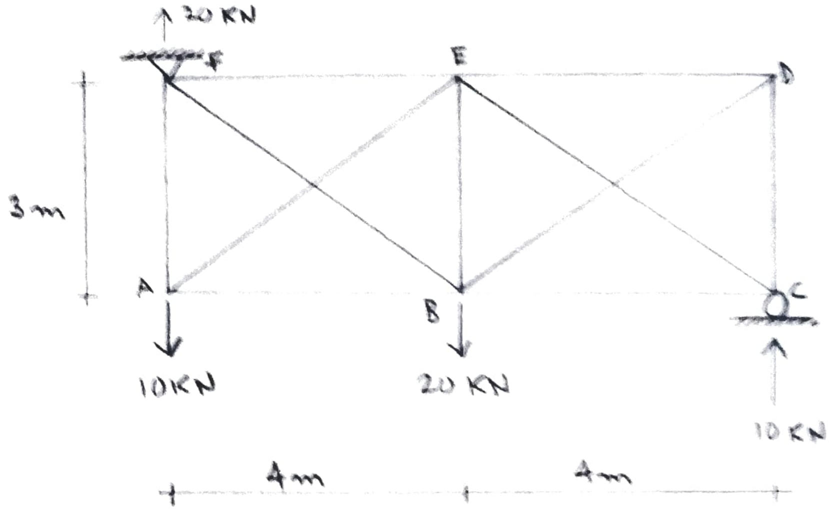
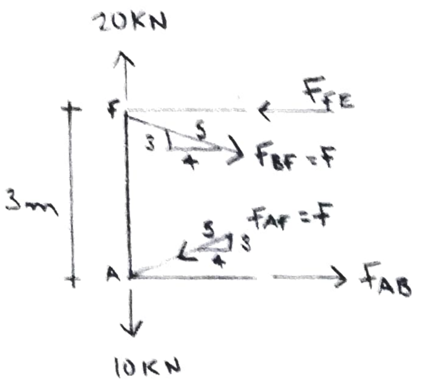
ANALISIS APROXIMADO DE ARMADURAS





