



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 inestabilidad de la viga.

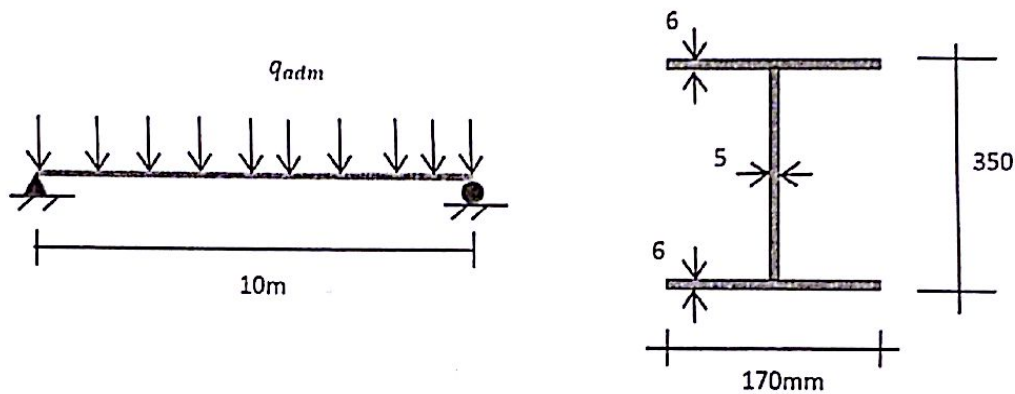


Figura 1

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 solicitaciones especificadas en la figura 2. (ii) Especifique la ubicación de los clavos y su espaciamiento (Considere resistencia al corte del clavo igual a 100 kgf). No considere inestabilidad lateral.

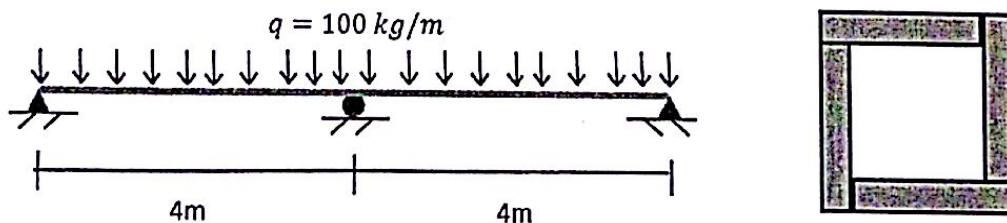
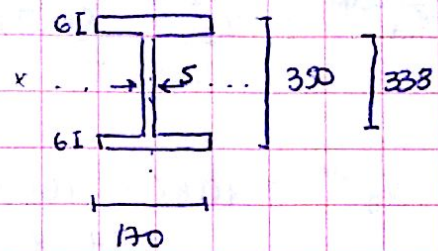
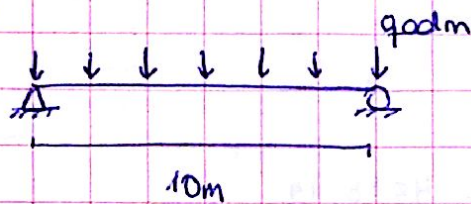


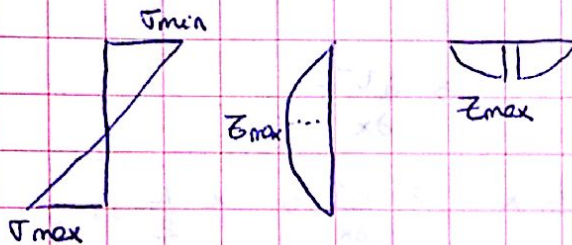
Figura 2

P1 A 42-27

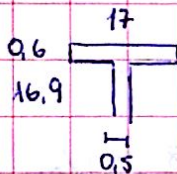


$$I_x = \frac{33.8^3 \cdot 0.5}{12} + 2 \left(\frac{17 \cdot 0.6^3}{12} + 17 \cdot 0.6 \cdot \left(\frac{35}{2} - \frac{0.6}{2} \right)^2 \right)$$

$$I_x = 1960.43 \text{ cm}^4$$



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



$$Q_x = 16.9 \cdot 0.5 \cdot \left(\frac{16.9}{2} \right) + 17 \cdot 0.6 \cdot \left(16.9 + \frac{0.6}{2} \right)$$

$$= 246.8 \text{ cm}^3$$

$$\sigma_y = 2700$$

$$\sigma_{adm} = 0.6 \sigma_y = 1620 \text{ kg/cm}^2$$

$$\tau_{adm} = 0.4 \sigma_y = 1080 \text{ kg/cm}^2$$

→ Por flexión

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

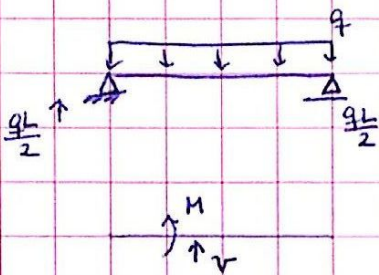
$$M_v^{adm} = \frac{1620 \cdot 1960.43}{(35/2)} = 181480 \text{ kg-cm}$$

