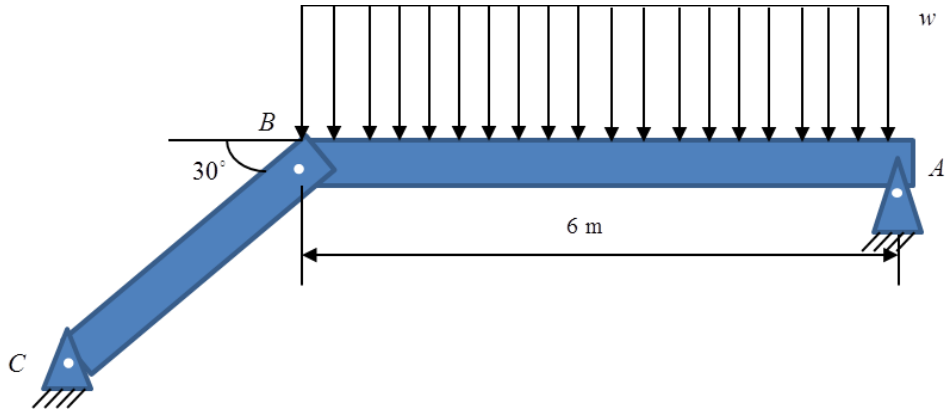
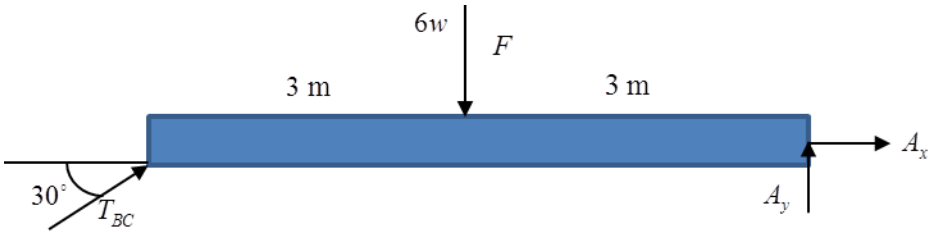
3. The beam *AB* is subject to a uniform load $w \sim N(1000, 10^2)$ N/m. The allowable normal force in member *BC* is given by $S \sim N(1020, 5^2)$ N. *w* and *S* are independent. Determine the probability of failure of member *BC*.



Solution



$$\Sigma M_A = 0;\ -F(3) + T_{BC}\sin 30^\circ (6) = 0$$

$$T_{BC} = F$$

For $F = w \sim N(1000, 10^2)$ N/m, we can get the distribution of T_{BC}

$$T_{BC} \sim N(1000, 10^2)\ \text{N/m}$$

$S \sim N(1020, 5^2)$ N. If *BC* fails, we need $Y = S - T_{BC} < 0$

$$\mu_Y = \mu_S - \mu_{T_{BC}} = 1020 - 1000 = 20\ \text{N}$$

$$\sigma_Y = \sqrt{\sigma_S^2 + \sigma_{T_{BC}}^2} = \sqrt{5^2 + 10^2} = 11.18\ \text{N}$$

$$P(Y < 0) = \Phi\left(\frac{0 - \mu_Y}{\sigma_Y}\right) = 0.0368$$ **Ans.**