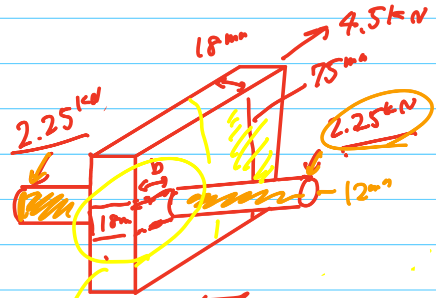
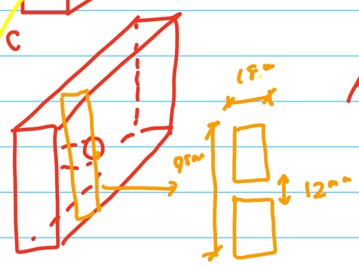
Solutions of Example question 1



(a) Maximum Normal stress

$$\sigma = \frac{P}{A}$$

$P = 4.5^{kN} = 4500\ N$

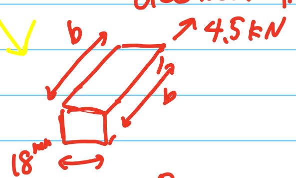


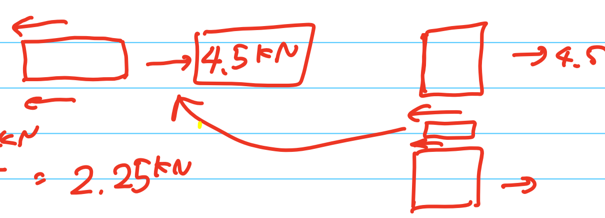
$A = 18^{mm} \times (75^{mm} - 12^{mm}) = 1134^{mm^2}$

$$\sigma = \frac{4500^{N}}{1134^{mm^2}} = 3.97\ MPa = 4.0\ MPa$$

(b) the distance b for which the average shearing stress is 620 kPa on the surface indicated by the dashed line.

double shear.





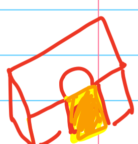
$$F = \frac{P}{2} = \frac{4.5^{kN}}{2} = 2.25^{kN}$$

$A = b \times 18^{mm} = 18b^{mm^2}$ $\qquad \tau = 620\ kPa = 0.62\ MPa$

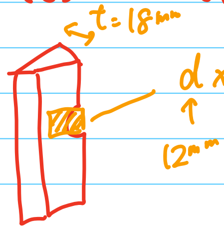
$$\tau = \frac{F}{A} \qquad 0.62^{MPa} = \frac{2.25^{kN}}{18 \cdot b}$$

$b = 201.6^{mm}$

$\approx 202^{mm}$



(c) the average bearing stress on the wood.



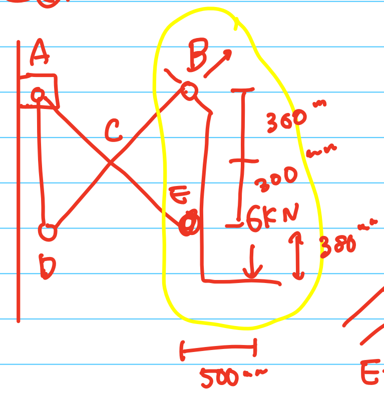
$$\sigma_B = \frac{P}{A}$$

$P = 4.5^{kN}$

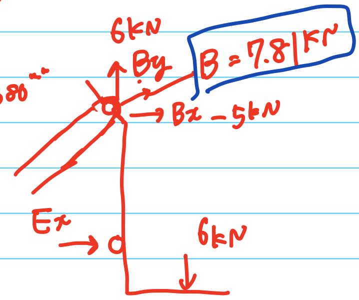
$A = 12^{mm} \times 18^{mm} = 216^{mm^2}$

$$\sigma_B = \frac{4.5^{kN}}{216^{mm^2}} = \underline{20.8\ MPa}$$

EQ2



(a) the average shearing stress in the 12-mm-diameter pin at B.



