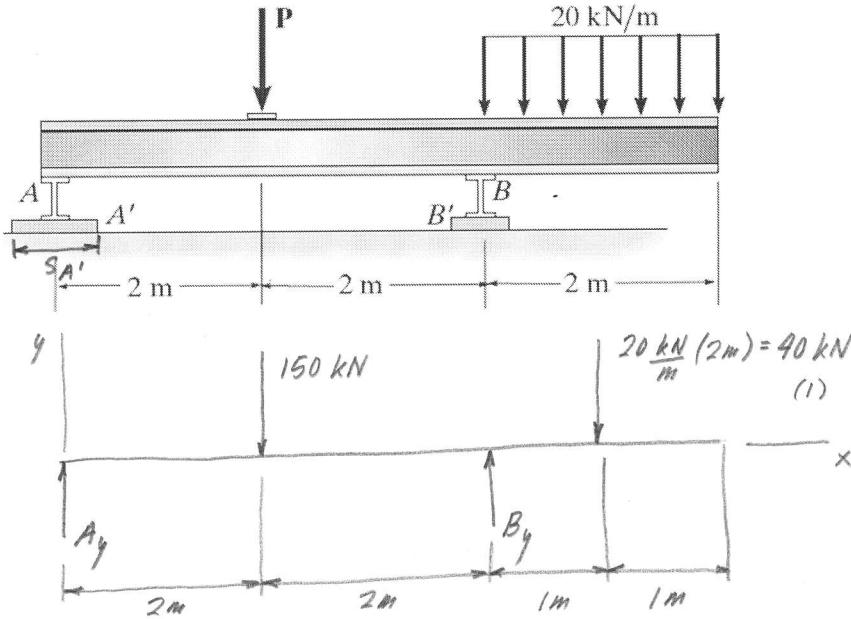


Warrior ID # Grading

Do one of the two problems shown below (the second problem has two parts and is on the back).
Show your work (you will not receive any credit if all you have is a final answer, right or wrong).

1. The failure bearing stress for the plates A' and B' under the supports at A and B is $(\sigma_b)_{fail} = 3.6$ MPa. A factor of safety for bearing in the plates of $F.S. = 2.0$ is to be applied. Determine the dimension for the square bearing plate A' (to the nearest mm) required to support the load. $P = 150$ kN and the reactions at the supports A and B are vertical.



$$F.S. = \frac{(\sigma_b)_{fail}}{(\sigma_b)_{allow}}$$

$$(\sigma_b)_{allow} = \frac{3.6 \text{ MPa}}{2.0} = 1.8 \text{ MPa} \quad (2)$$

$$\text{@ } A': (\sigma_b)_{allow} = \frac{A_y}{(S_{A'})^2}$$

$$S_{A'} = \sqrt{\frac{65 \text{ kN}}{1.8 \times 10^3 \frac{\text{kN}}{\text{m}^2}}}$$

$$S_{A'} = 0.190 \text{ m}$$

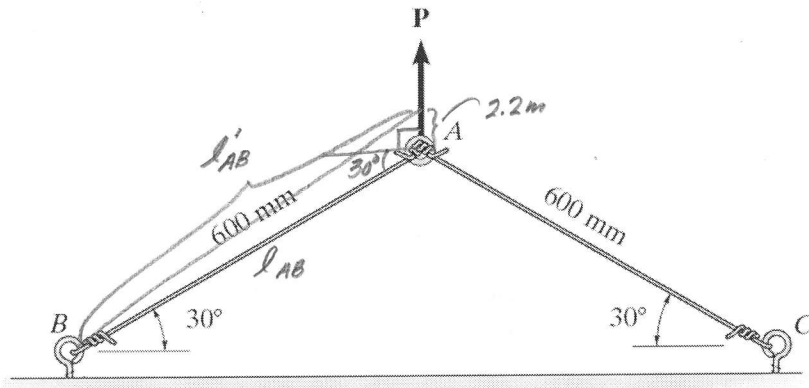
OR 190 mm

(4)

$$\sum M_B = 0, \quad -(A_y)(4\text{m}) + (150 \text{ kN})(2\text{m}) - (40 \text{ kN})(1\text{m}) = 0$$

$$A_y = 65 \text{ kN} \quad (3)$$

2(a) The force P displaces point A vertically by 2.2 mm. Determine the normal strain in each wire.



$$l'_{AB} = \sqrt{(600 \text{ mm})^2 + (2.2 \text{ mm})^2 - 2(600 \text{ mm})(2.2 \text{ mm}) \cos(120^\circ)}$$

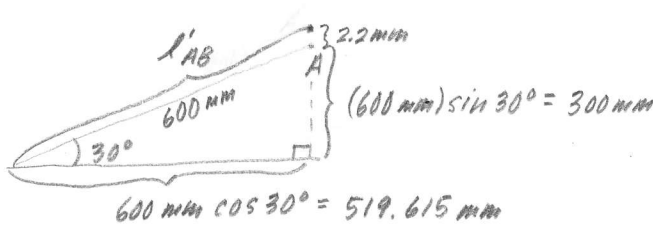
$$l'_{AB} = 601.103 \text{ mm} \quad (3)$$

$$\epsilon_{AB} = \epsilon_{AC} = \frac{601.103 \text{ mm} - 600 \text{ mm}}{600 \text{ mm}}$$

$$= 0.00184 \frac{\text{mm}}{\text{mm}}$$

$$\text{or } 1.84 \times 10^{-3} \frac{\text{mm}}{\text{mm}} \quad (2)$$

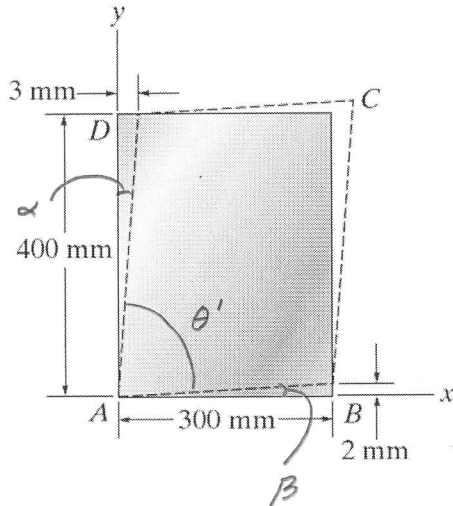
alternate approach to determine l'_{AB}



$$l'_{AB} = \sqrt{(519.615 \text{ mm})^2 + (302.2 \text{ mm})^2}$$

$$= 601.103 \text{ mm} \quad (3)$$

(b) The material is originally rectangular and is then deformed into the shape shown by the dashed lines. Determine the average shear strain γ_{xy} at corner A.



$$(\gamma_{xy})_A = \frac{\pi}{2} - \theta' = \alpha + \beta \quad (2)$$

$$\tan \alpha = \frac{3 \text{ mm}}{400 \text{ mm}}$$

$$\alpha = 0.00750 \text{ rad} \quad (1)$$

$$\tan \beta = \frac{2 \text{ mm}}{300 \text{ mm}}$$

$$\beta = 0.00667 \text{ rad} \quad (1)$$

$$(\gamma_{xy})_A = \alpha + \beta = 0.0142 \text{ rad} \quad (1)$$