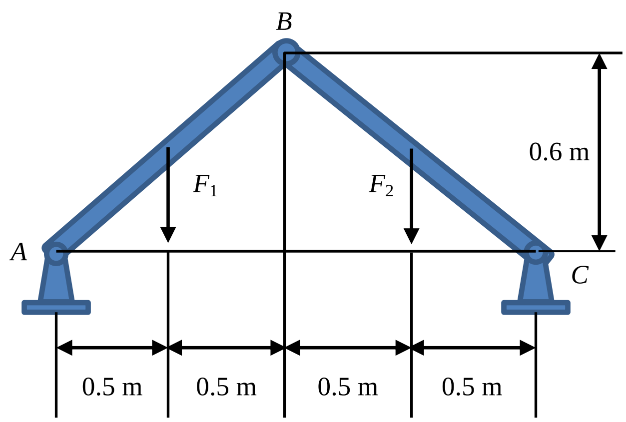
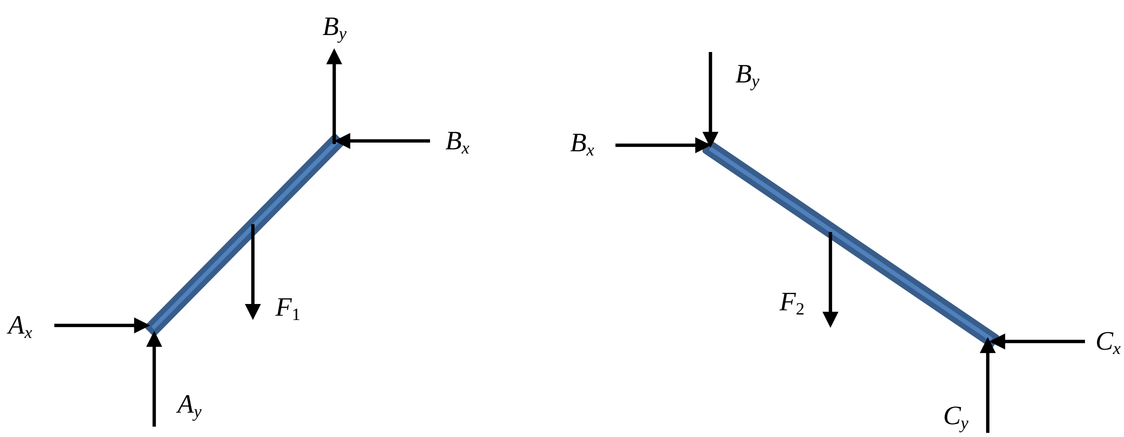
18. The two loads are normally and independently distributed as $F_1 \sim N(850, 5^2)$ N and $F_2 \sim N(600, 4^2)$ N. Determine the distributions of the horizontal and vertical forces at pins A and C.



Solution



Member *AB*:

$$\sum M_A = 0 \quad B_y(1.0) - F_1(0.5) + B_x(0.6) = 0$$

Member *BC*:

$$\sum M_C = 0 \quad B_y(1.0) + F_2(0.5) - B_x(0.6) = 0$$

Solve the above two equations, we can obtain the distributions of B_x and B_y.

$$\mu_{B_x} = \frac{5(\mu_{F_1} + \mu_{F_2})}{12} = 604.17 \text{ N}$$

$$\sigma_{B_x} = \frac{5\sqrt{\sigma^2{}_{F_1} + \sigma^2{}_{F_2}}}{12} = 2.67$$

$$\mu_{B_y} = \frac{\mu_{F_1} - \mu_{F_2}}{4} = 62.5 \text{ N}$$

$$\sigma_{B_y} = \frac{\sqrt{\sigma^2{}_{F_1} + \sigma^2{}_{F_2}}}{4} = 1.6$$

Member *AB*:

$$\sum F_x = 0 \quad A_x = B_x$$

And

$$\sum F_y = 0 \quad A_y = F_1 - B_y$$

Then, we can have:

$$\mu_{A_x} = \mu_{B_x} = 604.17 \text{ N}$$ **Ans.**

$$\sigma_{A_x} = \sigma_{B_x} = 2.67$$ **Ans.**

$$\mu_{A_y} = \mu_{F_1} - \mu_{B_y} = 787.5 \text{ N}$$ **Ans.**

$$\sigma_{A_y} = \sqrt{\sigma^2{}_{F_1} + \sigma^2{}_{B_y}} = 5.25$$ **Ans.**

Member *BC*:

$$\sum F_x = 0 \quad C_x = B_x$$

And

$$\sum F_y = 0 \quad C_y = F_2 + B_y$$

Thus, we can obtain:

$$\mu_{C_x} = \mu_{B_x} = 604.17 \text{ N}$$ **Ans.**

$$\sigma_{C_x} = \sigma_{B_x} = 2.67$$ **Ans.**

$$\mu_{C_y} = \mu_{F_2} + \mu_{B_y} = 662.5 \text{ N}$$ **Ans.**

$$\sigma_{C_y} = \sqrt{\sigma^2{}_{F_2} + \sigma^2{}_{B_y}} = 4.31$$ **Ans.**