1) $\Sigma M_A = 0$

$3F_{FE} - 3\left(\frac{4}{5}\right)F = 0$

$F_{FE} = 0{,}8F$

$\boxed{F_{FE} = 6{,}66\ KN}$ C

$\Sigma F_y = 0$

$20 - 10 - 2\left(\frac{3}{5}\right)F = 0$

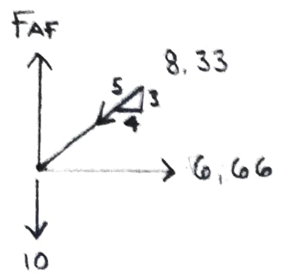
$10 - 1{,}2F = 0$

$\boxed{F = 8{,}33\ KN}$

2) $\Sigma M_F = 0$

$-\frac{4}{5}(8{,}33) + 3F_{AB} = 0$

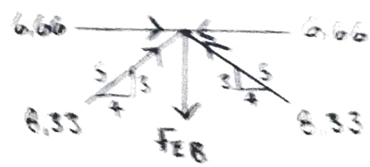
$\boxed{F_{AB} = 2{,}22\ KN}$ T

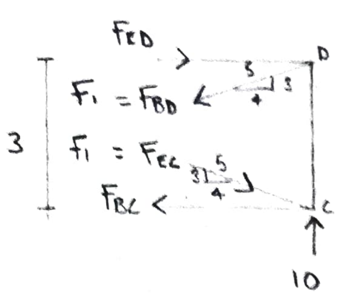


$\Sigma F_y = 0$

$F_{AF} - \frac{3}{5}(8{,}33) - 10 = 0$

$\boxed{F_{AF} = 15\ KN}$ T





3) $\Sigma M_C = 0$

$-3F_{ED} + \frac{4}{5}F_1 = 0$

$-3F_{ED} + 6{,}66 = 0$

$\boxed{F_{ED} = 2{,}22\ KN}$ C

4) $\Sigma M_D = 0$

$-3F_{BC} + 3\left(\frac{4}{5}\right)(8{,}33) = 0$

$\boxed{F_{BC} = 6{,}66\ KN}$ T

$\Sigma F_y = 0$

$-2\left(\frac{3}{5}\right)F_1 + 10 = 0$

$\boxed{F_1 = 8{,}33\ KN}$

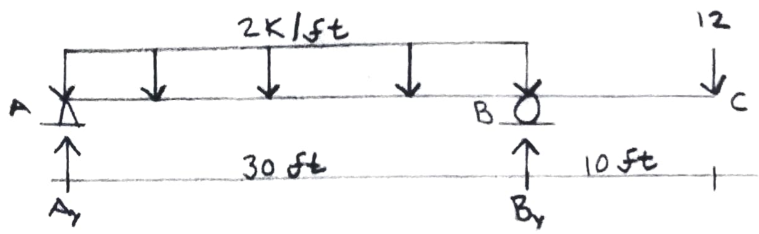
$\Sigma F_y = 0$

$2\left(\frac{3}{5}\right)8{,}33 - F_{EB} = 0$

$\boxed{F_{EB} = 10\ KN}$ T

METODO CASTIGLIANO

DETERMINE LA DEFLEXIÓN EN EL PUNTO C DE LA VIGA POR EL SEGUNDO TEOREMA DE CASTIGLIANO. $E = 29\,000$ KSI , $I = 2000$ in^4



$\Sigma M_A = 0$

$-2(30)(15) + 30B_y - 40P = 0$

$-900 + 30B_y - 40P = 0$

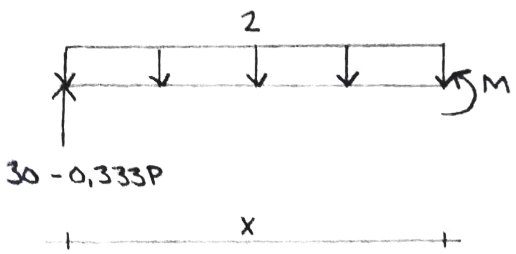
$B_y = 30 + 1{,}3333P$

$\Sigma F_y = 0$

$A_y - 2(30) + 30 + 1{,}3333P - P$

$A_y = 30 - 0{,}3333P$

TRAMO AB $\longrightarrow$ $0 \le x \le 30$



$\Sigma M = 0$

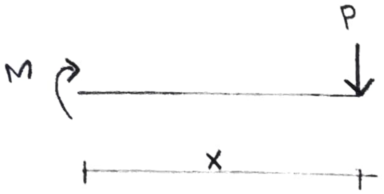
$2x\left(\frac{x}{2}\right) - x(30 - 0{,}333P) + M = 0$

$x^2 - 30x + 0{,}333Px + M = 0$

$M = -0{,}333Px + 30x - x^2$

$\frac{\partial M}{\partial P} = -0{,}333x$

TRAMO CB $\longleftarrow$ $0 \le x \le 10$



$\Sigma M = 0$

$-M - Px = 0$

$M = -Px$

$\frac{\partial M}{\partial P} = -x$

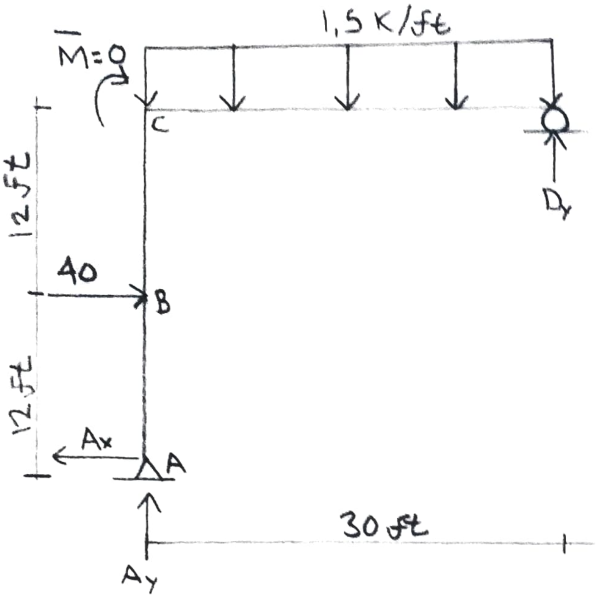
$$\Delta_C = \int_0^{30} (-0{,}333x)((-0{,}333x(12)) + 30x - x^2 + \int_0^{10} (-x)(-12x)$$

$$\Delta_C = \frac{-6501{,}5\,(12)^3}{29000\,(2000)} = -0{,}194 \text{ in} \downarrow$$

METODO CASTIGLIANO

DETERMINAR ROTACIÓN EN C.

