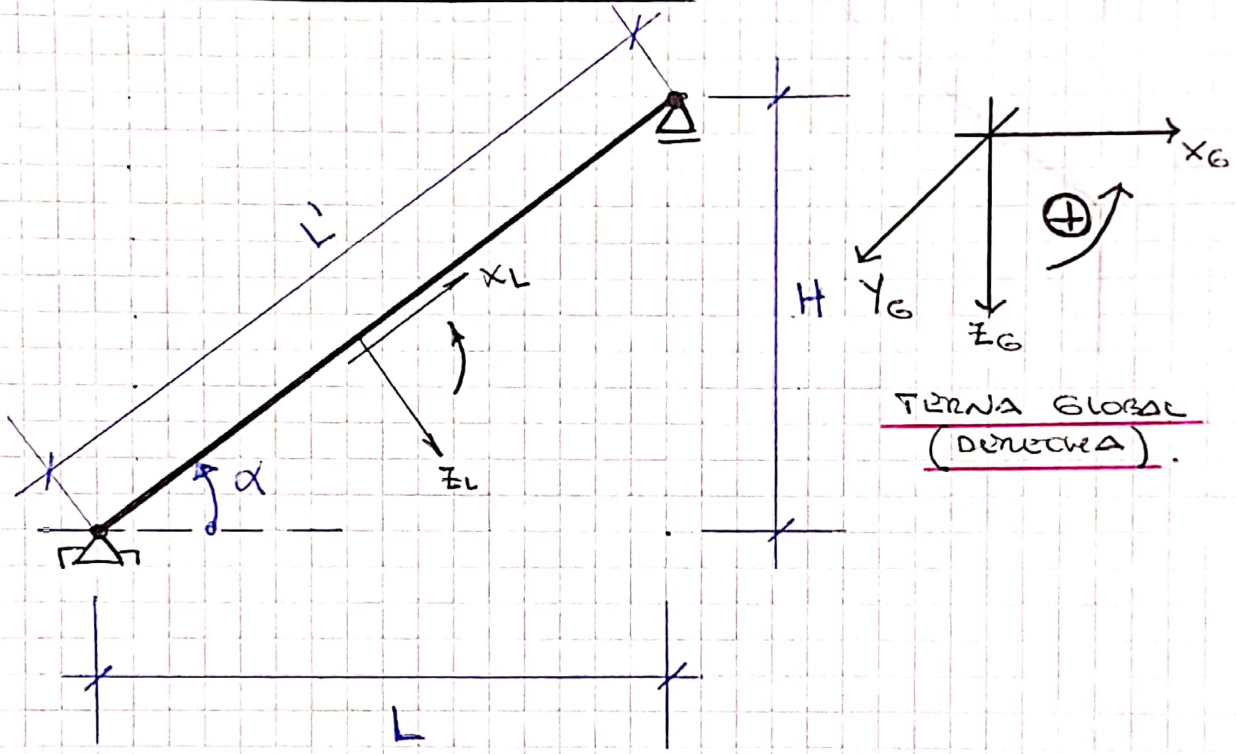
01 - ESQUEMA ESTRUCTURAL GENERAL

DATOS - CONVENCIONES:



$$L' = \sqrt{L^2 + H^2}$$

$$\cos\alpha = \frac{L}{L'} \quad ; \quad \operatorname{sen}\alpha = \frac{H}{L'} \quad ; \quad \tan\alpha = \frac{H}{L}$$

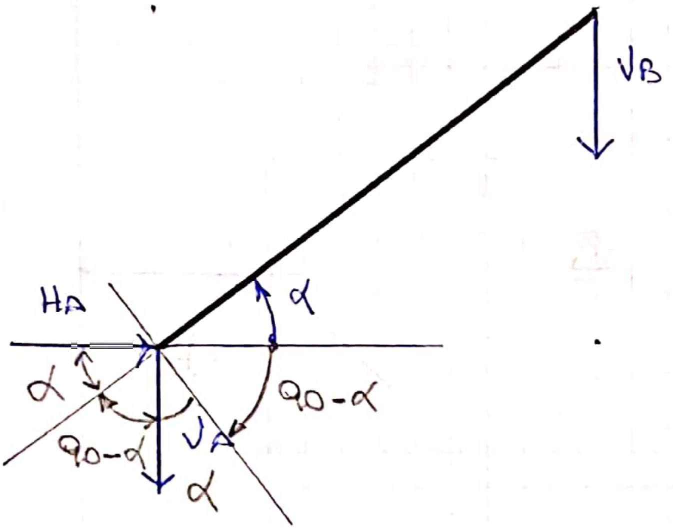
- DATOS:

