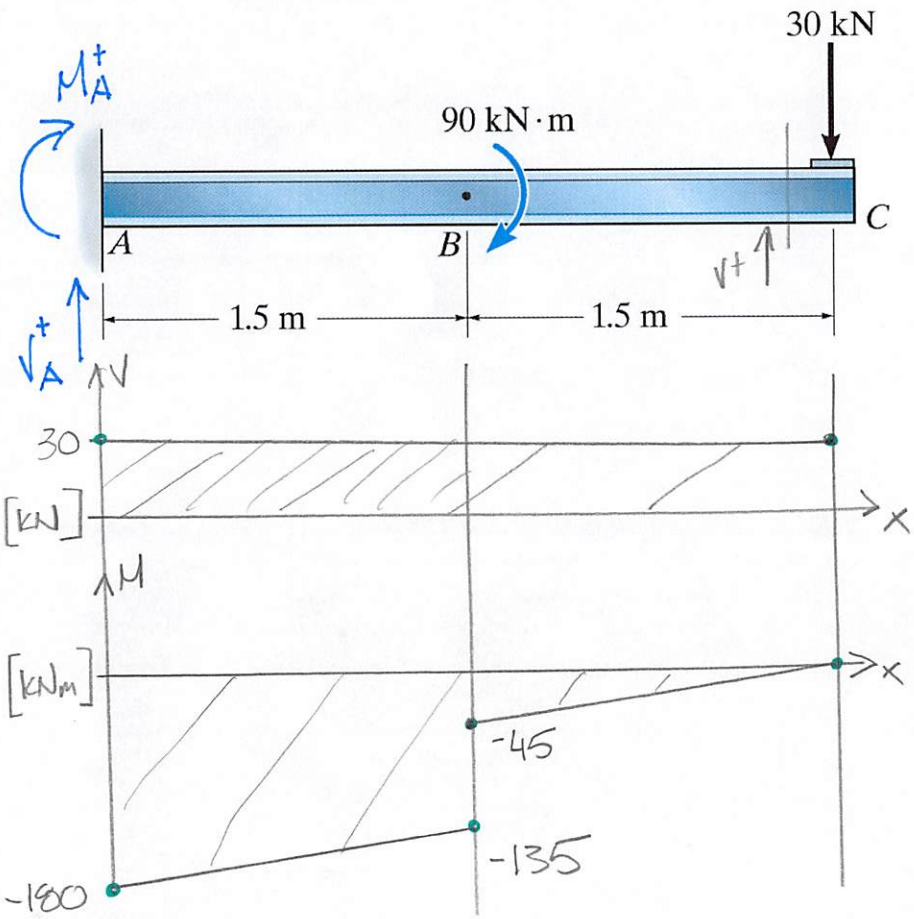
Example 7b-5: Use the conjugate beam method to determine the slope and displacement at point *C*. Assume that $E = 200$ GPa and $I = 300(10^6)$ mm^4.

