



Ayudantía 5  
23 de abril 2015

**Problema 1.** Calcule la carga admisible  $q_{adm}$  para la viga de la figura 1(A420-270). No considere instabilidad de la viga.

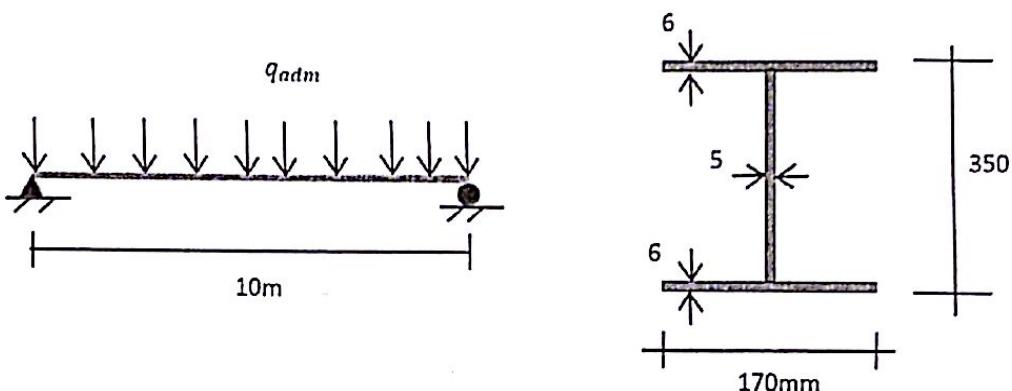


Figura 1

**Problema 2.** La viga de la figura 2 está formada por cuatro piezas de madera (Pino Radiata Seco G1) iguales. Las piezas están unidas por clavos espaciados a una distancia  $s$ . (i) Determine las dimensiones de las piezas a unir para que la viga resista las solicitudes especificadas en la figura 2. (ii) Especifique la ubicación de los clavos y su espaciamiento (Considere resistencia al corte del clavo igual a 100kgf). No considere instabilidad lateral.

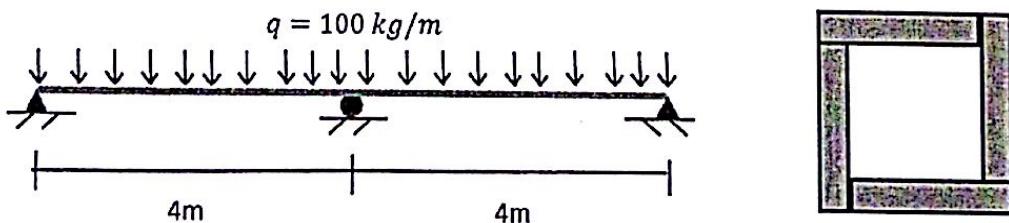
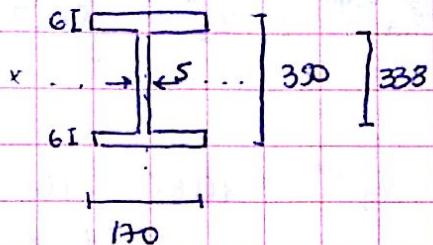
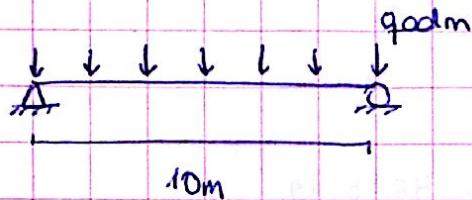


Figura 2

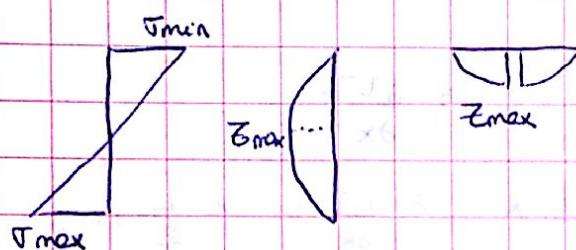
# Ayudante 5 Diseño

P1) A 42-27

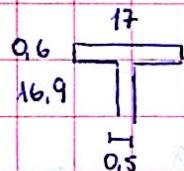


$$I_x = \frac{33,8^3 \cdot 0,5}{12} + 2 \left( \frac{17 \cdot 0,6^3}{12} + 17 \cdot 0,6 \cdot \left( \frac{35}{2} - \frac{0,6}{2} \right)^2 \right)$$

