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مدرس خصوصى
اونلاين
يحصل الطالب على ...
*مقاطع فيديوهات لشرح المقرربشكل وافي
*ملخص للمادة للمراجعة النهائية
*محاضرات مباشرة على برنامج Zoom
*تواصل مستمر مع معلم المادة للمناقشة
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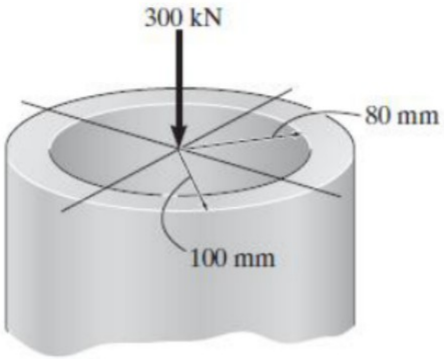
00201024041097
00201096019763
Mrahmedmahdy.com

Assignment No (1)

Basic Concepts of Normal and Shear Stresses

1. **Determine** the average normal stress developed on the cross section. Sketch the normal stress distribution over the cross section.



$A_1 = \pi * 0.1^2 m^2$

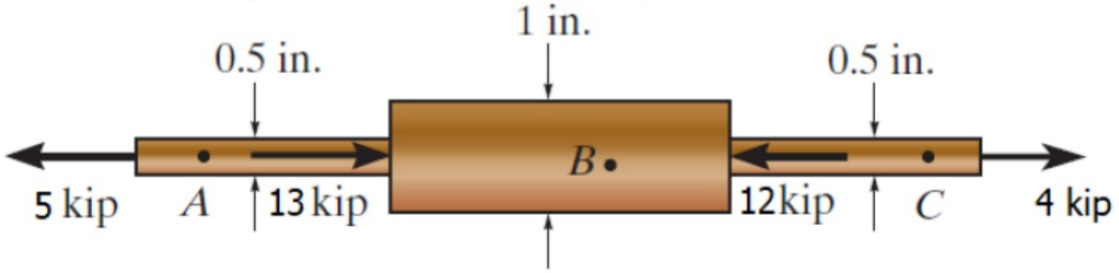
$A_2 = \pi * 0.08^2 m^2$

$A = \pi (0.1^2 - 0.08^2)$

$A = 3.6 * 10^{-3} \pi \ m^2$

$$\sigma_{avg} = \frac{P}{A} = \frac{300 * 10^3}{3.6 * 10^{-3} \pi} = 26.5 * 10^6 \ Pa = 26.5 \ MPa$$

2. **Calculate** the average normal stress developed at points A, B, and C. The diameter of each segment is indicated in the figure.



$A_A = A_C = \frac{\pi}{4} * 0.5^2 = \frac{\pi}{16} \ in^2$, $A_B = \frac{\pi}{4} * 1^2 = \frac{\pi}{4} \ in^2$

$N_A = 5 \ kip$, $N_B = -8 \ kip$, $N_C = 4 \ kip$

$\sigma_A = \frac{5}{(\pi/16)} = 25.46 \ ksi$ Tension

$\sigma_B = \frac{-8}{(\pi/4)} = -10.19 \ ksi = 10.19 \ ksi$ Compression

$\sigma_C = \frac{4}{(\pi/16)} = 20.37 \ ksi$ tension

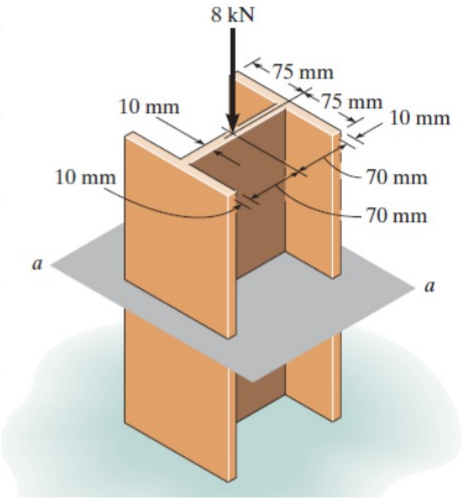
3. The column is subjected to an axial force of 8 kN, which is applied through the centroid of the cross-sectional area. **Compute** the average normal stress acting at section a–a. Show this distribution of stress acting over the area's cross section.

