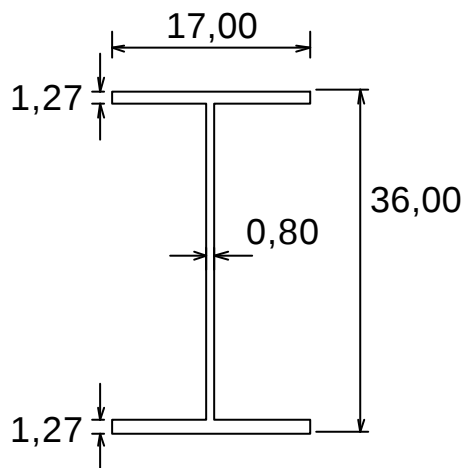


EJERCICIO N° 4 - G6

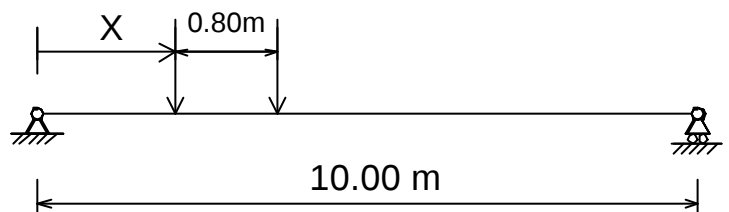
Para la viga de la figura 1, cuya sección transversal se muestra en la figura 2, se pide:

- Determinar los valores de "x" que dan lugar al máximo momento flector y al máximo esfuerzo cortante, indicando los valores de dichos esfuerzos.
- Determinar el máximo valor de las cargas P, cuando se adopta el criterio de Von-Mises de plastificación. Para ello se evaluarán las tensiones normales y las tangenciales con todo rigor.

$$\sigma_f = 2600 \text{ kp/cm}^2$$

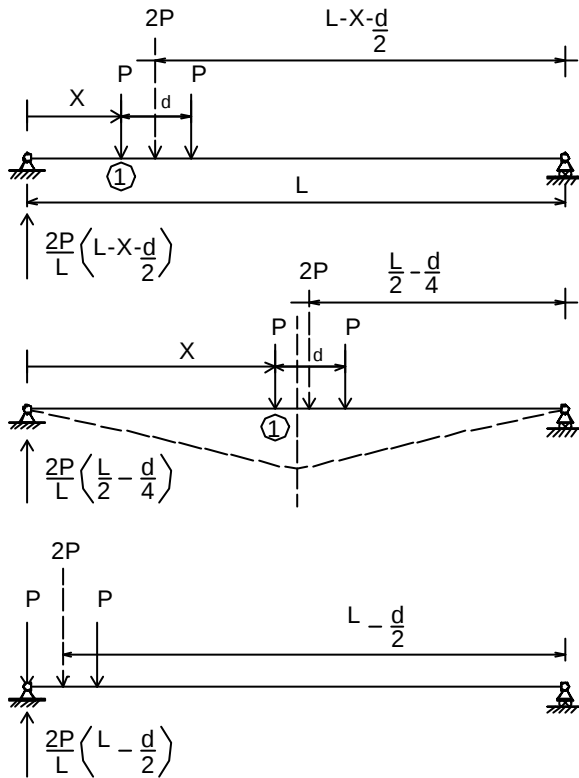


(Cotas en cm)



SOLUCION

a)



$$M^1 = \frac{2P}{L} \left(L - x - \frac{d}{2} \right) x$$

$$\frac{\partial M'}{\partial x} = 0 = L - 2x - \frac{d}{2} = 0$$

$$x = \frac{L}{2} - \frac{d}{4}$$

$$M_{\max} = \frac{2P}{L} \left(\frac{L}{2} - \frac{d}{4} \right) x$$

$$M_{\max} = \frac{2P}{L} \left(\frac{L}{2} - \frac{d}{4} \right) \left(\frac{L}{2} - \frac{d}{4} \right)$$

$$M_{\max} = \frac{2P}{L} \left(\frac{L}{2} - \frac{d}{4} \right)^2 = \frac{2P}{10m} (5 - 0,2)^2 = M_{\max} = 460,8 P \text{ [Kp-cm]}$$

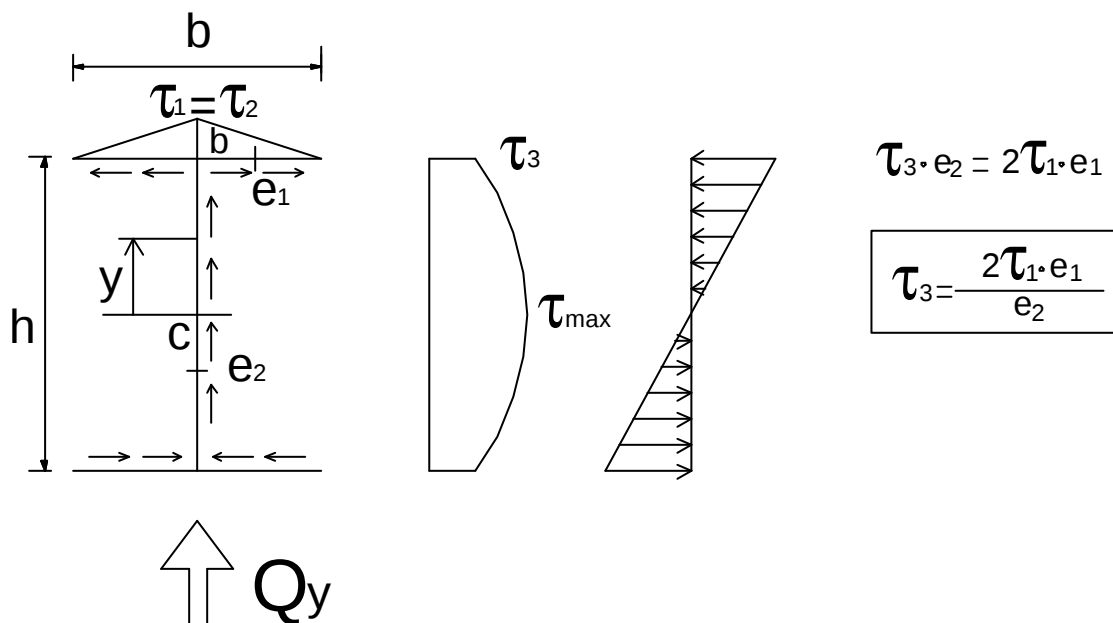
$$\therefore \text{El } M_{\max} \longrightarrow x = \frac{L}{2} - \frac{d}{4}$$