$$I_x = 1960,43 \text{ cm}^4$$



$$Q_x = \int y \cdot dA = \sum \bar{y} \cdot A =$$



$$Q_x = 6,9 \cdot 0,5 \cdot \left( \frac{16,9}{2} \right) + 17 \cdot 0,6 \cdot \left( 16,9 + \frac{0,6}{2} \right) = 246,8 \text{ cm}^3$$

$$\sigma_y = 2700$$

$$\sigma_{adm} = 0,6 \sigma_y = 1620 \text{ kg/cm}^2$$

$$z_{adm} = 0,4 \sigma_y = 1080 \text{ kg/cm}^2$$

→ Por flexión

$$\sigma = \frac{M \cdot y}{I} \Rightarrow M_{v}^{adm} = \frac{\sigma_{adm} \cdot I_x}{(h/2)}$$

$$M_{v}^{adm} = \frac{1620 \cdot 1960,43}{(35/2)} = 181480 \text{ kg-cm}$$

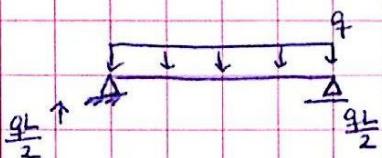
→ Por corte

$$Z = \frac{V \cdot Q}{b \cdot I}$$

$$Z_y^{\text{adm}} = \frac{V_y^{\text{adm}} \cdot Q(y)}{b(y) \cdot I}$$

$$V_y^{\text{adm}} = 1080 - 1960,43 \cdot 0,5 = 4288,74$$

246,8



$$V = q \cdot x - \frac{qL}{2} \quad \Rightarrow \quad \frac{\partial V}{\partial x} =$$

$$M = -\frac{q x^2}{2} + \frac{qL \cdot x}{2} \quad \Rightarrow \quad \frac{\partial M}{\partial x} = x = \frac{L}{2}$$

$$V_{\max} = \frac{qL}{2}$$

$$M_{\max} = \frac{qL^2}{8}$$

→ flexión

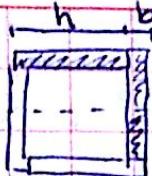
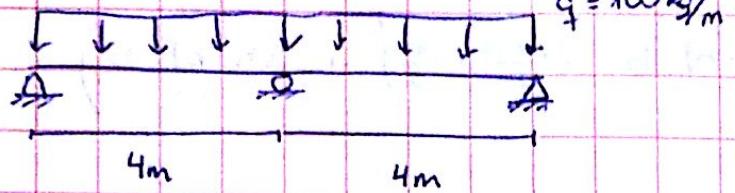
$$q_{\text{adm}} = \frac{8 \cdot M_y^{\max}}{L^2} = \frac{8 \cdot 1,81}{10^2} = 0,145 \text{ ton/m}$$

→ Contre

$$q_{\text{adm}} = \frac{2 \cdot V_y^{\text{adm}}}{L} = \frac{2 \cdot 4,28}{10} = 0,858 \text{ ton/m}$$

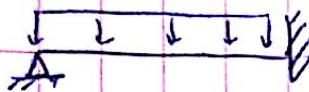
$$q_{\text{adm}} = 0,145 \rightarrow \text{control de flexión.}$$

P2)

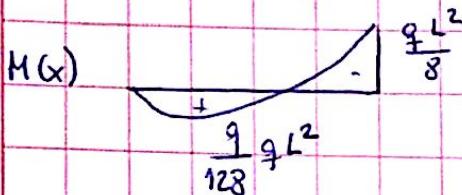


$$I_b = \frac{b}{2} \cdot \frac{(h-b)}{2}$$

(B2.14)

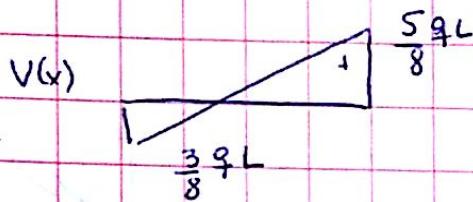


• Soluciones



$$L = 4 \text{ m}$$

$$q = 100 \text{ kg/m}$$



$$M^{\text{dus}} = \frac{100 \cdot 4^2}{8} = 20000 \text{ kg-cm}$$

$$V^{\text{dus}} = \frac{5}{8} \cdot 100 \cdot 4 = 250 \text{ kg}$$

$$\delta_{\max} = \frac{q \cdot L^4}{185 EI}$$

• Resistencia. (M8)

