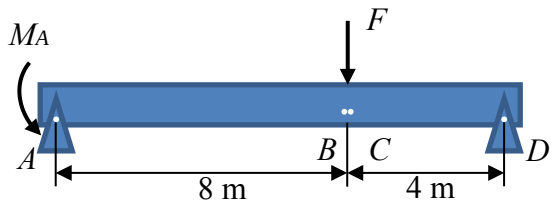
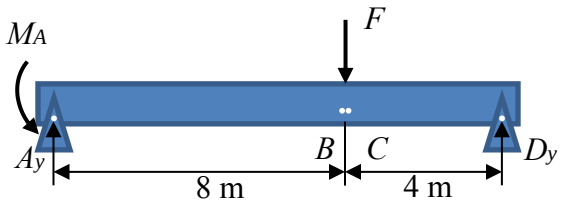
9. The beam is subjected to a force $F \sim N(8, 0.5)$ kN and a bending moment $M_A \sim N(15, 1^2)$ kN·m as shown. F and M_A are independently distributed. Determine the distribution of internal normal force, shear force, and bending moment acting just to the right point C.



Solution



$$\sum M_A = 0; \;\; M_A + D_y(12) - F(8) = 0$$

$$D_y = \frac{F(8) - M_A}{12}$$

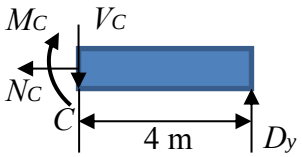
$$\mu_{D_y} = \frac{\mu_F(8) - \mu_{M_A}}{12}$$

$$\sigma_{D_y} = \frac{\sqrt{(8\sigma_F)^2 + \sigma_{M_A}^2}}{12}$$

Since $M_A \sim N(15, 1^2)$ kN·m and $F \sim N(8, 0.5)$ kN, we get the distribution of D_y as follows:

$$D_y \sim N(4.08, 0.34) \text{ kN}$$

The free-body diagram of the segment CD is shown as follows:



$$\sum F_x = 0;\ N_C = 0 \qquad \textbf{Ans.}$$

$$\sum F_y = 0;\ D_y - V_C = 0 \qquad V_C = D_y \sim N(4.08, 0.34)\ \text{kN} \qquad \textbf{Ans.}$$

$$\sum M_C = 0;\ -D_y(4) + M_C = 0,\ M_C = 4D_y, \quad M_C \sim N(16.33, 1.37)\ \text{kN}\cdot\text{m} \qquad \textbf{Ans.}$$