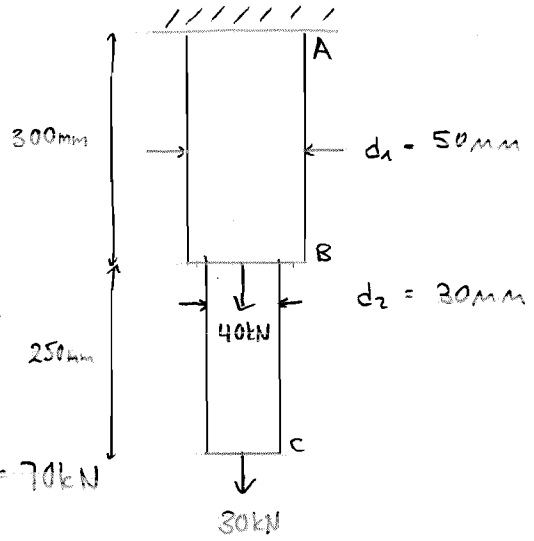
1.1 Two solid cylindrical rods AB and BC are welded together at B and loaded as shown. Knowing that $d_1 = 50mm$ and $d_2 = 30mm$, find average normal stress at the midsect. of

a) rod AB

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



Cross sectional area of AB = $\pi r^2 = \pi(0.025)^2$

Area = $1.963 \times 10^{-3}\ m^2$

Force = 30kN + 40kN = 70kN

$$\sigma = \frac{70kN}{1.963 \times 10^{-3} m^2}$$

$\sigma = 35.65 \times 10^6\ Pa \rightarrow$ <u>35.7 MPa</u> ✓

b) rod BC

Cross sectional area of BC = $\pi r^2 = \pi(0.015)^2 = 706.8 \times 10^{-6} m^2$

Force = 30kN

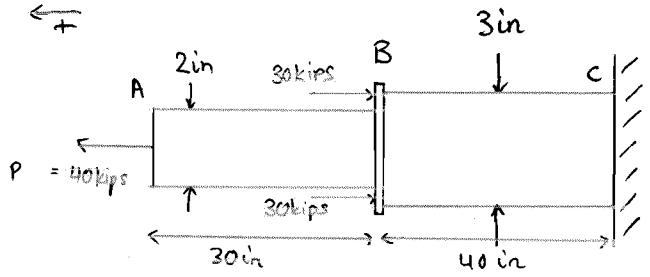
$$\sigma = \frac{30kN}{706.8 \times 10^{-6} m^2} = 42.44 \times 10^6\ Pa \rightarrow \underline{42.4 MPa}$$

✓

1.3

Two solid cylindrical rods AB and BC are welded together at B and loaded as shown. Determine the average normal stress at the midsection of

a) rod AB



Cross sectional area of AB = $\pi r^2 \Rightarrow \pi(1)^2 = 3.141\,in^2$

Force on AB = 40kips

$$\sigma = \frac{P}{A} = \frac{40kips}{3.14in^2} = 12.734\,ksi \rightarrow \underline{12.73\,ksi}$$

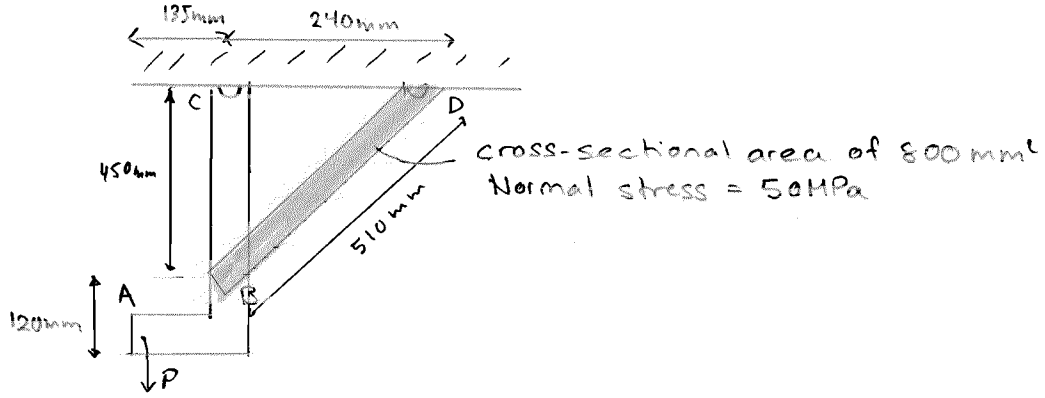
b) rod BC

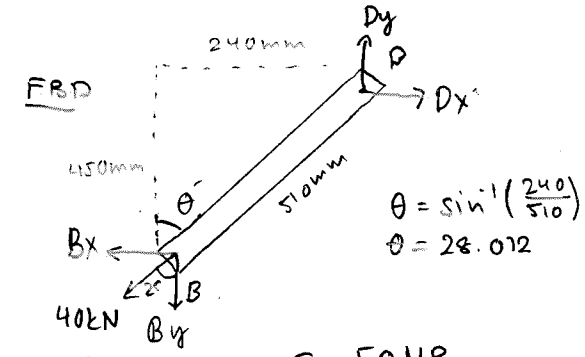
Cross sectional area of BC = $\pi r^2 \Rightarrow \pi(1.5in)^2 = 7.068\,in^2$

