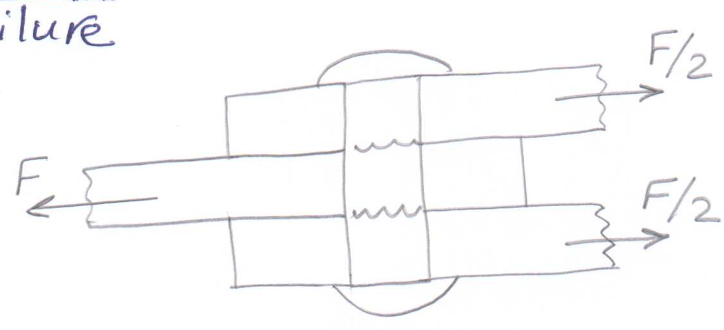


F // A

$$\tau = \frac{F}{A}$$

$$= \frac{\text{shear force}}{\text{Area of failure}}$$

* Double shear



$$\tau = \frac{F}{n\,A}$$

as n: no. of areas of failure

Design equation:

$$\tau_{max} \leq \tau_{all}$$

$$\frac{F}{A} \leq \frac{0.5\,S_y}{F.S.}$$

$F \leq$ —

$A \geq$ —

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cut equation (shear eqn)

τ_{max} = ultimate shear stress

هى المفروض تكون

$$\tau_{max} \geq S_{u_{sh}}$$

ولأننا نأخذ أقل قيمه فأصبحت

$$\tau_{max} = S_{u_{sh}}$$

$$= 0.5 * S_u$$

sheet #2

No 1

to shear $\therefore \tau = \tau_{ultimate}$

$$\frac{F}{A} = \tau_u$$

Area of rectangle

$A = b * t$

$$\frac{F}{5 * 0.8 * 10^3} = 50$$

$$F = 50 * 5 * 0.8 * 10^3 = 200 KN$$

No 2

to punch $\therefore \tau = \tau_u$

$$\frac{F}{A} = \tau_u$$

$$\frac{F}{\pi d t} = \tau_u$$

side Area of a cylinder

$A = \pi d t$

$$\frac{F}{\pi * 30 * 3} = 60$$

$$\therefore F = 60 * \pi * 30 * 3 = 16964.6 \simeq 17 KN$$

No 3

to shear $\therefore \tau = \tau_u$

$$\frac{F}{\frac{\pi}{4} d^2} = \tau_u$$

Area of circle

$A = \frac{\pi}{4} d^2$

$$\therefore F = 60 * \frac{\pi}{4} (8)^2$$

$$= 3015.929 \text{ N}$$

$$\simeq 3 KN$$

Equilibrium of a rigid body

steps

1. Draw the body
2. put the external forces
3. Replace supports by reactions
4. use equilibrium eqns

$$\Sigma F_x = 0 \;,\; \Sigma F_y = 0 \;,\; \Sigma M = 0$$

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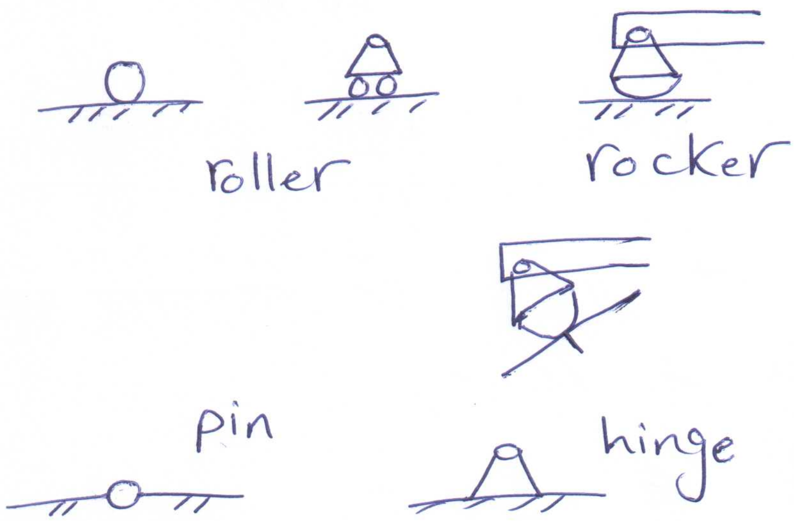
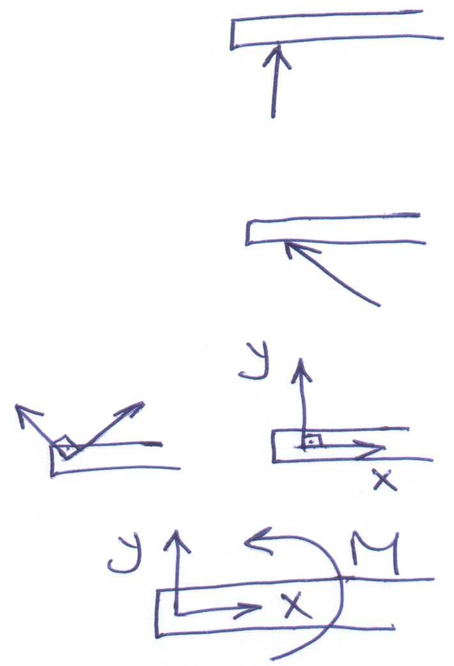
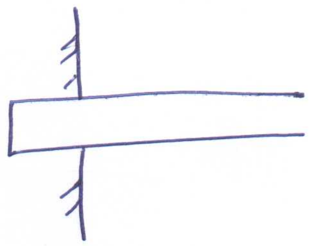
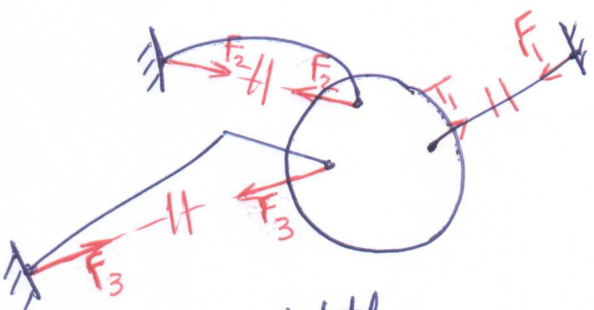
supports | reactions