$E = 29\,000$, $I = 2\,500\ in^4$



$\Sigma M_A = 0$

$-40(12) - 1{,}5(30)(15) - M + 30 D_y = 0$

$-480 - 675 - \overline{M} + 30 D_y = 0$

$D_y = 38{,}5 + \dfrac{\overline{M}}{30} \uparrow$

$\Sigma F_y = 0$

$A_y - 1{,}5(30) + 38{,}5 + \dfrac{\overline{M}}{30}$

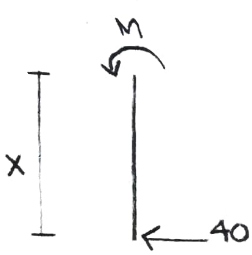
$A_y = 6{,}5 - \dfrac{\overline{M}}{30} \uparrow$

$\Sigma F_x = 0$

$-A_x + 40 = 0$

$A_x = 40$

TRAMO AB $\rightarrow 0 \leq x \leq 12$



$\Sigma M = 0$

$M - 40x = 0$

$M = 40x$

$\dfrac{\partial M}{\partial P} = 0$

TRAMO CB $\rightarrow 0 \leq x \leq 12$

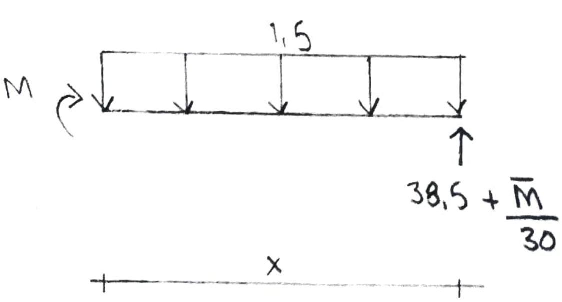
$\Sigma M = 0$

$-M + 480 = 0$

$M = 480$

$\dfrac{\partial M}{\partial P} = 0$

TRAMO DC $\rightarrow 0 \leq x \leq 30$



$\Sigma M = 0$

$-M - 1{,}5x\left(\dfrac{x}{2}\right) + x\left(38{,}5 + \dfrac{\overline{M}}{30}\right) = 0$

$\dfrac{\partial M}{\partial P} = \dfrac{x}{30}$

$-M - 0{,}75x^2 + 38{,}5x + \dfrac{\overline{M}}{30}x = 0$

$M = -0{,}75x^2 + 38{,}5x + \dfrac{\overline{M}}{30}x$

$$\theta_c = \int_0^{30} \left(\frac{x}{30}\right)\left(-0{,}75x^2 + 38{,}5x\right) dx = \frac{6487{,}5}{EI}\ K \cdot ft^2$$

$$\theta_c = \frac{6487{,}5(12)^2}{29000(2500)} = 0{,}01289\ \text{RAD}$$

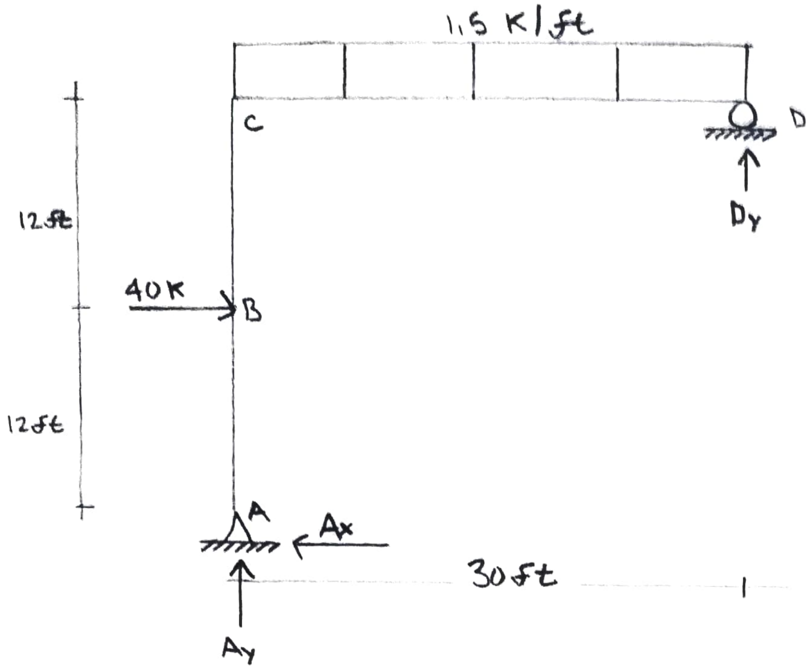
METODO DE TRABAJO VIRTUAL

DETERMINE LA ROTACIÓN EN EL NODO C DEL MARCO QUE SE MUESTRA EN LA FIGURA.

