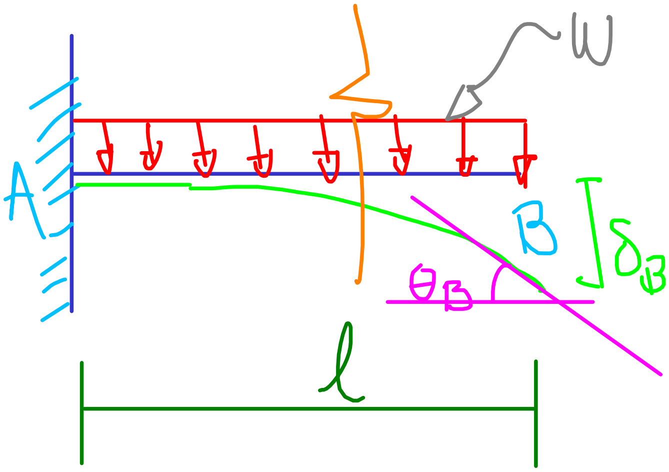
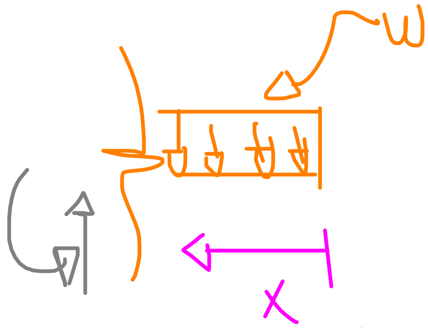
¿ δ_B & θ_B ?

Trabajo Virtual



$EI = cte.$

$$\Sigma Q \delta_p = \Sigma \int_{x=0}^{x=\ell} \frac{M_Q \, M_p}{EI} \, dx$$



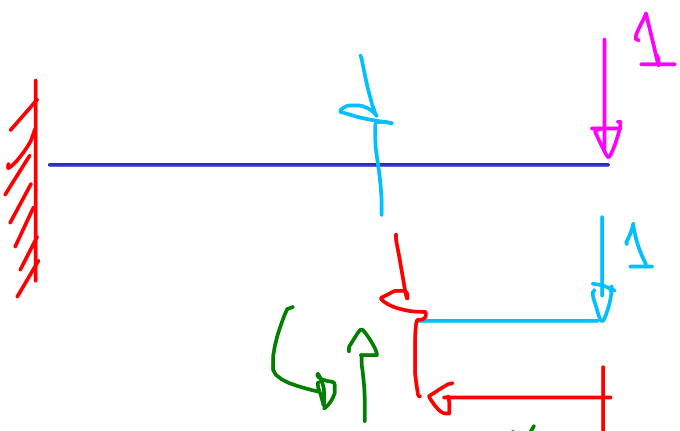
$$M_p = wx\left(\frac{x}{2}\right) = \frac{wx^2}{2}$$

$$1 \delta_p = \int_0^{\ell} (x)\left(\frac{wx^2}{2}\right) \frac{dx}{EI}$$

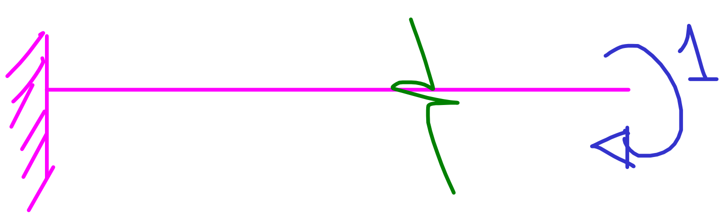
$$= \int_0^{\ell} \frac{wx^3}{2} \frac{dx}{EI}$$

$$= \frac{wx^4}{8EI} \Big|_0^{\ell}$$

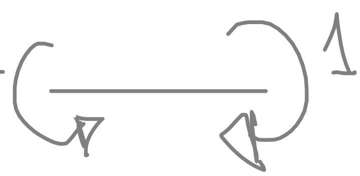
$$\delta_{p_{By}} = \frac{w\ell^4}{8EI} \downarrow$$