Force on BC = $-60kips + 40kips = -20kips$

$$\sigma = \frac{P}{A} = \frac{-20kips}{7.068in^2} = -2.829\,ksi \rightarrow \underline{-2.83\,ksi}$$

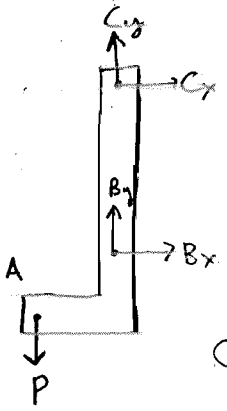
1.7 Knowing that the central portion of the link BD has a uniform cross-sectional area of 800 mm², determine the magnitude of the load P for which the normal stress in that portion of BD is 50MPa.





$\theta = \sin^{-1}\left(\frac{240}{510}\right)$

$\theta = 28.072$



$\sigma = \frac{P}{A} \Rightarrow$ $\sigma = 50\,MPa$, $A = 800\,mm^2$

$\Sigma F_x = 0$

$C_x + B_x = 0$

$C_x = -B_x$

$\Sigma F_y = C_y + B_y - P = 0$

$\circlearrowright \Sigma M_C = 0$

$P(0.135) + B_x(0.450) = 0$

$\Sigma F_x = 0$ $\quad$ $\Sigma F_y = 0$

$B_x = D_x$ $\quad$ $B_y = D_y$

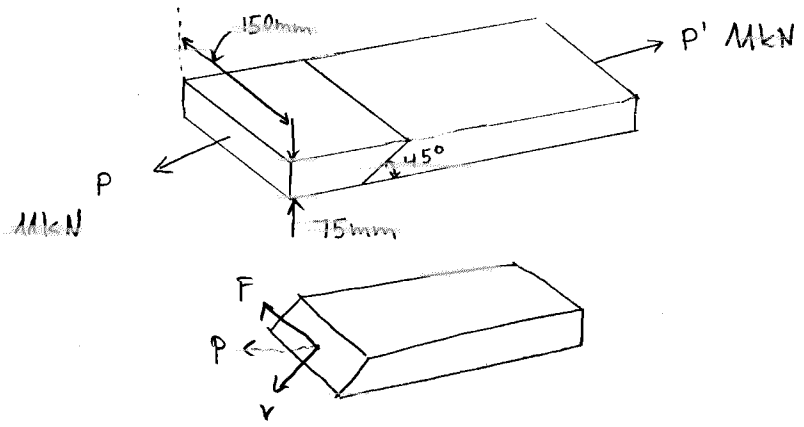
$\sigma = \frac{P_B}{A} =$ $\quad P_B = 50MPa \cdot 800mm^2 = 40'000\,N \Rightarrow 40kN$

$B_x = B\sin(28.072) = 18.82kN$

$P(0.135) = 18.82kN(0.45)$

$\underline{P = 62.7kN}$ ✓

1.29 Two wooden members of uniform rectangular cross-section are joined by the simple glued scarf splice shown. Knowing that P = 11kN, determine the normal and shearing stresses in the glued splice.

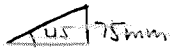


$F = P\cos\theta$ $V = P\sin\theta$

$F = 11\cos(45)$ $V = 11\sin 45$

$F = 7.778\ kN$ $V = 7.778\ kN$

Area of glued part



$h\sin 45 = 75$

$h = \frac{75}{\sin 45} = 106.06\ mm$

$A_\theta = (150mm)(106.06mm) = 15.909\ mm^2$

$15.909 \times 10^{-6}\ m^2$

$$\sigma = \frac{F}{A_\theta} = \frac{7.778\ kN}{15.909 \times 10^{-6}\ m^2} = 488.9\ kPa$$

$$\tau = \frac{V}{A_\theta} = \frac{7.778\ kN}{15.909 \times 10^{-6}\ m^2} = 488.9\ kPa$$

$\sigma = 489\ kPa$ $\tau = 489\ kPa$

✓

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