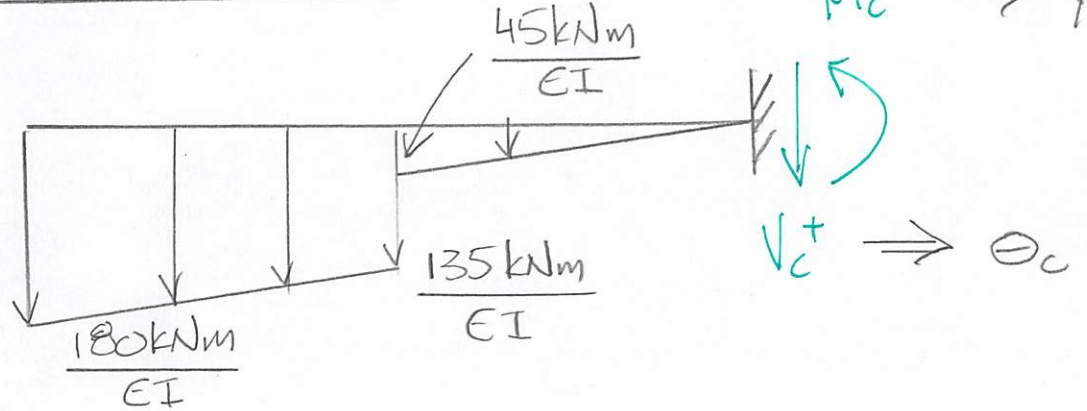


$$\circlearrowleft + \sum M_A = 0 = -M_A - 90\,kN\cdot m - 30\,kN(3\,m)$$

$$M_A = -180\,kN\cdot m$$

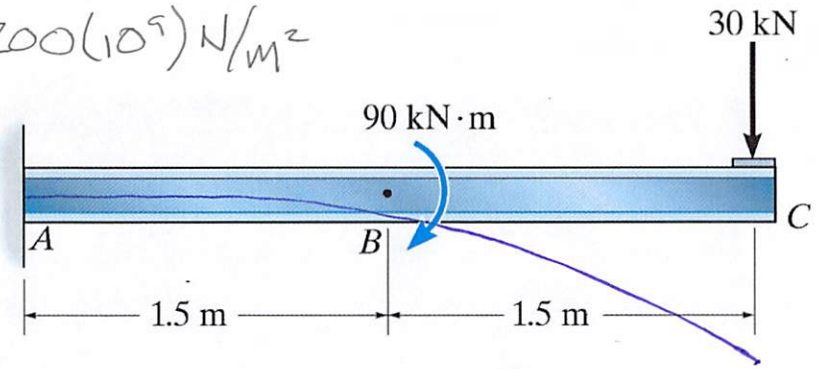
$$+\uparrow \sum F_y = 0 = V_A - 30\,kN \qquad V_A = 30\,kN$$

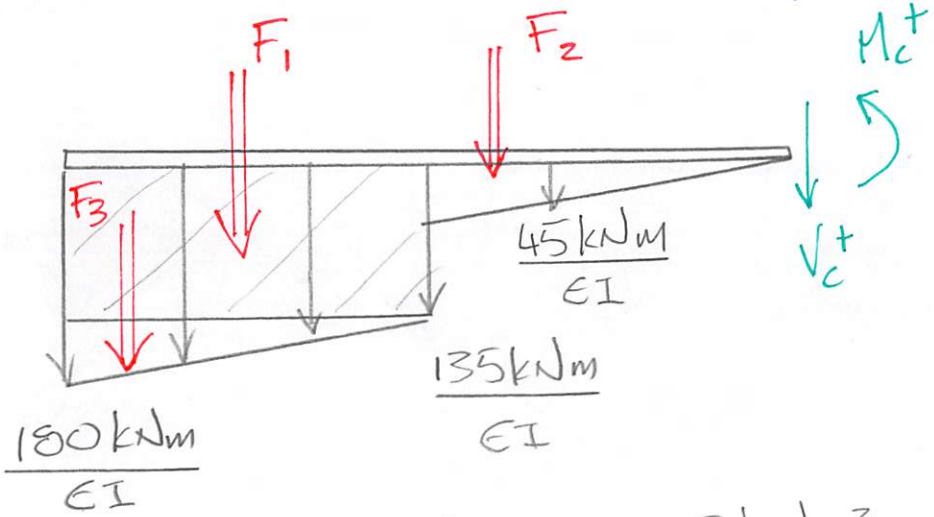
CONJUGATE BEAM



Example 7b-5: Use the conjugate beam method to determine the slope and displacement at point *C*. Assume that $E = 200$ GPa and $I = 300(10^6)$ mm^4.

$200(10^9)\ N/m^2$





$$F_1 = (1.5m)\frac{135\,kNm}{EI} = \frac{202.5\,kNm^2}{EI}$$

$$F_2 = \tfrac{1}{2}(1.5m)\frac{45\,kNm}{EI} = \frac{33.75\,kNm^2}{EI}$$

$$F_3 = \tfrac{1}{2}(1.5m)\frac{45\,kNm}{EI} = \frac{33.75\,kNm^2}{EI}$$

$$\circlearrowleft +\Sigma M_C = 0 = M_C + F_1 d_1 + F_2 d_2 + F_3 d_3$$

$$= M_C + \frac{202.5\,kNm^2}{EI}\underbrace{\left(1.5 + \tfrac{1}{2}(1.5m)\right)}_{d_1} + \frac{33.75\,kNm^2}{EI}\Big[\underbrace{\tfrac{2}{3}(1.5m)}_{d_2} + \underbrace{\left(1.5 + \tfrac{2}{3}(1.5m)\right)}_{d_3}\Big]$$

$$M_C = -\frac{573.75\,kNm^3}{EI} \Rightarrow Y_C$$

$$= -\frac{573.75\,kN\cancel{m^3}}{200(10^6)\,kN}\,\frac{m^2}{300(10^6)\,\cancel{mm^4}}\left[\frac{10^3\,mm}{m}\right]^4$$

$$= -0.00956\,m = -9.56\,mm$$

$$+\uparrow \Sigma F_y = 0 = -V_C - F_1 - F_2 - F_3$$

$$V_C = -\frac{270\,kNm^2}{EI} \Rightarrow \theta_C$$

$$= -0.0045\ \text{RADIANS}$$