ℓ $M_Q = x$ $\leftarrow$ 0



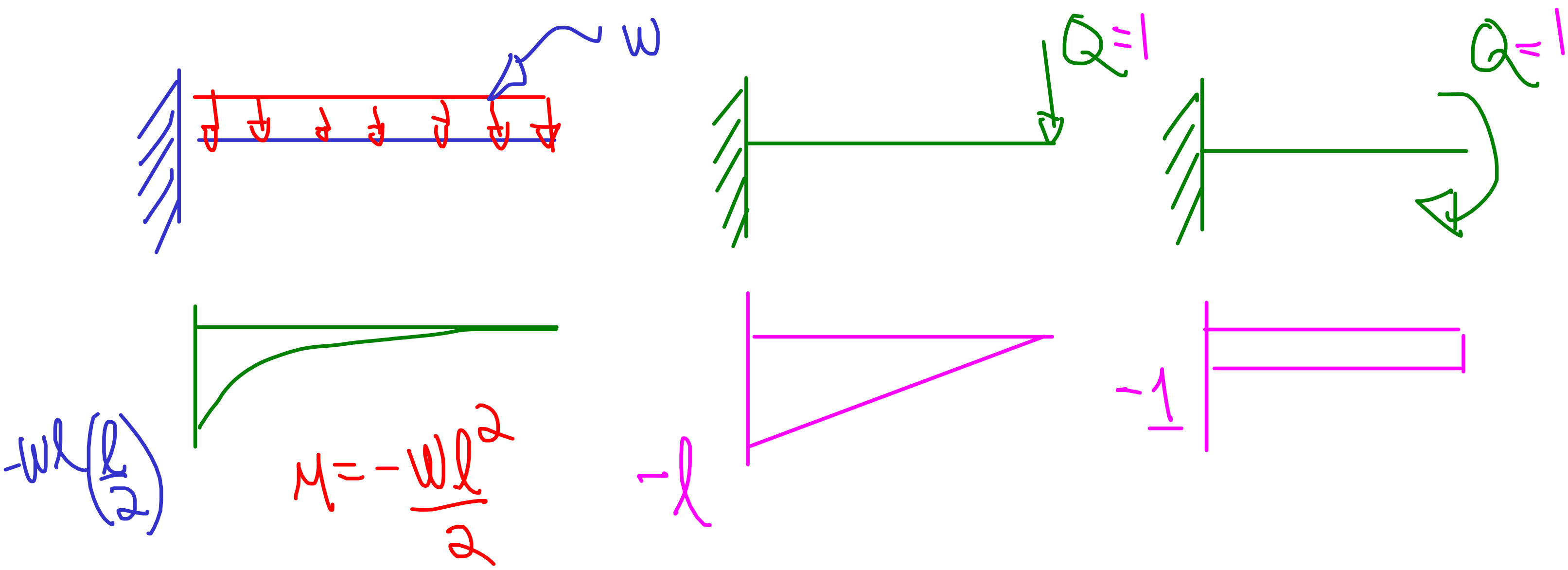
$M_Q = 1$



$$\sum Q\theta_p = \sum \int_0^{l} \frac{M_Q M_P}{EI}\,dx$$

$$1\,\theta_p = \int_0^{l} (1)\left(\frac{wx^2}{2}\right)\frac{dx}{EI} = \frac{wx^3}{6EI}\Big|_0^{l}$$

$$\theta_{p_B} = \frac{wl^3}{6EI}$$



Parábola X triángulo

$$\delta_B = \frac{1}{4} M_1 M_3 L \left(\frac{1}{EI}\right)$$

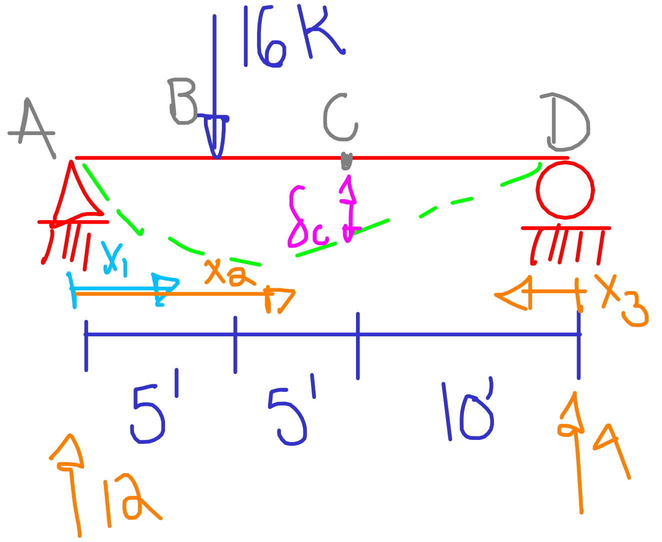
$$\delta_B = \frac{1}{4EI}(-l)\left(-\frac{wl^2}{2}\right)l = \frac{wl^4}{8EI}$$