EI = CONSTANTE

E = 29 000 KSI

I = 2500 in^4



$\circlearrowleft + \; \Sigma M_A = 0$

$-40(12) - 1{,}5(30)(15) + 30\,D_y = 0$

$D_y = 38{,}5 \text{ K·ft} \uparrow$

$\Sigma F_y = 0$

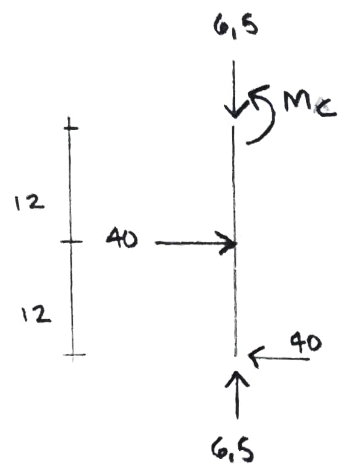
$A_y - 1{,}5(30) + 38{,}5 = 0$

$A_y = 6{,}5 \text{ K} \uparrow$

$\Sigma F_x = 0$

$40 - A_x = 0$

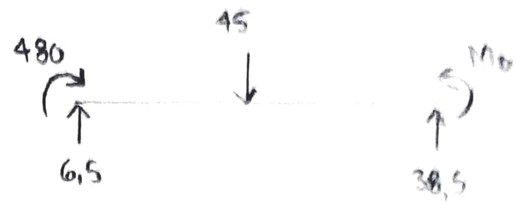
$A_x = 40 \text{ K} \leftarrow$



$\circlearrowleft + \; \Sigma M_C = 0$

$40(12) - 40(24) + M_A = 0$

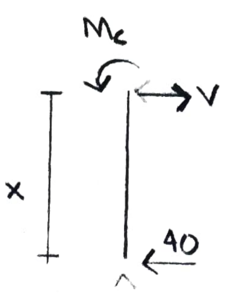
$M_C = 480 \text{ K·ft} \circlearrowleft$



