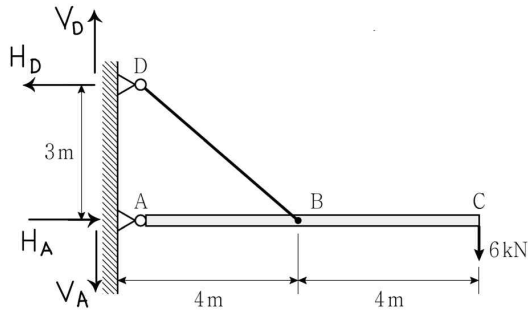


1. ②번

$$\bullet \bar{y}_{(a)} = \frac{h}{2}, \bar{y}_{(b)} = \frac{h}{3}, \bar{y}_{(c)} = \frac{h}{2}, \bar{y}_{(a)} = \frac{4h}{3\pi}$$

$$\therefore \bar{y}_{\min} = \bar{y}_{(b)} = \frac{h}{3}$$

2. ③번



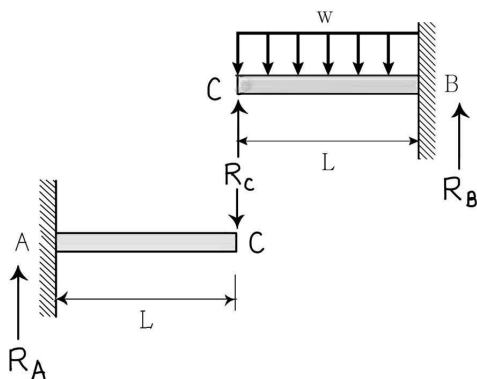
$$\bullet \sum M_D = 0, \curvearrowright$$

$$-H_A(3) + 6(8) = 0, H_A = 16[\text{kN}]$$

$$\therefore F_{AB} = -H_A = -16[\text{kN}] (\text{압축})$$

3. ④번

C점에서 변위일치법 이용



$$\bullet \frac{wL^4}{8EI} - \frac{R_C L^3}{3EI} = \frac{R_C L^3}{3EI}, R_C = \frac{3wL}{16}$$

$$\bullet \text{AB부재에서 } \sum V = 0 \text{을 적용하면}$$

$$R_A = R_C = \frac{3wL}{16}$$

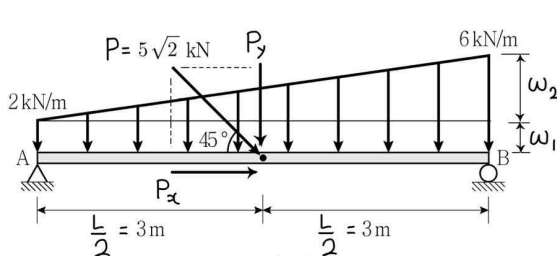
$$\bullet \text{BC부재에서 } \sum V = 0 \text{을 적용하면}$$

$$R_B = (w \times L) - R_C = wL - \frac{3wL}{16} = \frac{13wL}{16}$$

$$\therefore \frac{R_A}{R_B} = \frac{3}{13}$$

4. ②번

암기하면 편리한 반력 이용



$$\bullet P_y = P \sin 45^\circ = 5\sqrt{2} \times \frac{\sqrt{2}}{2} = 5[\text{kN}]$$