$A = 10 * 140 + 2 * (10 * 150)$

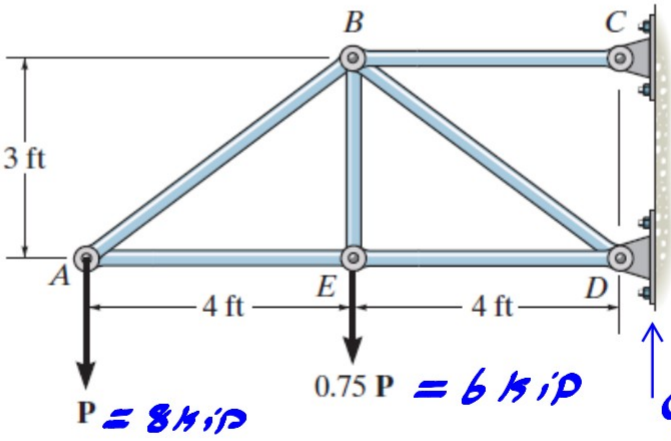
$= 4400 mm^2 = 4400 * 10^{-6} m^2$

$\sigma = \frac{8 * 10^3 N}{4400 * 10^{-6} m^2} = 1.818 * 10^6 Pa$

1.818 MPa



4.The bars of the truss each have a cross-sectional area of 1.25 in^2. **Determine** the average normal stress in each member due to the loading P= 8 kip. **State** whether the stress is tensile or compressive.



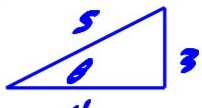
reactions

$\Sigma M_D = 6 * 4 + 8 * 8 - C_x * 3 = 0 \Rightarrow C_x = 29.3 kip \rightarrow$

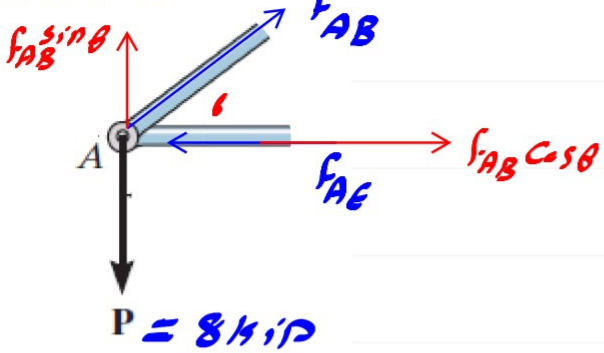
$F_{EB} = 8 kip$ Tension ; $F_{CB} = 29.3 kip$ Tension

$\sin\theta = \frac{3}{5}$

$\cos\theta = \frac{4}{5}$



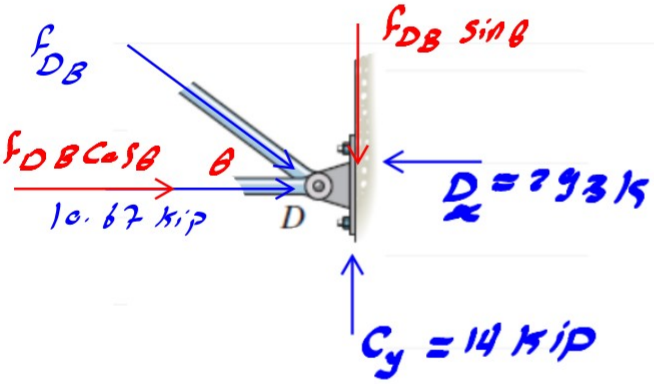
at joint A



$\Sigma f_y = f_{AB}\sin\theta - 8 = 0 \Rightarrow f_{AB} = \frac{8}{\sin\theta} = 13.33$ kip Tension

$\Sigma f_x = -f_{AE} + f_{AB}\cos\theta \Rightarrow f_{A-C} = 13.33\cos\theta = 10.67$ kip Comp