$L = 8{,}00\ m \qquad H = 6{,}00\ m.$

$$L' = \sqrt{8^2 + 6^2} \longrightarrow L' = 10\,m.$$

$$\cos\alpha = \frac{8}{10} = 0{,}80 \qquad \operatorname{sen}\alpha = \frac{6}{10} = 0{,}60.$$

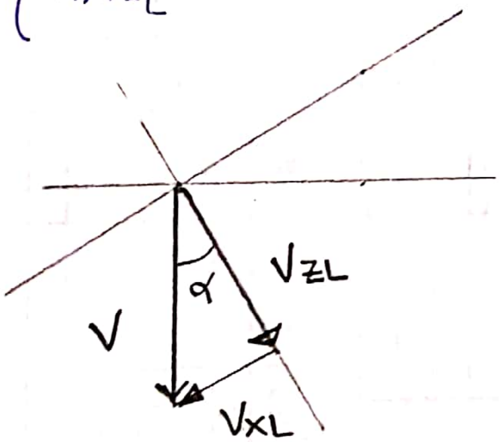
$$\tan\alpha = \frac{6}{8} = 0{,}75$$



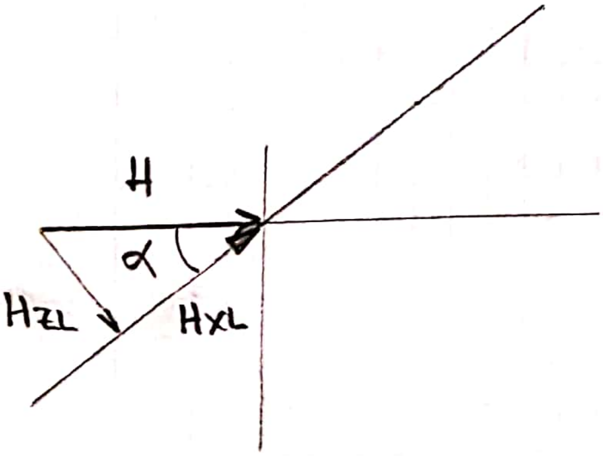
$$\begin{cases} V_{AX_L} = -V_A \cdot \text{sen}\ \alpha \\ V_{AZ_L} = V_A \cdot \cos \alpha \end{cases}$$

$$\begin{cases} V_{BX_L} = -V_B \cdot \text{sen}\ \alpha \\ V_{BZ_L} = V_B \cdot \cos \alpha \end{cases}$$

$$\begin{cases} H_{AX_L} = H_A \cdot \cos \alpha \\ H_{AZ_L} = H_A \cdot \text{sen}\ \alpha \end{cases}$$