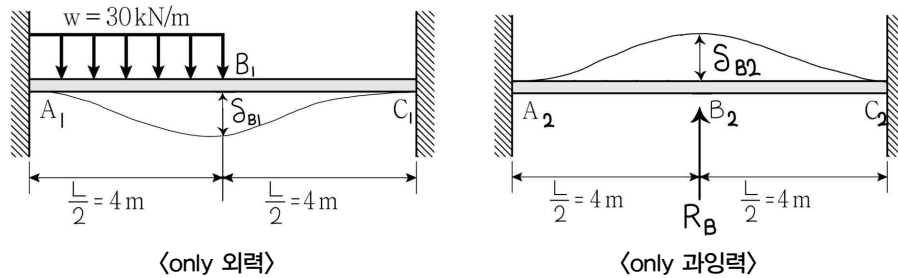
$$\bullet w_1 = 2[\text{kN/m}]$$

$$\bullet w_2 = 6 - 2 = 4[\text{kN/m}]$$

$$\therefore R_A = \frac{P_y}{2} + \frac{w_1 L}{2} + \frac{w_2 L}{6}$$

$$= \frac{5}{2} + \frac{2 \times 6}{2} + \frac{4 \times 6}{6} = 12.5[\text{kN}]$$

5. ②번



$$\bullet \delta_{B1} \left(= \frac{wL^4}{384EI} \times \frac{1}{2} \text{배} \right) = \delta_{B2} \left(= \frac{R_B L^3}{192EI} \right) \text{이므로 } R_B = \frac{wL}{4} \text{이다.}$$

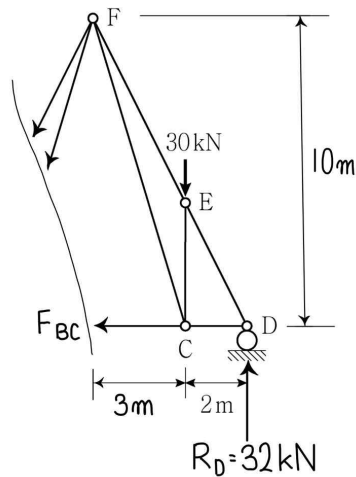
$$\therefore R_B = \frac{30 \times 8}{4} = 60 [\text{kN}]$$

6. ④번

(1) 반력 산정

$$\sum M_A = 0, \curvearrowright; 10(4) + 20(2) + 30(8) - R_D(10) = 0, R_D = 32 [\text{kN}] (\uparrow)$$

(2) BC의 부재력 산정(단면법 이용)



$$\bullet \sum M_F = 0, \curvearrowright$$

$$30(3) - 32(5) + F_{BC}(10) = 0$$

$$\therefore F_{BC} = 7 [\text{kN}] (\text{인장})$$

7. ③번

공식 이용

$$\bullet \sum M_B = 0, \curvearrowright; R_A(5) - (20 \times 2) \left(\frac{2}{2} + 3 \right) = 0, R_A = 32 [\text{kN}] (\uparrow)$$

$$\bullet x = \frac{R}{w}, M = \frac{R^2}{2w}$$

$$\therefore \left| \frac{x}{M} \right| = \frac{\left(\frac{R}{w} \right)}{\left(\frac{R^2}{2w} \right)} = \frac{2}{R} = \frac{2}{32} = \frac{1}{16}$$

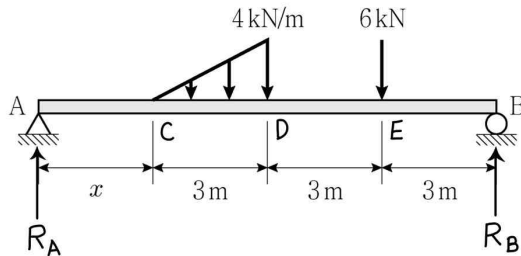
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8. ④번

비례관계 이용

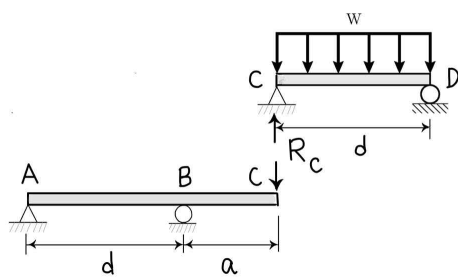


$$\begin{aligned} \bullet \Sigma V = 0, (R_A + R_B) &= \left(\frac{1}{2} \times 3 \times 4\right) + 6 = 12 \text{ [kN]} \\ \bullet R_B &= 2R_A, R_A + 2R_A = 12 \text{ [kN]} \Rightarrow R_A = 4 \text{ [kN]}, R_B = 8 \text{ [kN]} \text{ 이다.} \\ \bullet \Sigma M_C = 0, \curvearrowright; 4(x) + \left(\frac{1}{2} \times 3 \times 4\right) \left(3 \times \frac{2}{3}\right) + 6(6) - 8(9) &= 0 \\ \therefore x &= 6 \text{ [m]} \end{aligned}$$