Parábola X Rect.

$$\theta_B = \frac{1}{3} M_1 M_3 L \left(\frac{1}{EI}\right)$$

$$= \frac{1}{3}\frac{(1)}{EI}\left(-\frac{wl^2}{2}\right)l$$

$$= \frac{wl^3}{6EI}$$



¿δ_C?

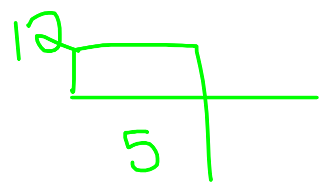
$EI = \text{cte.}$

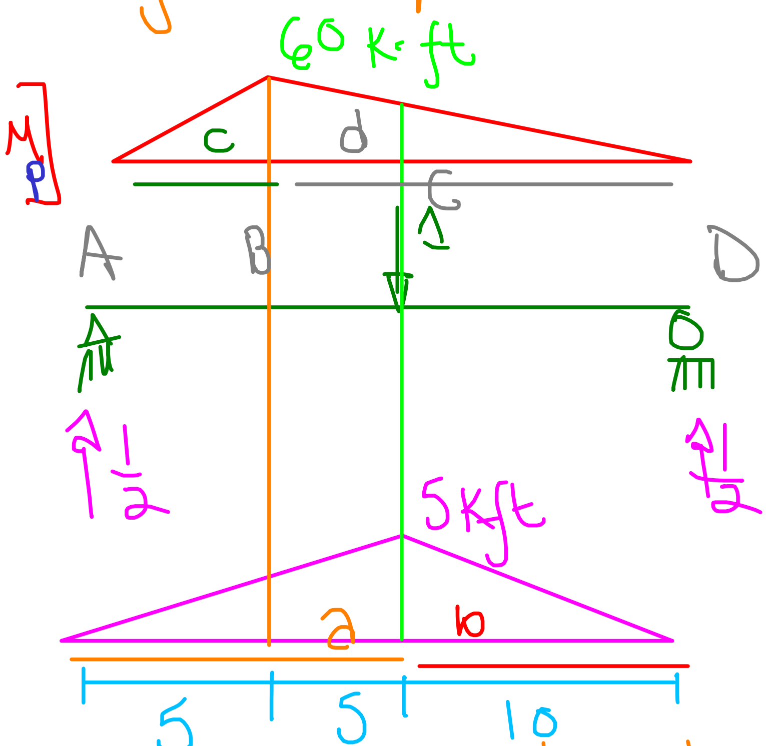
$E = 29{,}000\ \text{ksi}$

$I = 240\ \text{in}^4$

$$\sum M_A = 0 = 16(5) - R_D(20) \rightarrow R_D = 4$$

$$0 = \sum F_y = 16 - 4 + R_A \rightarrow R_A = 12$$





Tramo	Origen	Límites	M_Q	M_P
AB	A	0-5	$\frac{1}{2}x_1$	$12x_1$
BC	A	5-10	$\frac{1}{2}x_2$	$12x_2 - 16(x_2 - 5)$
DC	D	0-10	$\frac{1}{2}x_3$	$4x_3$

$$EI\,1\,\delta_{PC_y} = \int_0^5 \frac{1}{2}x_1\,(12x_1)\,dx + \int_5^{10} \frac{1}{2}x_2\,(12x_2 - 16(x_2-5))\,dx + \int_0^{10} \frac{1}{2}x_3\,(4x_3)\,dx$$

$$= \int_0^5 6x_1^2\,dx + \int_5^{10} \frac{x_2}{2}\,(12x_2 - 16x_2 + 80)\,dx + \int 2x_3^2\,dx = 2x_1^3\Big|_0^5 + \int_5^{10} 6x_2^2 - 8x_2^2 + 40x_2$$