→ Por corte

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

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

$$V_y^{adm} = \frac{1080 - 1960,43 \cdot 0,5}{246,8} = 4288,74$$



$$V = q \cdot x - \frac{qL}{2} \Rightarrow \frac{\partial V}{\partial x} = 0$$

$$M = -\frac{q}{2}x^2 + \frac{qL}{2}x \Rightarrow \frac{\partial M}{\partial x} = 0 \Rightarrow x = \frac{L}{2}$$

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

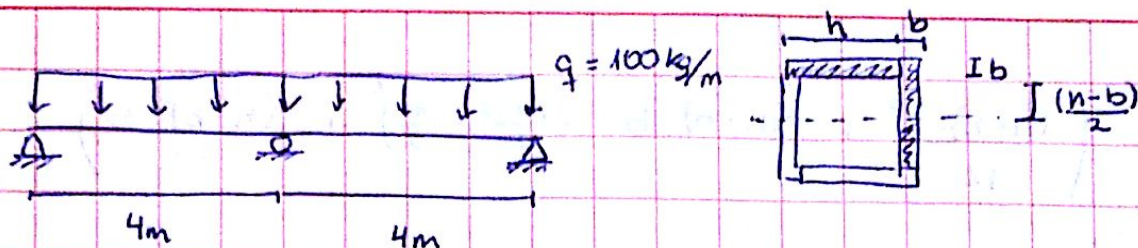
$$M_{max} = \frac{qL^2}{8}$$

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

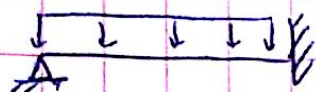
→ corte $q_{adm} = \frac{2 \cdot V_y^{adm}}{L} = \frac{2 \cdot 4,28}{10} = 0,858 \text{ ton/m}$

$q_{adm} = 0,145 \rightarrow \text{controla flexión}$

P2]



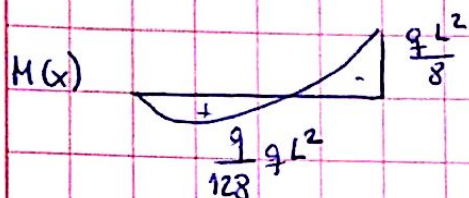
(B2.14)



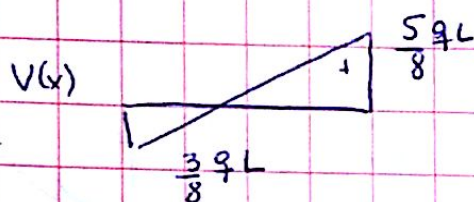
• Soluciones

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

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



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



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

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

• Resistencia. (M8)

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

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

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

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

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

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

$$K_r = 1$$

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

$$1 \cdot 0.9 \cdot \left(\frac{9}{h} \right)^{1/5} \cdot 75 = 67.5 \cdot \left(\frac{9}{h} \right)^{1/5}$$

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

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

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

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

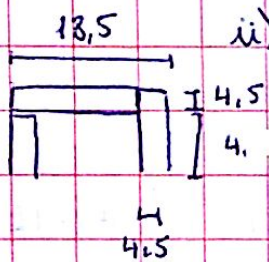
considerando $b = 2'' \rightarrow 4,5 \text{ cm}$
 $h = 6'' \rightarrow 13,69 \text{ cm} \approx 14 \text{ cm}$

Use $4'' \times 6''$

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

$$\sigma_{F adm} = 58,4 \text{ Kg/cm}^2$$

Chequeando i) flexão $\sigma = \frac{20000 \cdot 9,25}{3255} = 56,88 \text{ Kg/cm}^2 < 58,4 \text{ Kg/cm}^2$ ✓



ii) conte

$$Q = 2 \cdot \left(\frac{4,75}{2} \cdot 4,75 \cdot 4,5 \right) + \left(4,75 + \frac{4,5}{2} \right) \cdot 18,5 \cdot 4,5$$

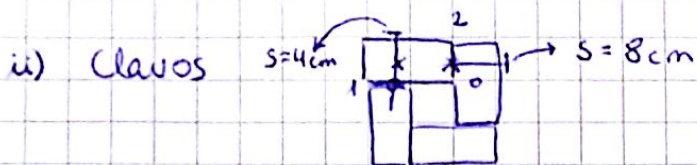
$$= 633,5 \text{ cm}^2$$

$$\tau = \frac{250 \cdot 633,5}{(4,5 \cdot 2) \cdot 3255} = 5,4 \text{ Kg/cm}^2 < 6,3 \text{ ✓}$$

iii) servidão

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

$$A_{adm} = \frac{L}{300} = \frac{400}{300} = 1,33 > \delta \text{ ✓}$$



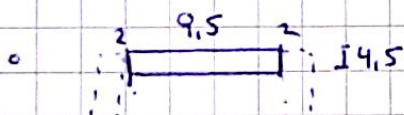
$$Q = 18,5 \cdot 4,5 \cdot \left(\frac{4,5}{2} + 4,75 \right) = 582,75 \text{ cm}^3$$

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

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

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

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



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

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

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