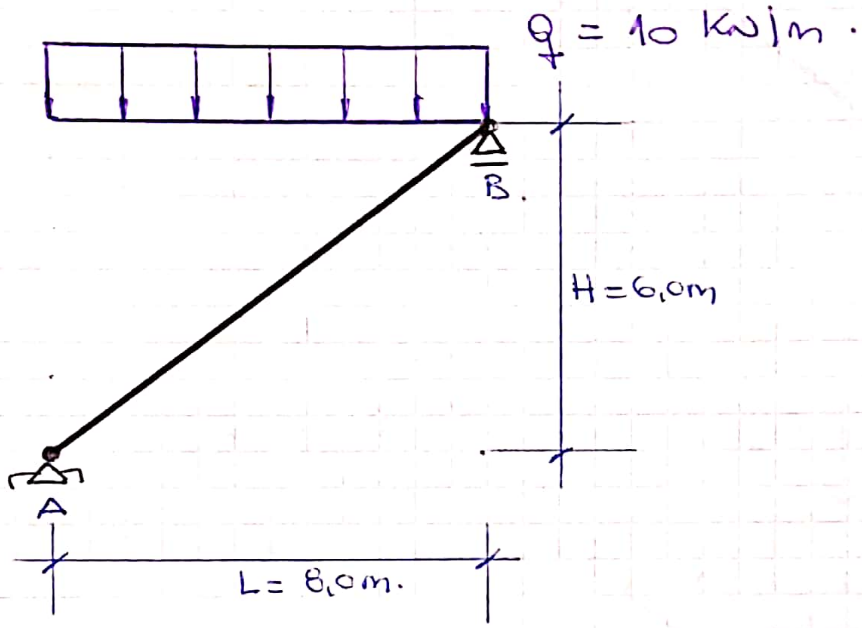


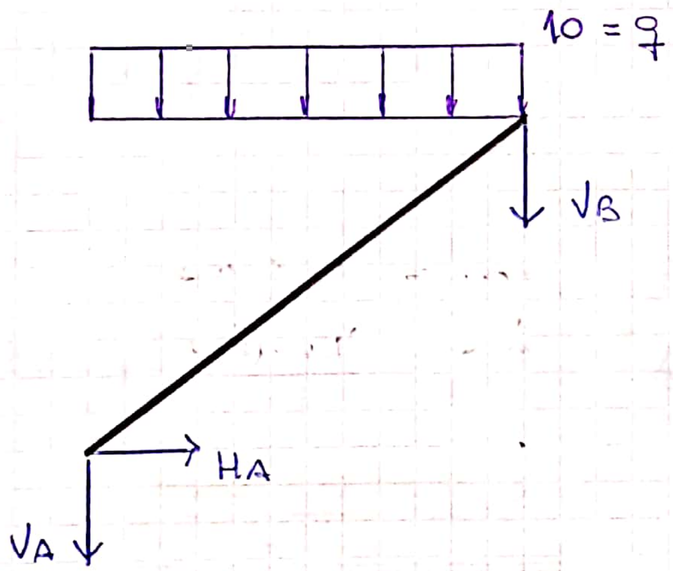
$$\begin{cases} V_{XL} = V \cdot \text{sen}\ \alpha \\ V_{ZL} = V \cdot \cos \alpha \end{cases}$$



$$\begin{cases} H_{XL} = H \cdot \cos \alpha \\ H_{ZL} = H \cdot \text{sen}\ \alpha \end{cases}$$

CASO (I):





DCL

$\Sigma M^{A}_{Fc} = 0 \quad -q \cdot L \cdot \frac{L}{2} - V_B \cdot L = 0 \rightarrow V_B = -q\frac{L}{2} \uparrow$

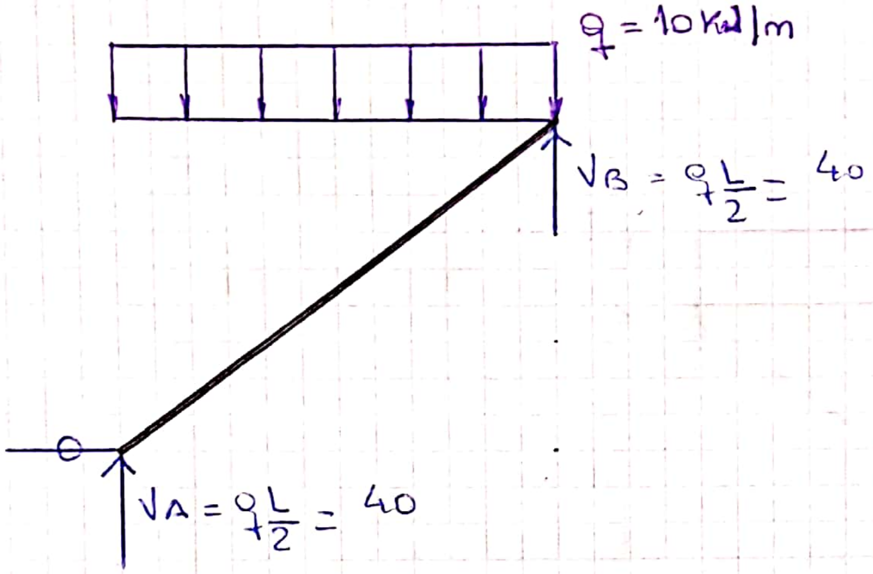
$\Sigma F_z = 0 \quad q L + V_A + V_B = 0.$