$45(15) + 6{,}5(30) - 480 + M_D = 0$

$M_D = 0$

$AB \rightarrow 0 \leq x \leq 12$



$\circlearrowleft + \; \Sigma M_c = 0$

$M_c - 40(x) = 0$

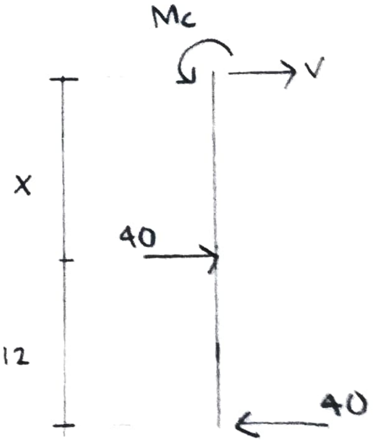
$M_c = 40x$

$\Sigma F_x = 0$

$V - 40 = 0$

$V = 40$

$BC \rightarrow 12 \leq x \leq 24$



$\circlearrowright \Sigma M_c = 0$

$M_c + 40x - 40(12 + x) = 0$

$M_c + 40x - 480 + 40x = 0$

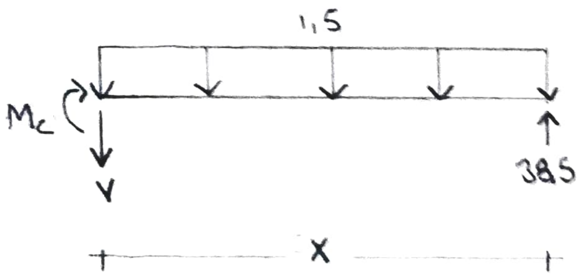
$M_c = 480$

$\Sigma F_x = 0$

$V - 40 + 40 = 0$

$V = 0$

$DC \rightarrow 0 \leq x \leq 30$



$\Sigma M_c = 0$

$-M_c - 1{,}5(x)\left(\frac{x}{2}\right) + 38{,}5(x) = 0$

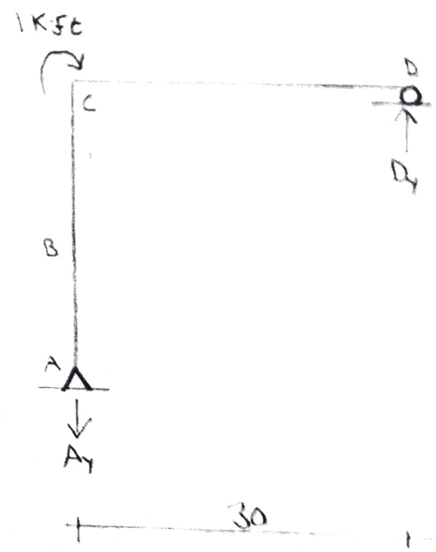
$M_c = 38{,}5x - 0{,}75x^2$

$\Sigma F_y = 0$

$-V - 1{,}5(x) + 38{,}5 = 0$

$V = 38{,}5 - 1{,}5x$

MARCO VIRTUAL



$\circlearrowright \Sigma M_A = 0$

$-1 + 30D_y = 0$

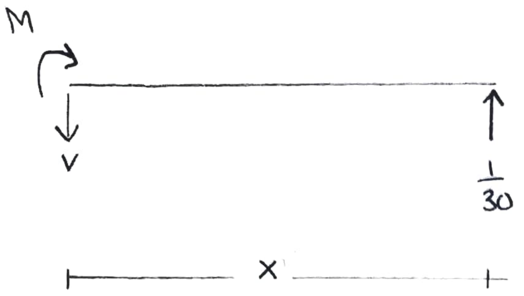
$D_y = \frac{1}{30} \uparrow$

$\Sigma F_y = 0$

$-A_y + \frac{1}{30} = 0$

$A_y = \frac{1}{30} \downarrow$

$CD \rightarrow 0 \leq x \leq 30$



$\Sigma M = 0$

$-M + \frac{1}{30}x = 0$

$M = \frac{1}{30}x$

$\Sigma F_y = 0$

$-V + \frac{1}{30} = 0$

$V = \frac{1}{30}$

SEGMENTO	ORIGEN	LIMITES	M (k·ft)	M_v (k·ft)
AB	A	0-12	$40x$	0
BC	B	12-24	480	0
DC	D	0-30	$38{,}5x - 0{,}75x^2$	$\frac{1}{30}x$

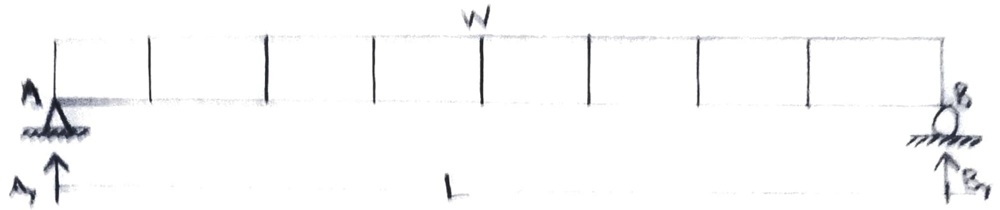
$$1(\theta_c) = \int \frac{M_v \cdot M}{EI}\,dx$$

$$= \int_0^{30} \frac{x}{30}\left(38{,}5x - 0{,}75x^2\right)$$

$$\theta_c = \frac{6487{,}5\,(12)^2}{29\,000\,(2\,500)} = 0{,}01289 \text{ RAD}$$

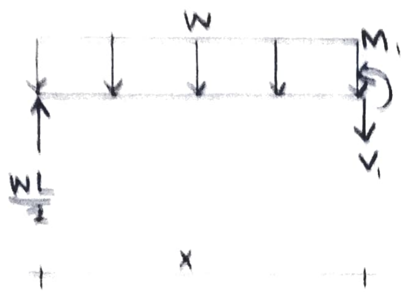
METODO DE DOBLE INTEGRACIÓN

DETERMINE LA ECUACIÓN DE LA PENDIENTE Y LA DEFLEXIÓN DE LA VIGA MOSTRADA. TAMBIEN CALCULE LA PENDIENTE EN CADA EXTREMO Y LA DEFLEXIÓN EN LA MITAD