$$\text{El } Q_{\max} \longrightarrow \text{para } x = 0 \Rightarrow Q_{\max} = \frac{2P}{L} \left(L - \frac{d}{2} \right)$$

$$Q_{\max} = 1,92 P \text{ [Kp]}$$

b) Diagrama de Tensiones

b.1. Sección de Máximo momento flector



$$t_1 = \frac{Q_y}{I_z \times e_1} \left(\frac{b}{2} \times e_1 \times \frac{h}{2} \right) \Rightarrow \boxed{t_1 = \frac{1}{4} b h \frac{Q_y}{I_z}}$$

$$t_3 = 2 \left(\frac{1}{24} b h \frac{Q_y}{I_z} \right) \frac{e_1}{e_2} \Rightarrow \boxed{t_3 = \frac{1}{2} b h \frac{Q_y}{I_z} \times \frac{e_1}{e_2}}$$

$$t^{bc} = \frac{Q_y}{I_z \times e_2} \left[b \times e_1 \times \frac{h}{2} + \left(\frac{h}{2} - y \right) e_2 \times \frac{1}{2} \left(y + \frac{h}{2} \right) \right]$$

$$t^{bc} = \frac{Q_y}{I_z \times e_2} \left[b \times e_1 \times \frac{h}{2} + \frac{e_2}{2} \left(\frac{h^2}{4} - y^2 \right) \right]$$

$$t^{bc} = \frac{1}{2} b h \frac{Q_y}{I_z} \frac{e_1}{e_2} + \frac{Q_y}{2 I_z} \left(\frac{h^2}{4} - y^2 \right)$$

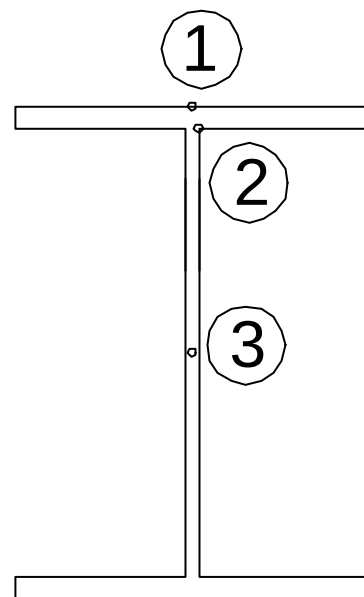
$$\boxed{t_{\max}^{bc} = t_3 + \frac{Q_y h^2}{8 I_z}}$$

$$I_z = \frac{1}{12} b h^3 - \frac{1}{2} (b - e_2) (h - 2e_1)^3$$

$$I_z = \frac{1}{12} [17 \times 36^3 - (17 - 0,8) 836 - 2 \times 1,27^3]$$

$$\boxed{I_z = 15523,83 \text{ cm}^4}$$

$$Q_y = \frac{2P}{L} \left(\frac{L}{2} - \frac{d}{4} \right) = \frac{2P}{10} \left(5 - \frac{0,8}{4} \right) = 0,96P \quad [\text{Kp}]$$



Reemplazando valores: $\tau_{pto\ 1} = 0$

$$t_{pto2} = t_3 = \frac{1}{2} \times 17 \times 36 \times \frac{0,96P}{15523,83} \times \frac{1,27}{0,8} = 0,03P$$

$$t_{pto3} = t_{max} = 0,03P + \frac{0,96P(36)^2}{8 \times 15523,83} = 0,04P$$

Para el pto. 1:

$$s_e = s = \frac{460,8P \times 18}{15523,83} = 0,53P \quad [\text{Kp/cm}^2]$$

$$0,53P = 2600 \Rightarrow \boxed{P = 5 \text{ Mp}}$$

Para el pto 2:

$$s_c = \sqrt{\approx (0,53P)^2 + 3(0,03P)^2} = 0,53P \approx Pto1$$

Para el pto 3:

$$\sigma_c = \sigma_3 \tau_{max} = \sqrt{3} 0,04P = 2600 \Rightarrow \boxed{P = 37,5 \text{ Mp}}$$

b.2 Sección de máximo esfuerzo cortante

$$Q_y = Q_{max} = 1,92P \quad [\text{Kp}]$$

$$\tau_{max} = \tau_3 + \frac{Q_y}{8I_z} \times h^2 = \frac{1}{2} \times 17 \times 36 \times \frac{1,92P}{15523,83} \times \frac{1,27}{0,8} + \frac{1,92P}{8 \times 15523,83} (36)^2 = 0,08P \quad [\text{Kp/cm}^2]$$

$$t_c = \sqrt{3} t_{max} \Rightarrow 0,14P = 2600 \Rightarrow \boxed{P = 18,6 \text{ Mp}}$$

$\therefore$ Máximo $P = 5 \text{ Mp}$