

・問題 1 : 曲げ部材の解析と設計

a.

弾性係数比 n :

付表 (紅白の教科書 pp.57 付表 4-1) より $n=6.1$

鉄筋比 p :

$$p = \frac{A_s}{A_c} = \frac{4D35}{bd} = \frac{38.3}{35 \times 70} = 0.01563$$

$$np = 6.1 \times 0.01563 = 0.09534$$

中立軸比 k :

$$k = -np + \sqrt{(np)^2 + 2np} = 0.09534 + \sqrt{0.09534^2 + 2 \times 0.09534} = 0.3516$$

コンクリート応力 σ'_c :

$$s'_c = \frac{\frac{M}{bd^2}}{\frac{1}{2}k\left(1 - \frac{k}{3}\right)} = \frac{200 \times 10^3 \times 10^3 [N \cdot mm] / (350 \times 700^2 [mm^3])}{\frac{1}{2} \cdot 0.3516 (1 - 0.3516 / 3)} = \underline{7.51 N / mm^2}$$

b.

釣合い鉄筋比 p_b :

$$p_b = \frac{0.68 f'_c}{f_y} \cdot \frac{700}{700 + f_y} = \frac{0.68 \times 50}{345} \cdot \frac{700}{700 + 345} = 0.06601$$

$\therefore p < p_b$ ($0.01563 < 0.06601$) \Rightarrow 鉄筋降伏先行型

曲げ終局耐力 M_u の算定:

$$(\text{力学的鉄筋比}) y = p \times \frac{f_y}{f'_c} = 0.01563 \times \frac{345}{50} = 0.1078$$

$$\frac{M_u}{bd^2 f'_c} = y \left(1 - \frac{y}{1.7}\right) = 0.1078 \left(1 - \frac{0.1078}{1.7}\right) = 0.1010$$

$$\therefore M_u = \left\{ y \left(1 - \frac{y}{1.7}\right) \right\} bd^2 f'_c = 0.1010 \times 350 \times 700^2 \times 50 = 866 \times 10^6 N \cdot mm = \underline{866 kN \cdot m}$$

c.

$$p = \frac{A_s}{bd} > 0.023 \quad A_s > 0.023 \times bd = 0.023 \times 35 [cm] \times 70 [cm]$$

$$A_s > 56.35 \text{ cm}^2$$

よって, 例えば

$$\underline{6D35 = 57.4 \text{ cm}^2} > 56.35 \text{ cm}^2, \quad \underline{5D38 = 57.0 \text{ cm}^2} > 56.35 \text{ cm}^2, \quad \text{etc.}$$

・問題 2 : 等分布を受ける単純梁のせん断耐力

A

$$f_{vc} = 0.20^3 \sqrt{f'_c} = 0.20^3 \sqrt{40} = 0.6840 \text{ N/mm}^2$$

よって,

$$V_c = b_d b_p b_n f_{vc} b_w d = 1 \cdot 0.684 \cdot 450 \cdot 1500 = \underline{462 \text{ kN}}$$

$$V_s = \frac{(A_w \cdot f_{wy})z}{s} = \frac{(3.97 \times 10^2 \cdot 295) \cdot 1500 / 1.15}{200} \text{ [N]} = \underline{764 \text{ kN}}$$

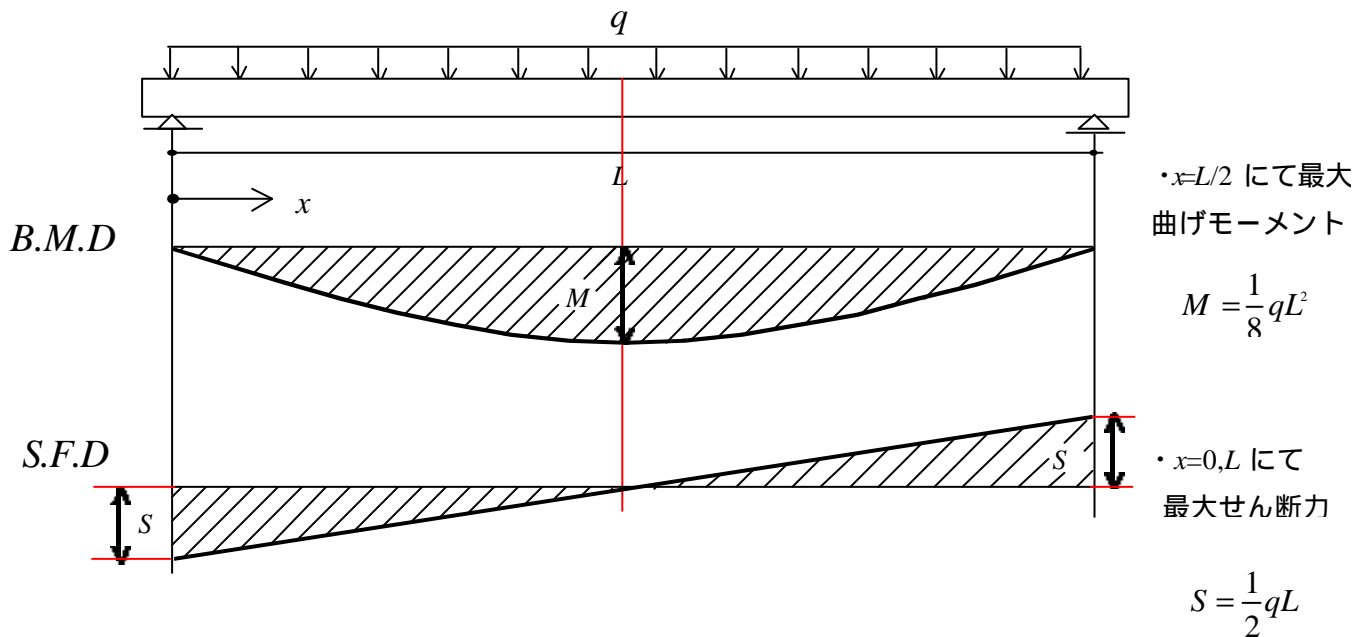
B

$$V_y = V_c + V_s = 462 + 764 = 1226 \text{ kN} = \underline{1.23 \text{ MN}}$$

$V_y = S$ (作用せん断力) のとき

$$S = \frac{qL}{2} \text{ より (下図参照)}$$

$$q = \frac{2V_y}{L} = \frac{2 \cdot 1226}{10 \text{ [m]}} = \underline{245 \text{ kN/m}}$$



等分布荷重を受ける梁の曲げモーメント, せん断力図