$A_y = \frac{WL}{2} \uparrow$

$B_y = \frac{WL}{2} \uparrow$



1) $\Sigma M_A = 0$

$$-\frac{WL}{2}(x) + W(x)\left(\frac{x}{2}\right) + M_1 = 0$$

$$\frac{-WLX}{2} + \frac{WX^2}{2} + M_1 = 0$$

$$M_1 = \frac{WLX}{2} - \frac{WX^2}{2} \Rightarrow M_1 = \frac{W}{2}(Lx - x^2)$$

$$\frac{M}{EI} = \frac{W}{2EI}(Lx - x^2)$$

$$\Theta = \int \frac{W}{2EI}(Lx - x^2)$$

$$= \frac{W}{2EI}\int Lx - x^2$$

$$\Theta = \frac{W}{2EI}\left(\frac{Lx^2}{2} - \frac{x^3}{3}\right) + C_1$$

$$\delta = \int \frac{W}{2EI}\left(\frac{Lx^2}{2} - \frac{x^3}{3}\right) + C_1$$

$$= \frac{W}{2EI}\int \frac{Lx^2}{2} - \frac{x^3}{3} + C_1$$

$$\delta = \frac{W}{2EI}\left(\frac{Lx^3}{6} - \frac{x^4}{12}\right) + C_1 X + C_2$$

$$\Delta = \frac{W}{2EI}\left(\frac{Lx^3}{6} - \frac{x^4}{12}\right) + C_1 x + C_2$$

$$0 = \frac{W}{2EI}\left(\frac{L(0)^3}{6} - \frac{0^4}{12}\right) + C_1(0) + C_2$$ $\longrightarrow$ SE EVALUA EN $X = 0$

CUANDO $X = 0$ LA DEFORMADA ES IGUAL A 0 PORQUE EN EL APOYO NO HAY DEFORMADA

$$C_2 = 0$$

$$\Delta = \frac{W}{2EI}\left(\frac{Lx^3}{6} - \frac{x^4}{12}\right) + C_1 x + C_2$$

$$0 = \frac{W}{2EI}\left(\frac{L(L)^3}{6} - \frac{L^4}{12}\right) + C_1(L) + 0$$ $\longrightarrow$ SE EVALUA EN $X = L$

$$0 = \frac{W}{2EI}\left(\frac{2L^4 - L^4}{12}\right) + C_1 L$$

$$C_1 L = \frac{-W}{2EI}\left(\frac{L^4}{12}\right)$$

$$C_1 = \frac{-WL^4}{24EI}\left(\frac{1}{L}\right) \Rightarrow C_1 = \frac{-WL^3}{24EI}$$

$$\theta = \frac{W(6x^2L - 4x^3 - L^3)}{24EI}$$

$X = 0 \Rightarrow \theta_A = \dfrac{-WL^3}{24EI}$

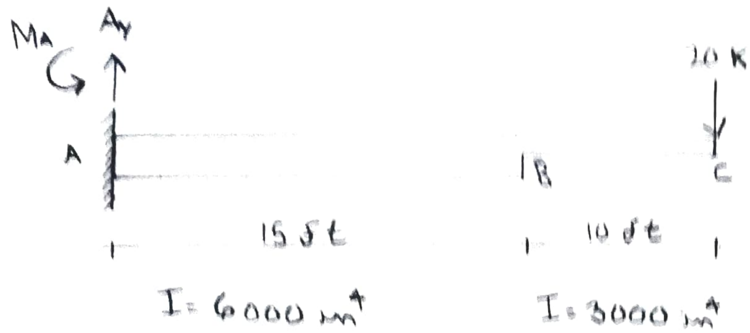
$X = L \Rightarrow \theta_B = \dfrac{WL^3}{24EI}$

$$\delta_c = \frac{WL}{12EI}\left(Lx^2 - \frac{x^3}{2} - \frac{L^3}{2}\right)$$

$X = \dfrac{L}{2} \Rightarrow \Delta_c = \dfrac{-5WL^4}{384EI} \downarrow$

METODO DE AREA MOMENTO

DETERMINE LA PENDIENTE Y LA DEFLEXIÓN EN LOS PUNTOS B, C DE LA VIGA EN CANTILIVER QUE SE MUESTRA POR EL METODO ÁREA MOMENTO.



