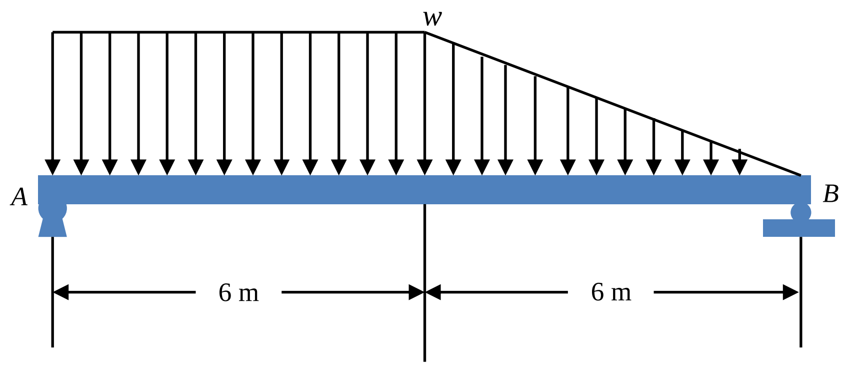
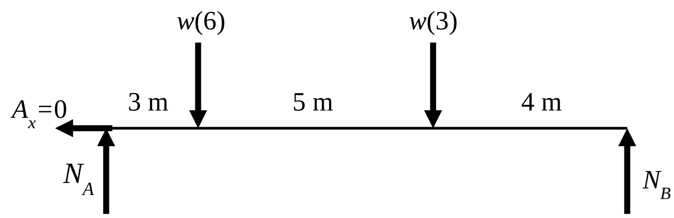
13. The distributed load w follows a normal distribution of $N(2.5, 0.05^2)$ kN/m. The two pins at A and B can support a maximum load of 15 KN, what are the probabilities of failures of the two pins?



Solution



$$\sum M_B = 0; \quad -N_A(12) + w(6)(9) + w(3)(4) = 0,$$
$$\sum F_y = 0; \quad N_B = w(6) + w(3) - N_A.$$

Where the intensity of load follows the normal distribution $N(2.5, 0.05^2)$ kN/m, then we can obtain

$$\mu_{N_A} = 5.5\mu_w = 13.75 \text{ kN},$$
$$\sigma_{N_A} = 5.5\sigma_w = 0.275,$$
$$\mu_{N_B} = 3.5\mu_w = 8.75 \text{ kN},$$
$$\sigma_{N_B} = 3.5\sigma_w = 0.175.$$

Therefore, we obtain the distributions of $N_A \sim N(13.75, 0.275^2)$ kN and $N_B \sim N(8.75, 0.175^2)$ kN. **Ans.**

The probability that pin A might fail is

$$P_A = P(N_A \geq 15 \text{ kN}) = 1 - P(N_A < 15 \text{ kN}) = 1 - \Phi\left(\frac{15 - 13.75}{0.275}\right) = 2.74 \times 10^{-6}.$$ **Ans.**

The probability that roller B might fail is

$$P_B = P\left(N_B \geq 15 \text{ kN}\right) = 1 - P\left(N_B < 15 \text{ kN}\right) = 1 - \Phi\left(\frac{15 - 8.75}{0.175}\right) = 0.$$ **Ans.**