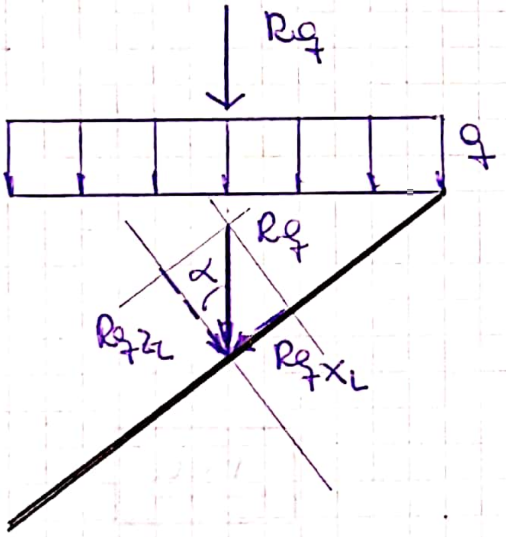
$q L + V_A - q\frac{L}{2} = 0 \rightarrow V_A = -q\frac{L}{2} \uparrow$

$\Sigma F_x = 0 \quad H_A = 0.$

$\boxed{\text{DCLE}}$

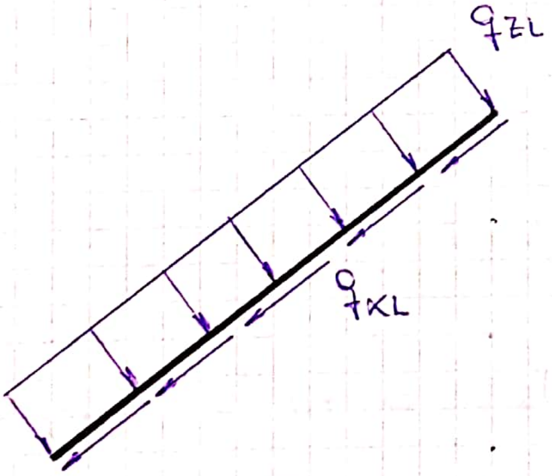
TG





$$Rq = q \cdot L.$$

$$\begin{cases} Rq_{xL} = Rq \cdot \operatorname{sen}\alpha. \\ Rq_{zL} = Rq \cdot \cos\alpha \end{cases}$$



$$q_{xL} = \frac{Rq_{xL}}{L'} = \frac{Rq \cdot \operatorname{sen}\alpha}{L'}$$

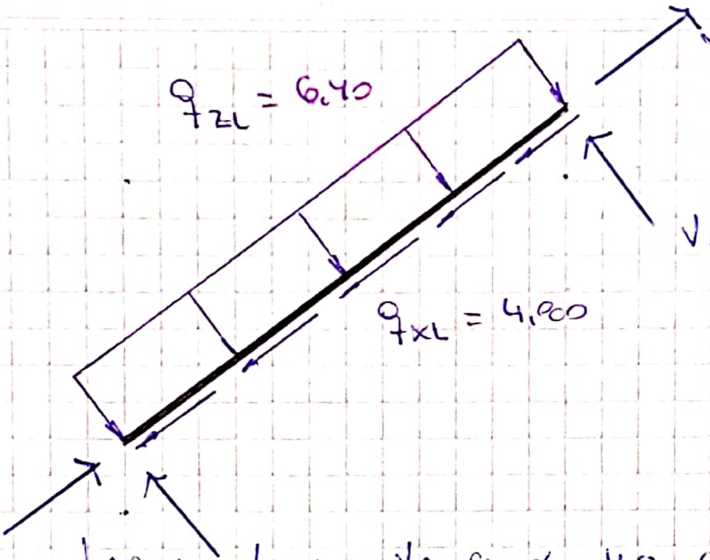
$$q_{xL} = \frac{q\, L \operatorname{sen}\alpha}{L'}$$

$$q_{zL} = \frac{Rq_{zL}}{L'} = \frac{Rq \cdot \cos\alpha}{L'}$$

$$q_{zL} = \frac{q\, L \cos\alpha}{L'}$$

$$q_{xL} = \frac{10 \cdot 8 \cdot 0{,}60}{10} = 4.8 \frac{kN}{m} \qquad q_{zL} = \frac{10 \cdot 8 \cdot 0{,}80}{10} = 6{,}4 \frac{kN}{m}$$