$B_x = -5^{kN}$

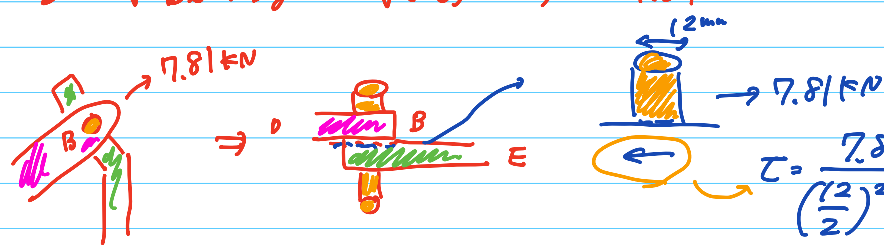
$B_y = 6^{kN}$

$E_x =$

$\overrightarrow{\Sigma}: \ B_x + E_x = 0 \qquad \uparrow\Sigma: \ B_y - 6^{kN} = 0 \qquad B_y = 6^{kN}$

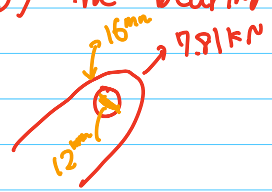
$\circlearrowleft M_E: \ -B_x \cdot 600^{mm} - 6^{kN} \cdot 500^{mm} = 0 \qquad B_x = -5^{kN}$

$$B = \sqrt{B_x^2 + B_y^2} = \sqrt{(-5)^2 + (6)^2} = 7.81^{kN}$$



$$\tau = \frac{7.81^{kN}}{\left(\frac{12}{2}\right)^2 \pi} = 69.1 \ MPa$$

(b) the bearing stress at B in member BD



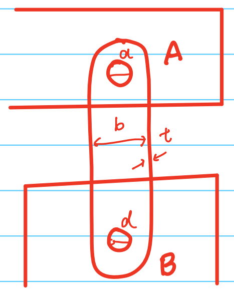
$\sigma_B = \dfrac{P}{A}$

$P = 7.81^{kN}$

$A = 16^{mm} \times 12^{mm}$

$$\sigma_B = \frac{7.81^{kN}}{16 \times 12} = 40.67 = 40.7 MPa$$

EQ3



Link AB, of width $b = 50\text{mm}$ and thickness $t = 6\text{mm}$, is used to support the end of a horizontal beam.

Knowing that the average normal stress in the link is $-140\,\text{MPa}$, and that the average shearing stress in each of the two pins is $80\,\text{MPa}$.

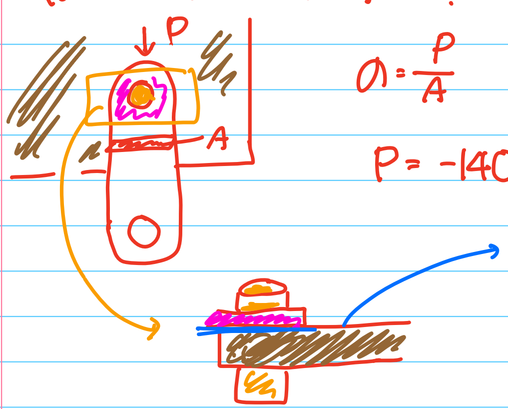
Determine (a) the diameter d of the pins. and
(b) the average bearing stress in the link.

Solution

* "the average normal stress in the link is $-140\,\text{MPa}$." *

→ Rod AB is in compression! (Because it is minus)

(a) the diameter of d.



$$\sigma = \frac{P}{A}$$

$\sigma = -140\,\text{MPa}$

$A = 50^{\text{mm}} \times 6^{\text{mm}} = 300^{\text{mm}^2}$

$$P = -140^{\text{N/mm}^2} \cdot 300^{\text{mm}^2} = -42000^{\text{N}} = -42^{\text{kN}}$$

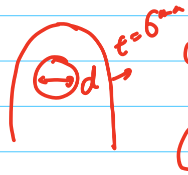
→ τ (shearing stress τ is 80MPa) from Question sentence.

$$80\,\text{MPa} = \frac{42^{\text{kN}}}{\left(\frac{d}{2}\right)^2 \pi} \qquad d^2\pi = \frac{42000 \cdot 4}{80} \qquad d^2 = \frac{42000 \cdot 4}{80\pi}$$

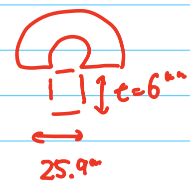
$$d = \sqrt{\frac{42000 \cdot 4}{80\pi}}$$

$$\therefore d = 25.85 \doteqdot 25.9^{\text{mm}}$$

(b) the average bearing stress in the link



$d = 25.9^{mm}$



$$\sigma_B = \frac{42 \cdot 1000^{N}}{25.9^{mm} \times 6^{mm}} = 270.37$$

$$= 270.4\ MPa$$