at joint D



$\Sigma f_y = 14 - f_{DB}\sin\theta = 0 \Rightarrow f_{DB} = 23.33$ kip Ten

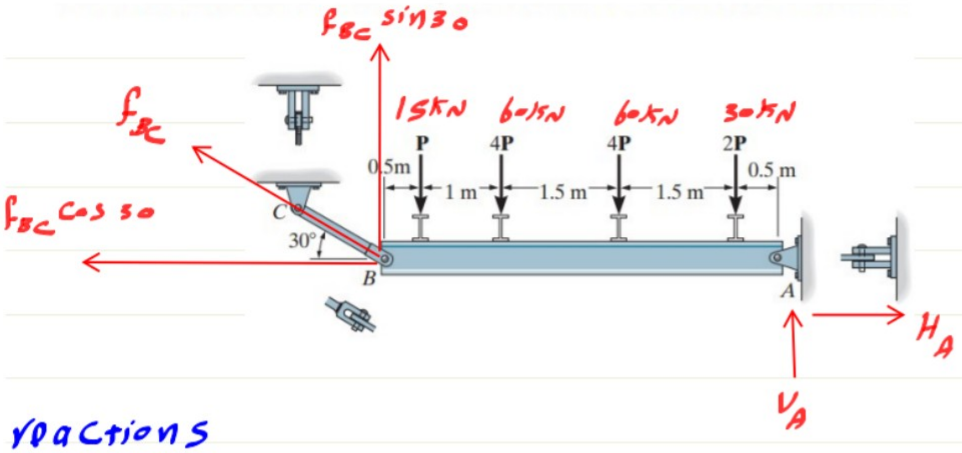
$\sigma_{AE} = \sigma_{ED} = \frac{10.67}{1.25} = 8.536$ ksi Comp & $\sigma_{AB} = \frac{13.33}{1.25} = 10.664$ ksi Ten

&

$\sigma_{EB} = \frac{6}{1.25} = 4.8$ ksi Ten & $\sigma_{BC} = \frac{29.3}{1.25} = 23.44$ ksi Ten

$\sigma_{DB} = \frac{23.33}{1.25} = 18.664$ ksi Comp

5.The beam is supported by a pin at A and a short link BC. If P = 15 kN, determine the average shear stress developed in the pins at A, B, and C. All pins have a diameter of 18 mm.



reactions

$$\Sigma M_A = 30*0.5 + 60*2 + 60*3.5 + 15*4.5 - f_{BC}\sin 30 * 5 = 0$$

$$f_{BC} = 165\ kN$$

$$\Sigma f_x = -f_{BC}\cos 30 + H_A = 0 \Rightarrow H_A = 142.95\ kN$$

$$\Sigma f_y = f_{BC}\sin 30 - 15 - 60 - 60 - 30 + V_A = 0$$

$$V_A = 82.5\ kN$$

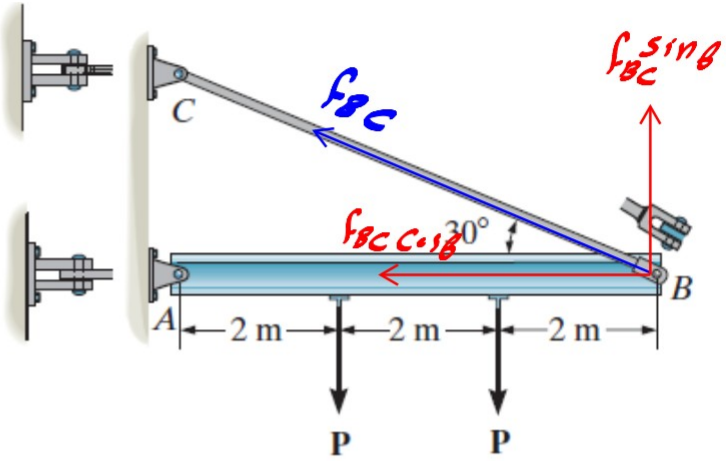
$$f_A = \sqrt{V_A^2 + H_A^2} = \sqrt{82.5^2 + 142.9^2} = 165\ N$$

$$\tau_A = \frac{f_A}{2A} = \frac{165*10^3}{2*\frac{\pi}{4}*(18)^2} = 324.2\ MPa$$

$$\tau_B = \tau_C = \frac{f_{BC}}{2A} = \frac{165*10^3}{2*\frac{\pi}{4}*18^2} = 324\ MPa$$

average shear stress = 324 MPa

6. Find the maximum magnitude P of the load the beam will support if the average shear stress in each pin is not to allowed to exceed 60 MPa. All pins are subjected to double shear as shown, and each has a diameter of 18 mm.



$\Sigma M_A = P*2 + P*4 - f_{BC}\sin 30 * 6 = 0$

$f_{BC} = 2P$

$\Sigma f_x = A_x - 2P\cos 30 = 0 \Rightarrow A_x = \sqrt{3}\,P$

$\Sigma f_y = A_y - P - P + 2P\sin 30 = 0 \Rightarrow A_y = P$

$f_A = \sqrt{A_x^2 + A_y^2} = \sqrt{3P^2 + P^2} = 2P$

$V = P$

$\tau = \frac{V}{A} = \frac{P}{A} \Rightarrow P = \tau A = 60*10^6*(\frac{\pi}{4}*0.018)^2$

$P = 15268\,N = 15.268\,kN$