$V_{BXL} = V_B \cdot \operatorname{sen} \alpha = 40 \cdot 0{,}6 = 24$



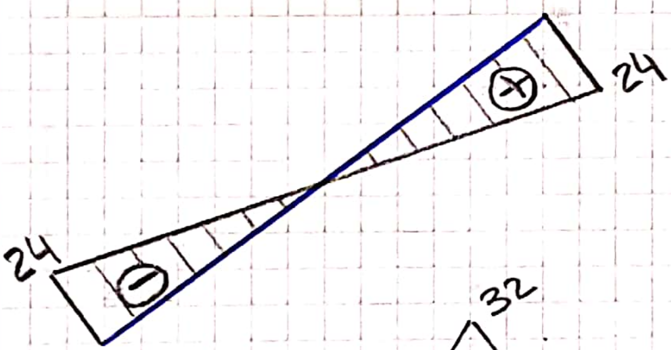
$V_{BZL} = V_B \cdot \cos \alpha = 40 \cdot 0{,}8 = 32.$

$\boxed{\text{DCLE}}$

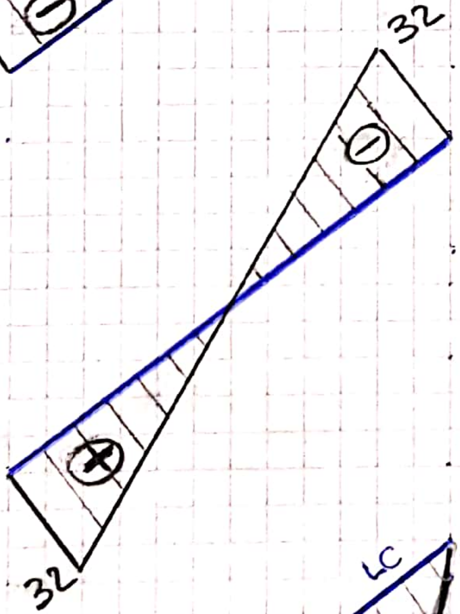
TL

$V_{AXL} = V_A \operatorname{sen} \alpha \qquad V_{AZL} = V_A \cdot \cos \alpha = 40 \cdot 0{,}8 = 32$

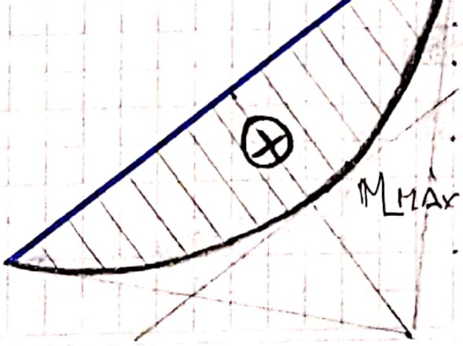
$V_{AXL} = 40 \cdot 0{,}60 = 24.$



$N(x)$



$Q_z(x)$



$M_y(x)$

$$M_{MAX} = q_{ZL} \cdot \frac{L'^2}{8} = \frac{6{,}40 \cdot 10^2}{8} = 80\,\text{kNm}$$

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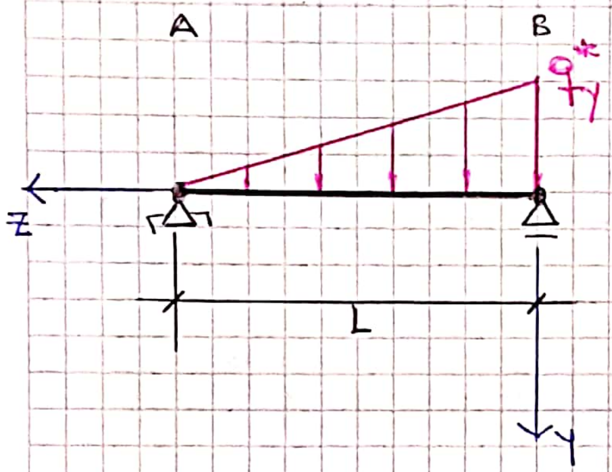
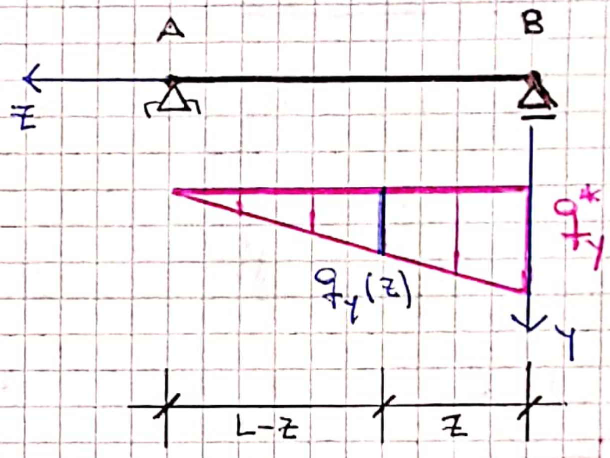