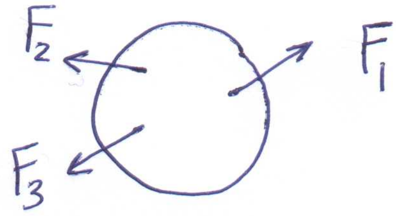


Complete fixation





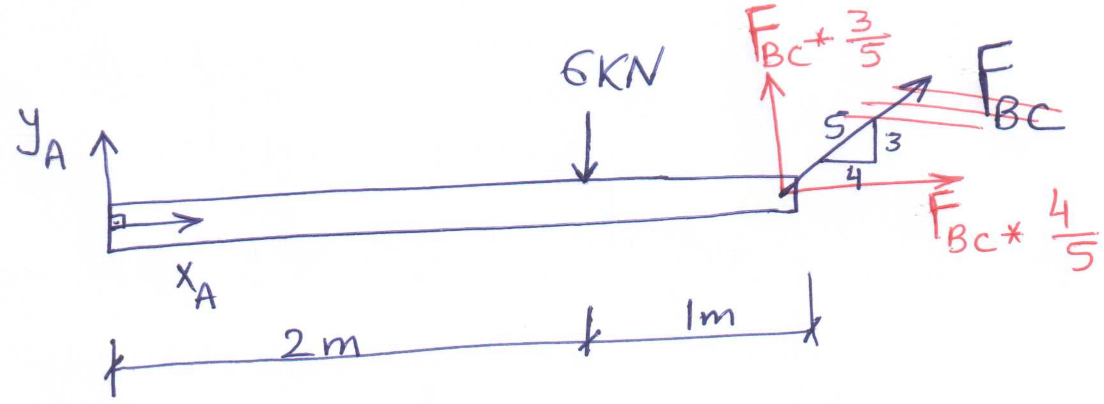
weightless links



Ex. 1-10

Pg 35

Q5
sheet 2



$\tau_{all} = 90$ MPa $\qquad \sigma_t)_{all}^{CB} = 115$ MPa

Determine, to nearest mm, the smallest dia of d_A, d_B, d_C

& $d_{CB} = ??$

soln

$\Sigma M_A = 0$ (+↺)

$-6 * 2 + F_{BC} * \frac{3}{5} * 3 = 0$

$F_{BC} = 12 * \frac{5}{9} = \frac{20}{3}$ KN $= 6.667$ KN

$\Sigma F_x = 0 \quad \xrightarrow{+}$

$X_A + F_{BC} * \frac{4}{5} = 0$

$X_A = - F_{BC} * \frac{4}{5}$

$= - \frac{20}{3} * \frac{4}{5} = \frac{-16}{3}$ KN $= -5.33$ KN

$\Sigma F_y = 0 \quad +\uparrow$

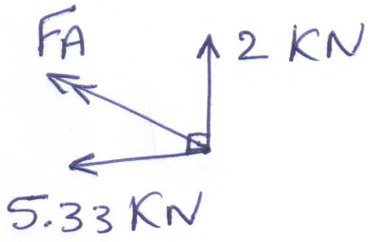
$y_A - 6 + F_{BC} * \frac{3}{5} = 0$

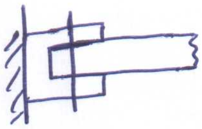
$y_A = 6 - F_{BC} * \frac{3}{5}$

$= 6 - \frac{20}{3} * \frac{3}{5} = 2$ KN

pin A

$$F_A = \sqrt{5.33^2 + 2^2} = 5.68\ KN$$





double shear

$$\tau = \frac{F_A}{n A} \leq \tau_{all}$$

$$\frac{5.68 * 10^3}{2 * \frac{\pi}{4} d_A^2} \leq 90$$

$$6.35 \leq d_A$$

$$\therefore d_A = 7\ mm$$

* تقرب لأكبر رقم صحيح

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pin B

single shear

$$\tau = \frac{F_{BC}}{A} \leq \tau_{all}$$

$$\frac{6.667 * 10^3}{\frac{\pi}{4} d_B^2} \leq 90$$

$$9.712 \leq d_B$$

$$\therefore d_B = 10\ mm$$

pin c double shear

$$\frac{6.667 * 10^3}{2 * \frac{\pi}{4} d_c^2} \leq 90$$

$$6.867 \leq d_c$$

$$\therefore d_c = 7 \text{ mm}$$

Rod CB

$$\sigma_t = \frac{F_{BC}}{A} \leq \sigma_{all}$$

$$\frac{6.667 * 10^3}{\frac{\pi}{4} d_{CB}^2} \leq 115$$

$$8.591 \leq d_{CB}$$

$$\therefore d_{CB} = 9 \text{ mm}$$