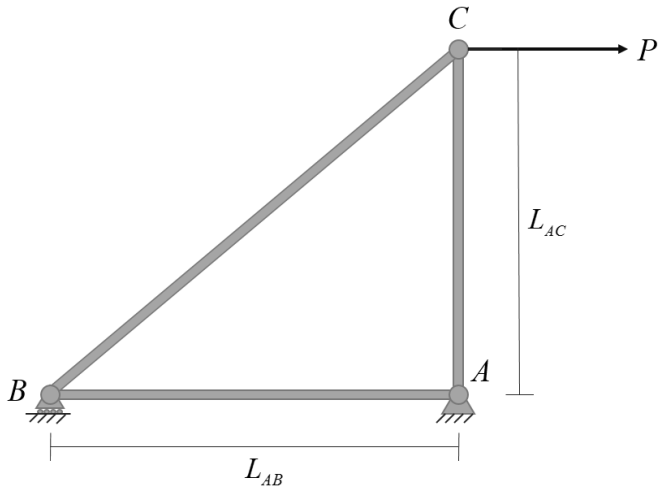
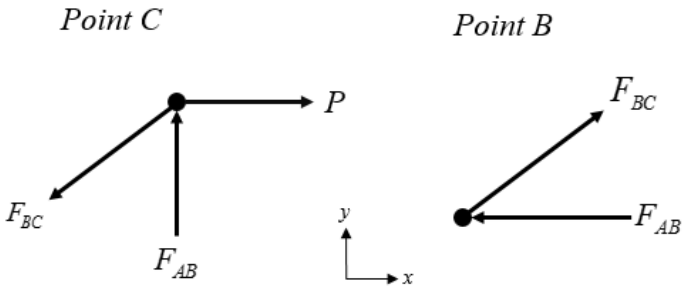
1-12. A force with a distribution of $P \sim N(45, 5^2)$ kN is applied to point *C* on the truss. If each bar has a diameter of d = 17 mm, find the distribution of the normal stress in member *AB*. Given that L_{AB} = 2.25 m and L_{AC} = 1.9 m.



Solution

Free Body Diagrams



Take the sum of the forces on point *C*

$$\Sigma F_x = P - F_{BC}\left(\frac{L_{AB}}{L_{BC}}\right) = 0$$

$$\Rightarrow F_{BC} = \left(\frac{L_{BC}}{L_{AB}}\right)P$$

Take the sum of the forces on point *B*

$$\Sigma F_x = F_{BC}\left(\frac{L_{AB}}{L_{BC}}\right) - F_{AB} = \left(\left(\frac{L_{BC}}{L_{AB}}\right)P\right)\left(\frac{L_{AB}}{L_{BC}}\right) - F_{AB} = 0$$

$$\Rightarrow F_{AB} = P$$

Find the cross-sectional area of the bar

$$A = \frac{\pi}{4}d^2 = \frac{\pi}{4}(0.017)^2 = 2.270\times10^{-4}\ \text{m}^2$$

Solving for the normal stress in member *AB*

$$S_{AB} = \frac{F_{AB}}{A} = \frac{P}{A}$$

$$\mu_S = \frac{\mu_P}{A} = \frac{45\left(10^3\right)}{2.270\left(10^{-4}\right)} = 198\ \text{MPa}$$

$$\sigma_S = \sqrt{\left(\frac{1}{A}\right)^2 {\sigma_P}^2} = \sqrt{\left(\frac{1}{2.270\left(10^{-4}\right)}\right)\times\left(5\left(10^3\right)\right)^2} = 22\ \text{MPa}$$

Then

$$S_{AB} \sim N(198, 22^2)\ \text{MPa}$$ **Ans.**