

1.

(1)

力のつり合い

$$R_C + R_E - 3P = 0 \cdots \textcircled{1}$$

モーメントのつり合い

$$-4P + 3R_C - 2P + R_E = 0 \cdots \textcircled{2}$$

①②より

$$R_C = R_E = \frac{3}{2}P = 150\text{N}$$

せん断力

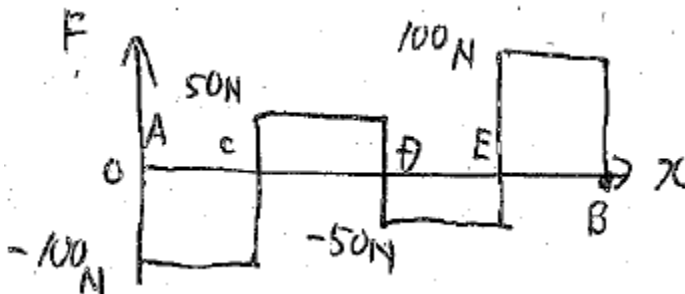
$$\text{AC間 } F = -P = -100\text{N}$$

$$\text{CD間 } F = -P + R_C = 50\text{N}$$

$$\text{DE間 } F = -P + R_C - P = -50\text{N}$$

$$\text{EB間 } F = -P + R_C - P + R_E = 100\text{N}$$

せん断力図 (SFD)



曲げモーメント

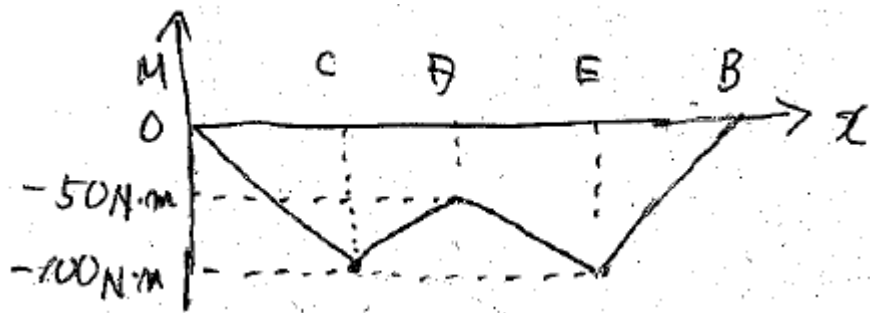
$$\text{AC間} \quad M = -Px = -100x \text{Nm}$$

$$\text{CD間} \quad M = -Px + R_C(x-1) = 50x - 150 \text{Nm}$$

$$\text{DE間} \quad M = -Px + R_C(x-1) - P(x-2) = -50x + 50 \text{Nm}$$

$$\text{EB間} \quad M = -Px + R_C(x-1) - P(x-2) + R_E(x-3) = 100x - 400 \text{Nm}$$

曲げモーメント図 (BMD)



$$|M|_{\max} = 100 \text{Nm}$$

(2)

力のつり合い

$$R_C + R_B - \omega \times 1 \times 2 = 0$$

$$R_C + R_B - 4000 = 0 \cdots \textcircled{1}$$

モーメントのつり合い

$$-\omega \times 1 \times 3.5 + R_C \times 3 + R_D \times 1 - \omega \times 1 \times 0.5 = 0$$

$$-8000 + 3R_C + R_D = 0 \cdots \textcircled{2}$$

①②より

$$R_C = R_D = 2000\text{N}$$

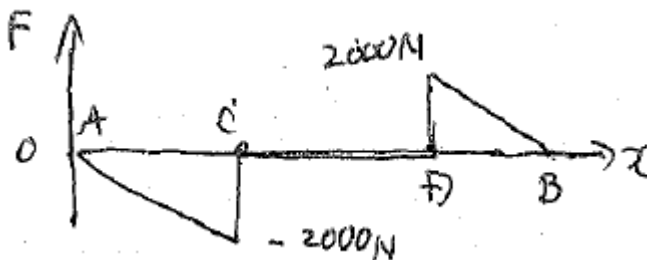
せん断力

$$\text{AC間 } F = -\omega x = -2000x\text{N}$$

$$\text{CD間 } F = -\omega \times 1 + R_C = 0\text{N}$$

$$\text{DB間 } F = -\omega \times 1 + R_C + R_D - \omega(x-3) = -2000x + 8000\text{N}$$

せん断力図



曲げモーメント

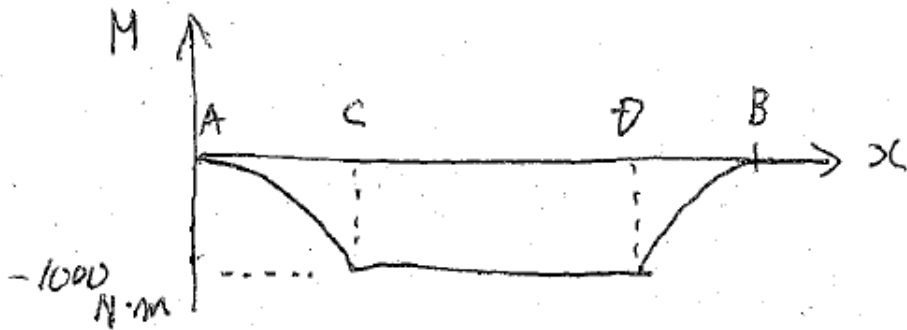
$$\text{AC間} \quad M = -\frac{\omega}{2}x^2 = -1000x^2 \text{Nm}$$

$$\text{CD間} \quad M = -2000 \times (x - 0.5) + R_C(x - 1) = -1000 \text{Nm}$$

DB間

$$\begin{aligned} M &= -2000(x - 0.5) + R_C(x - 1) + R_D(x - 3) - \frac{\omega(x - 3)^2}{2} \\ &= -1000x^2 + 8000x - 16000 \text{Nm} \end{aligned}$$

曲げモーメント図



$$|M|_{\max} = 1000 \text{Nm}$$

2.

$$(1) \int_{-5}^5 8y dy = 8 \left[\frac{y^2}{2} \right]_{-5}^5 = 4 \{5^2 - (-5)^2\} = 0$$

$$(2) \int_{-2}^2 5y^2 dy = 5 \left[\frac{y^3}{3} \right]_{-2}^2 = \frac{5}{3} \{2^3 - (-2)^3\} = \frac{80}{3} = 26.7$$

(3)

$$\begin{aligned} \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} 2 \cos^2 \theta \sin^2 \theta d\theta &= 2 \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \left(\frac{1}{2} \sin 2\theta \right)^2 d\theta \\ &= \frac{1}{2} \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} (1 - \cos 4\theta) d\theta = \frac{1}{4} \left[\theta - \frac{1}{4} \sin 4\theta \right]_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \\ &= \frac{1}{4} \left\{ \frac{\pi}{2} - \left(-\frac{\pi}{2}\right) - \frac{1}{4} \sin 2\pi + \frac{1}{4} \sin(-2\pi) \right\} \\ &= \frac{\pi}{4} \end{aligned}$$