• FUNCIÓN DE CARGA:

$$\frac{q^*}{L} = \frac{q(z)}{L-z} \rightarrow q(z) = \frac{(L-z)}{L}\, q^*$$

$$\boxed{q(z) = -\frac{q^*}{L}\cdot z + q^*} \qquad (1)$$

O TAMBIÉN:

$$q(z) = m z + b \qquad \begin{cases} b = \text{ORDENADA AL ORIGEN} = + q^* \\ m = -\dfrac{q^*}{L} = \text{PENDIENTE} \end{cases}$$

$$q(z) = -\frac{q^*}{L} z + q^*$$

• ESFUERZO DE CORTE:

$$(2) \quad q_y(z) = -\frac{dQ_y(z)}{dz} \rightarrow dQ_y(z) = -q_y(z)\cdot dz$$

$$Q_y(z) = -\int_L q_y(z)\cdot dz = -\int \left(-\frac{q^*}{L} z + q^*\right) dz$$

$$Q_y(z) = -\left[-\frac{q^*}{L}\frac{z^2}{2} + q^* z + C_1\right] \longrightarrow$$

NOTA

$$Q_y(z) = \frac{q^*}{2L} z^2 - q^* z + C_1 \qquad (3)$$

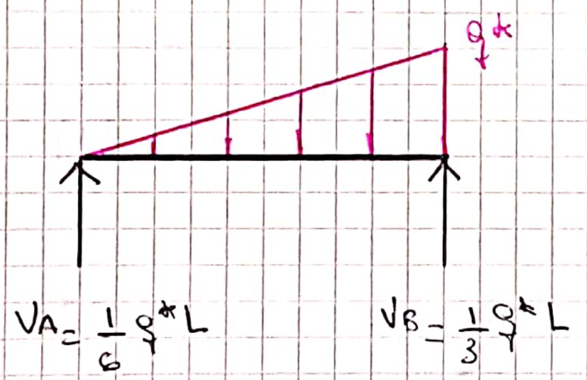
- MOMENTO FLECTOR:

$$Q_y(z) = \frac{dM_x(z)}{dz} \quad (4) \longrightarrow dM_x(z) = Q_y(z) \cdot dz$$

$$M_x(z) = \int_z Q_y(z)\, dz = \int \left(\frac{q^*}{2L} z^2 - q^* z + C_1 \right) dz$$

$$M_x(z) = \frac{q^*}{6L} z^3 - \frac{q^*}{2} z^2 + C_1 z + C_2 \qquad (4)$$

- CONDICIONES DE BORDE:



$$\sum M_{Fi}^{A} = 0 \qquad q^* \frac{L}{2} \cdot \frac{2}{3} L - V_B L = 0$$

$$\frac{1}{3} q^* L^2 - V_B L = 0$$

$$V_B = \frac{1}{3} q^* L \qquad (5a)$$

$$\sum M_{Fi}^{B} = 0 \qquad - q^* \frac{L}{2} \cdot \frac{1}{3} L + V_A L = 0$$

$$V_A = \frac{1}{6} q^* L \qquad (5b)$$

$$\begin{cases} Q_y(z=0) = +\frac{1}{3} q^* L & (6a) \\ Q_y(z=L) = -\frac{1}{6} q^* L & (6b) \end{cases}$$

$$\begin{cases} M_x(z=0) = 0 & (7a) \\ M_x(z=L) = 0 & (7b) \end{cases}$$

NOTA

HOJA 03/04

FECHA

- RESOLUCIÓN DE LAS ECUACIONES (3) Y (4):