$$\circ \sigma_f^{\text{adm}} = 75 \text{ kg/cm}^2$$

$$K_H = 1 - (H_s - 12) \cdot \Delta R = 1 \quad H_s = 12.$$

$$\circ Z_f^{\text{adm}} = 7 \text{ kg/cm}^2$$

$$K_0 = 0.9 \rightarrow \text{cargas permanentes.}$$

$$\bullet E_f = 90000 \text{ kg/cm}^2$$

$$K_n = \left( \frac{90}{n} \right)^{1/5} < 1$$

$$K_r = 1$$

$$\sigma_f^{\text{adm}} = K_H \cdot K_0 \cdot K_n \cdot \sigma_f^{\text{adm}}$$

$$1 \cdot 0.9 \cdot \left( \frac{q}{h} \right)^{1/5} \cdot 75 = 67.5 \cdot \left( \frac{q}{h} \right)^{1/5}$$

$$Z_f^{\text{adm}} = K_H \cdot K_0 \cdot K_r \cdot Z_t^{\text{adm}}$$

$$1 \cdot 0.9 \cdot 1 \cdot 7 = 6.3 \frac{\text{kg}}{\text{cm}^2}$$

$$I_x = 2 \left( \frac{(h+b) - b^3}{12} + (h+b) \cdot b \cdot \left( \frac{h+b}{2} - \frac{b}{2} \right)^2 + \frac{(h-b)^3 \cdot b}{12} \right)$$

$$\sigma_{adm} = 67,5 \cdot \left( \frac{9}{b+h} \right)^{1/5} = \frac{20000}{I_x} \cdot \left( \frac{h+b}{2} \right)$$

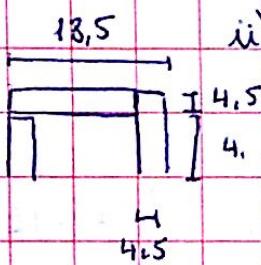
considerando  $b = 2'' \rightarrow 4,5 \text{ cm}$   
 $h = 6'' \rightarrow 13,69 \text{ cm} \approx 14 \text{ cm}$

uso "x 6"

$$\rightarrow I_x = 3255 \text{ cm}^2$$

$$\sigma_{f,adm} = 58,4 \text{ kg/cm}^2$$

chequeando i) flexión  $\sigma = \frac{20000 \cdot 9,25}{3255} = 56,88 \text{ kg/cm}^2 < 58,4 \text{ kg/cm}^2$

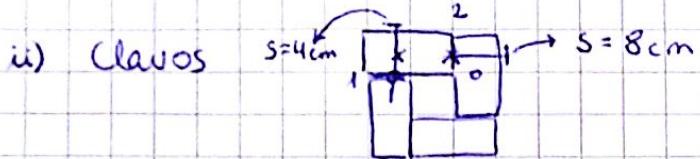
ii) corte  $Q = 2 \cdot \left( \frac{4,75 \cdot 4,75 \cdot 4,5}{2} \right) + \left( 4,75 + \frac{4,5}{2} \right) \cdot 18,5 \cdot 4,5$   
  
 $= 633,5 \text{ cm}^2$

$$Z = \frac{250 \cdot 633,5}{(4,5 \cdot 2) \cdot 3255} = 5,4 \text{ kg/cm}^2 < 6,3 \quad \checkmark$$

iii) sección abultada

$$\delta = \frac{9L^4}{185EI} = \frac{100 \cdot 4^4 \cdot 100^3}{185 \cdot 90000 \cdot 3255} = 0,47 \text{ cm}$$

$$A^{adm} = \frac{L}{300} = \frac{400}{300} = 1,33 > \delta \quad \checkmark$$



•

$$Q = 18,5 \cdot 14,5 \cdot \left( \frac{4,5}{2} + 4,75 \right) = 582,75 \text{ cm}^3$$

$$\bar{V} = \frac{V_{\text{clavo}}}{q} \cdot s = \frac{V_{\text{I}}}{q} \cdot Q \cdot s \leq V^{\text{adm}}$$

$$s_1 < \frac{V_{\text{clavo}}^{\text{adm}} \cdot I}{V_{\text{I}} \cdot Q} = \frac{100 \cdot 3255}{\left(\frac{250}{2}\right) \cdot 582,75}$$

$$s_1 \leq 4,46 \text{ cm}$$

$$s_1 = 4 \text{ cm.}$$

•

$$Q = 9,5 \cdot 4,5 \cdot \left( 4,75 + \frac{4,5}{2} \right) = 299,25 \text{ cm}^3$$

$$s_2 \leq \frac{100 \cdot 3255}{\left(\frac{250}{2}\right) \cdot 299,25} = 8,7 \text{ cm}$$

$$s_2 = 8 \text{ cm}$$