E = 29 000 KSI

$\sum F_y = 0$

$A_y - 20 = 0$

$\boxed{A_y = 20\,K \uparrow}$

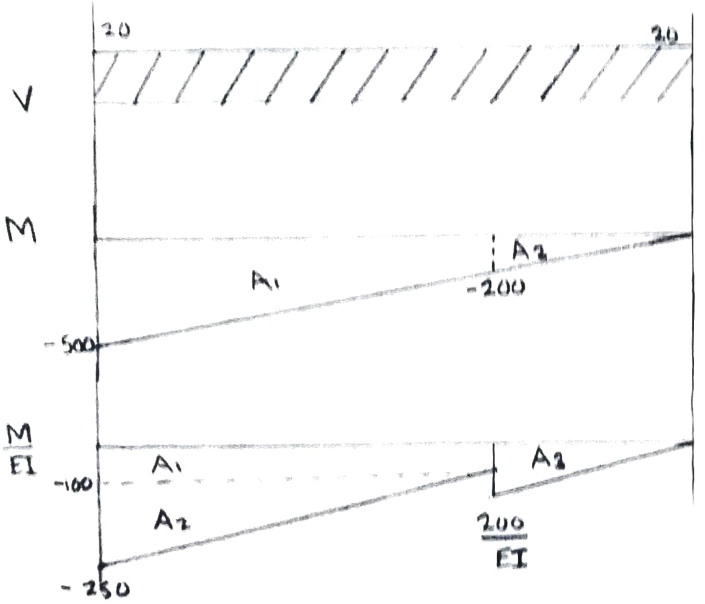
$\circlearrowleft \sum M_A = 0$

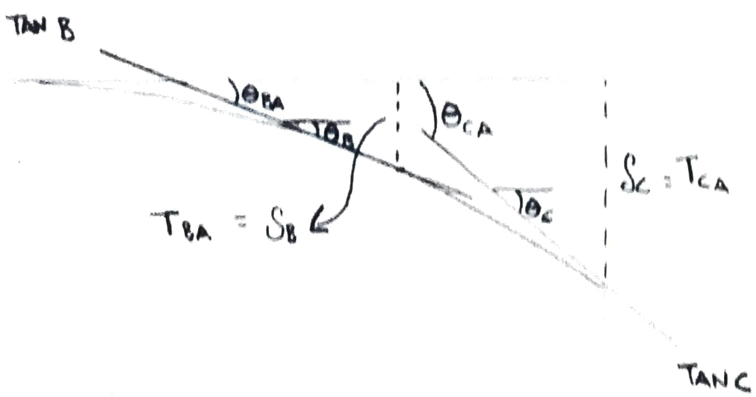
$M_A - 25(20) = 0$

$\boxed{M_A = 500\,K \cdot ft}$

$I = I_{BC} = 3000$

$I_{AB} = 6000 = 2(3000) = 2I$





$A_1 = -100(15) = -1500 \qquad A_2 = -\frac{1}{2}(150)(15) = -1125 \qquad A_3 = -\frac{1}{2}(200)(10) = -1000$

$$\theta_C = \theta_{CA} = \Sigma A_{CA} = -1500 - 1125 - 1000 = \frac{-3625\,(12)^2}{(29000)(3000)}$$

$\theta_C = 0{,}006$ RAD

$$\delta_C = T_{CA} = \Sigma A_{CA} \cdot \bar{X} = -1000(6{,}667) - 1125(20) - 1500(17{,}5)$$

$$\delta_C = \frac{55417\,(12)^3}{(29000)(3000)} = 1{,}1 \text{ in} \downarrow$$

$$\theta_B = \theta_{BA} = \Sigma A_{BA} = -1500 - 1125 = \frac{-2625\,(12)^2}{29000\,(3000)} = 0{,}0043 \text{ RAD}$$

$$\delta_B = T_{BA} = \Sigma A_{BA} \cdot \bar{X} = -1125(10) - 1500(7{,}5) = \frac{22500\,(12)^3}{29000\,(3000)}$$

$\delta_B = 0{,}4469$ in $\downarrow$