$$Q_y(z=0) = \frac{1}{3} q^* L - \frac{q^*}{2L} \cdot 0 - q^* \cdot 0 + C_1$$

$$\boxed{C_1 = \frac{1}{3} q^* L} \quad (8a)$$

$$M_x(z=0) = \frac{q^*}{6L} \cdot 0 - \frac{q^*}{2} \cdot 0 + C_1 \cdot 0 + C_2 = 0.$$

$$\boxed{C_2 = 0} \quad (8b)$$

FINALMENTE:

$$\boxed{Q_y(z) = \frac{q^*}{2L} z^2 - q^* z + \frac{1}{3} q^* L} \quad (9)$$

VERIFICANDO:

$$Q_y(z=0) = \frac{1}{3} q^* L$$

$$Q_y(z=L) = \frac{q^* L}{2} - q^* L + \frac{1}{3} q^* L = -\frac{1}{6} q^* L$$

$$\boxed{M_x(z) = \frac{q^*}{6L} z^3 - \frac{q^*}{2} z^2 + \frac{q^* L}{3} z} \quad (10)$$

$$M_x(z=0) = 0.$$

$$M_x(z=L) = \frac{q^*}{6\cancel{L}} L^{\cancel{3}2} - \frac{q^*}{2} L^2 + \frac{q^* L^2}{3} = 0$$

NOTA

• Momento máximo:

$$Q_y(z') = 0 = \frac{q^*}{2L} z^2 - q^* z + \frac{1}{3} q^* L$$

$$0 = \frac{1}{2L} z^2 - z + \frac{L}{3}$$

$$z_{1,2} = \frac{-(-1) \pm \sqrt{1 - 4 \cdot \frac{1}{2L} \cdot \frac{L}{3}}}{2 \cdot \frac{1}{2L}} = \frac{1 \pm \sqrt{1 - \frac{2}{3}}}{\frac{1}{L}}$$

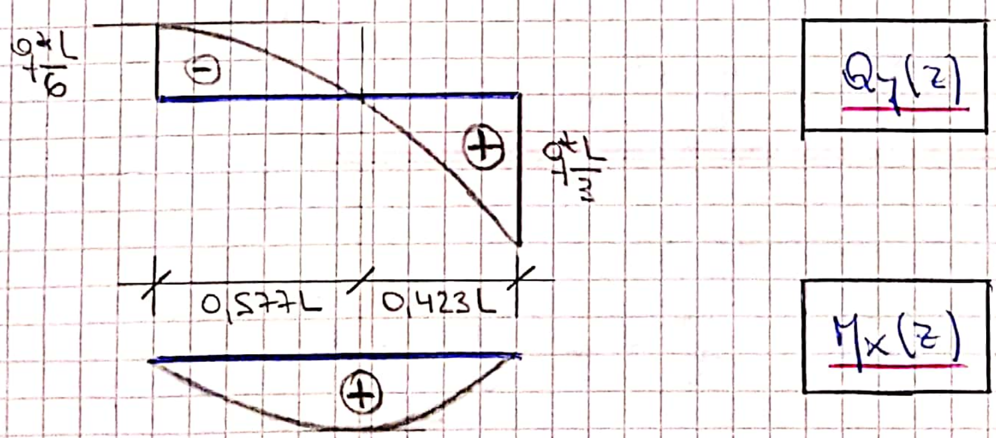
$$z_1 = \left(1 + \sqrt{\frac{1}{3}}\right) \cdot L = 1{,}577\,L$$ ← No es posible por ser mayor que 1.

$$\underline{z_2 = \left(1 - \sqrt{\frac{1}{3}}\right) L = 0{,}423\,L}$$

$$M_{x\text{-máx}}(z = 0{,}423L) = \frac{q^*}{6L}(0{,}423L)^3 - \frac{q^*}{2}(0{,}423L)^2 + \frac{q^* L}{3}(0{,}423L)$$

$$M_{x\text{-máx}}(z = 0{,}423L) = 0{,}0126\, q^* L^2 - 0{,}0895\, q^* L^2 + 0{,}141\, q^* L^2$$

$$\underline{M_{x\text{-máx}}(z = 0{,}423L) = 0{,}0641\, q^* L^2}$$



$$M_{máx} = 0{,}0641\, q^* L^2$$

NOTA