9. ①번

$$\begin{aligned} \bullet \sigma_{\max} &= \frac{M_{\max}}{Z} = \frac{\left(\frac{wL^2}{8}\right)}{\left(\frac{bh^3}{6}\right)} = \frac{3wL^2}{4bh^3} \\ \bullet \sigma_{\max} \left(= \frac{3wL^2}{4bh^3}\right) &\leq \sigma_a \Rightarrow w_{\max} = \frac{4bh^3\sigma_a}{3L^2} \text{ 이다.} \\ \therefore w_{\max} &= \frac{4 \times 300 \times 400^2 \times 6}{3 \times (10 \times 10^3)^2} = 3.84 \text{ [N/mm]} = 3.84 \text{ [kN/m]} \end{aligned}$$

10. ③번



〈자유물체도〉

$$\begin{aligned} \bullet M_{CD, \max} &= \frac{wd^2}{8} \\ \bullet M_B = R_C \times a &= \frac{wd}{2} \times a = \frac{wda}{2} \\ \bullet M_{CD, \max} \left(= \frac{wd^2}{8}\right) &= M_B \left(= \frac{wda}{2}\right) \\ \therefore a &= \frac{1}{4}d \end{aligned}$$

11. ③번

$$\begin{aligned} \bullet A_1 : A_2 &= \frac{\pi D^2}{4} : \frac{\pi \left(\frac{D}{2}\right)^2}{4} = 4 : 1 \\ \therefore y &= \frac{A_1 y_1 - A_2 y_2}{A_1 - A_2} = \frac{4 \times \frac{D}{2} - 1 \times \frac{D}{4}}{4 - 1} = \frac{7D}{12} \end{aligned}$$

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12. ④번

$$\begin{aligned}\bullet \delta_B(\text{BC변형}) &= \frac{P\left(\frac{L}{2}\right)}{2EA} = \frac{PL}{4EA} \\ \bullet \delta_A(\text{BC변형} + \text{AB변형}) &= \frac{P\left(\frac{L}{2}\right)}{2EA} + \frac{P\left(\frac{L}{2}\right)}{EA} = \frac{3PL}{4EA} \\ \therefore \frac{\delta_A}{\delta_B} &= 3.0(\text{배})\end{aligned}$$

13. ②번

평행축정리 이용

$$\begin{aligned}\bullet \text{축거리} &= 50 + 30 \times \frac{1}{3} = 60[\text{mm}] \\ \therefore I_{\text{입의축}} &= I_{\text{도심축}} + A \times \text{축거리}^2 \\ &= \frac{40 \times 30^3}{36} + \left(\frac{1}{2} \times 40 \times 30\right) \times 60^2 = 219 \times 10^4[\text{mm}^4]\end{aligned}$$

14. ③번

중첩공식 이용

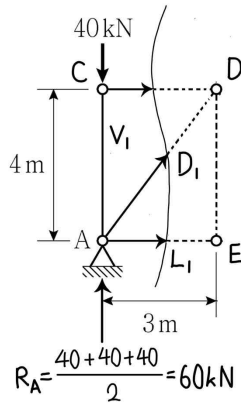
$$\begin{aligned}\bullet \delta_M &= \frac{ML^2}{2EI} = \frac{(10 \times 10^3) \times (2 \times 10^3)^2}{2 \times (2 \times 10^{10})} = 1[\text{mm}] \\ \bullet \delta_P &= \frac{PL^3}{3EI} = \frac{10 \times (2 \times 10^3)^3}{3 \times (2 \times 10^{10})} = \frac{4}{3}[\text{mm}] \\ \bullet \delta_w &= \frac{wL^4}{8EI} = \frac{(10 \times 10^{-3}) \times (2 \times 10^3)^4}{8 \times (2 \times 10^{10})} = 1[\text{mm}] \\ \therefore \delta_{\max} &= \delta_P \circ \text{이므로 } P = 10[\text{kN}] \text{ 일 때 최대 수직처짐이 발생한다.} \\ \delta_M + \delta_P + \delta_w &= 1 + \frac{4}{3} + 1 = \frac{10}{3}[\text{mm}]\end{aligned}$$

