9. 선형탄성 구조 해석 (Linear Analysis)

가. 단면 ① (중앙부)

$$-f_r = \frac{M_{cr}}{I} \cdot y + \frac{P_e \cdot e_3}{I} y + \frac{(P_1 + P_2) \cdot e_1}{I} y + \frac{P_e \cdot 3}{A_g}$$

$$M_{cr} = \left(-f_r + \frac{P_e \cdot e_3}{I} y + \frac{(P_1 + P_2) \cdot e_1}{I} y + \frac{P_e \cdot 3}{A_g} \right) \times \frac{I}{y}$$

$$M_{cr} = \left(-0.63\sqrt{f_{ck}} + \frac{(P_e \cdot e_3) \cdot 3}{I} y + \frac{(P_1 + P_2) \cdot e_1}{I} y + \frac{P_e \cdot 3}{A_g} \right) \times \frac{I}{y}$$

이때, $f_{ck} = 30MPa$

$P_e = 2400 \times 0.7 \times 1525.7 = 2{,}563{,}176N$

$e_1 = 410mm$

$e_2 = 52mm$

$I = 2.2929 \times 10^{11} mm^4$

$y = -514.323mm$

$$\therefore Mcr \fallingdotseq 1{,}066\,KN-m$$

나. 단면 ③ (우각부)

$$-f_r = \frac{M_{cr}}{I} \cdot y + \frac{P_e \cdot e_p}{I} y + \frac{P_e}{A}$$

$$M_{cr} = \left(-f_r + \frac{P_e \cdot e_p}{I} y + \frac{P_e}{A} \right) \times \frac{I}{y}$$

$$M_{cr} = \left(-0.63\sqrt{f_{ck}} + \frac{P_e \cdot e_p}{I} y + \frac{P_e}{A} \right) \times \frac{I}{y}$$

이때, $f_{ck} = 60MPa$

$P_e = 2{,}563{,}176N$

$e = 611mm$

$I = 1.425 \times 10^{11} mm^4$

$y = 717mm$

$$\therefore Mcr \fallingdotseq 5{,}263\,KN-m$$