$$+ \int_0^{10} 2x_3^2\,dx = 250 + 2x^3 - \frac{8}{3}x^3 + 20x^2\Big|_5^{10} + \frac{2}{3}x^3\Big|_0^{10} = 250 + \left(2000 - \frac{8000}{3} + 2000 - 250 + \frac{1000}{3} - 500\right) + \frac{2x^3}{3}\Big|_0^{10}$$

$$= 250 + 916.66 + 666.67$$

$$EI\,1\,\delta_{PC_y} = 1833.33$$

$$\int (k\cdot ft)(k\cdot ft) \to ft^3 \to in^3$$

$$\delta_c = \frac{1833.33\,(12)(12)(12)}{(29{,}000)(240)} = 0.455\,in \downarrow$$

Multiplicando Áreas

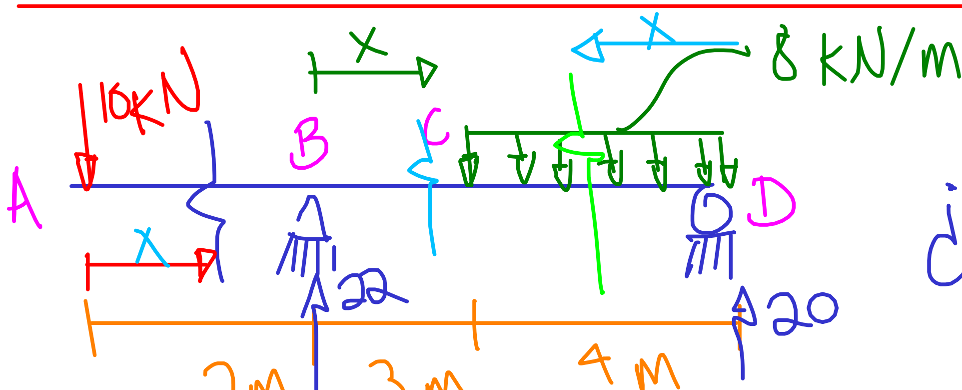
triáng. x triáng.

$$\left(\frac{1}{3} - \frac{(a-c)^2}{6ad}\right) M_1 M_3 L$$

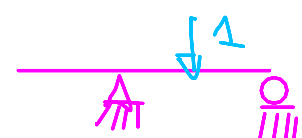
$$\left(\frac{1}{3} - \frac{(10-5)^2}{6(10)(15)}\right) 5 \cdot 60 \cdot 20 = 1833.33$$

12^3

$$\frac{1833.33(1728)}{29{,}000\,(240)} = \delta_c = 0.455\text{ in} \downarrow$$



¿ δ_c ?



$\Sigma M_B = 1(3) - R_D(7) = 0 \rightarrow R_D = \frac{3}{7}$

$\Sigma F_y \rightarrow R_A = 4/7$

$\circlearrowleft^{+} \Sigma M_B = -10(2) + 8(4)\left(3+\frac{4}{2}\right) - R_D(7) = 0 \rightarrow R_D = 20\text{ kN} \uparrow$

$\Sigma F_y = 0 = -10 - 8(4) + 20 + R_B = 0 \rightarrow R_B = 22\text{ kN} \uparrow$

Tramo	Origen	Límite	M_Q	M_P
AB	A	0-2	0	$-10x$
BC	B	0-3	$\frac{4}{7}x$	$-10(x+2)+22x$
DC	D	0-4	$\left(\frac{3}{7}\right)(x)$	$20x - 8x\left(\frac{x}{2}\right)$

$$\Sigma Q \delta_p = \Sigma M_Q \frac{M_p}{EI}$$

$$EI\, \underline{1}\, \delta_{v_C} = \int_0^2 0(-10x)\,dx + \int_0^3 \frac{4}{7}x(-10x - 20 + 22x)\,dx$$

$$+ \int_0^4 \left(\frac{3}{7}x\right)(20x - 4x^2)\,dx = \left(-\frac{40x^3}{21} - \frac{80}{14}x^2 + \frac{88x^3}{21}\right)\Bigg|_0^3$$

$$+ \left(\frac{60}{21}x^3 - \frac{12}{28}x^4\right)\Bigg|_0^4 = \frac{72}{7} + \frac{512}{7} = \frac{584}{7}$$

$$\delta_{v_C} = \frac{584}{7EI} \ (\downarrow)$$