15. ③번

$$\begin{aligned}\bullet EI &= 2 \times 10^{12}[\text{N} \cdot \text{mm}^2] = 2 \times 10^3[\text{kN} \cdot \text{m}^2] \\ \therefore \delta_C &= \frac{Pbx(L^2 - b^2 - x^2)}{6LEI} \\ &= \frac{2 \times 5 \times 3 \times (10^2 - 5^2 - 3^2)}{6 \times 10 \times (2 \times 10^3)} = 0.0165[\text{m}] = 16.5[\text{mm}]\end{aligned}$$

16. ④번

절점법, 단면법 이용



- ① C점에서 절점법을 적용하면 $V_1 = -40[\text{kN}]$ (압축)
 ② D점에서 단면법을 적용하면
 $\sum M_D = 0, \curvearrowright; 60(3) - 40(3) - L_1(4) = 0, L_1 = 15[\text{kN}]$ (인장)
 ③ 내적안정이고 외적안정이면서 정정이다.
 ④ $\sum V = 0, \uparrow +; 60 - 40 + D_1 \times \frac{4}{5} = 0, D_1 = -25[\text{kN}]$ (압축)

17. ①번

$$\bullet E_2 A_2 : E_1 A_1 = (3.2 \times 10^5) \times 80 \times 50 : (0.8 \times 10^5) \times 80 \times 100 = 2 : 1$$

$$\therefore \bar{y} = \frac{E_2 A_2 \times y_2 + E_1 A_1 \times y_1}{E_2 A_2 + E_1 A_1} = \frac{2 \times 25 + 1 \times \left(50 + \frac{100}{2}\right)}{2 + 1} = 50[\text{mm}]$$

18. ②번

$$\bullet \delta_1 = \frac{F_1 L_1}{EA_1} = \frac{(3P - P) \times L}{E \times A} = \frac{2PL}{EA}$$

$$\bullet \delta_2 = \frac{F_2 L_2}{EA_2} = \frac{(3P - P) \times 2L}{E \times \frac{A}{2}} = \frac{8PL}{EA}$$

$$\bullet \delta_3 = \frac{F_3 L_3}{EA_3} = \frac{3P \times 3L}{E \times \frac{A}{4}} = \frac{36PL}{EA}$$

$$\therefore \delta_1 : \delta_2 : \delta_3 = 2 : 8 : 36 = 1 : 4 : 18$$

19. ①번

$$\bullet L_e = kL = 0.5 \times 4,000 = 2,000[\text{mm}] \quad (\text{양단고정 } k = 0.5)$$

$$\therefore P_{cr} = \frac{\pi^2 EI_{\min}}{L_e^2} = \frac{10 \times 210}{2,000^2} \left(\frac{200 \times 100^3}{12} \right) = 8,750[\text{kN}]$$

20. ④번

중첩공식 이용

$$\bullet \delta_A = \frac{PL^3}{3EI} \left(\frac{1}{n} \right) + \frac{Pa^3}{3EI} \left(1 - \frac{1}{n} \right), \quad n = \frac{2I}{I} = 2$$

$$\therefore \delta_A = \frac{PL^3}{3EI} \left(\frac{1}{2} \right) + \frac{P \left(\frac{L}{2} \right)^3}{3EI} \left(1 - \frac{1}{2} \right) = \frac{3PL^3}{16EI}$$

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