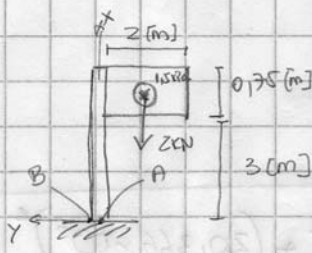


CONTROL #3 (PRIMAVERA 2008)

PAUTA



$$\phi_e = 100 \text{ mm}$$

$$\phi_i = 80 \text{ mm}$$

SOL:

$$F_{\text{viento}} = F_v = 1,5 \times 10^3 \times 2 \times 0,75 = 2,25 \times 10^3 \text{ [N]}$$

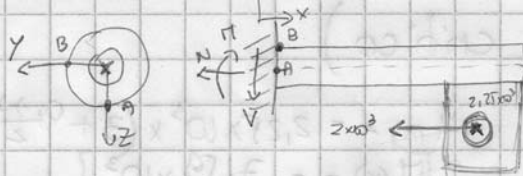
$$F_{\text{señal}} = 2 \times 10^3 \text{ [N]}$$

$$\phi_e = 0,1 \text{ (m)}$$

$$\phi_i = 0,08 \text{ (m)}$$

• Punto A

Plano (x-y)



$$M(x) = -2 \times 10^3 \times (1 + 0,05)$$

$$M(x) = -2 \times 10^3 \times (1,05)$$

$$M(x) = -2,1 \times 10^3 \text{ [Nm]}$$

$$N = -2 \times 10^3 \text{ [N]}$$

$$T = 2,25 \times 10^3 \times 1,05$$

$$T = 2,3625 \times 10^3 \text{ [Nm]}$$

$$\sigma_{\phi} = \frac{N}{A} = - \frac{2 \times 10^3 \times 4}{\pi \times 0,1^2 + \pi \times 0,08^2} = - \frac{2 \times 10^3}{0,0129} = -155038,76 \text{ [Pa]}$$

$$\sigma_f = 0$$

$$\tau_f = 0$$

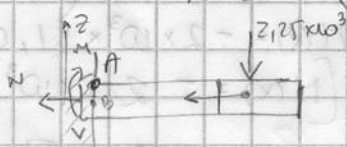
$$\tau_T = \frac{T \cdot r}{J} = \frac{2,3625 \times 10^3 \times \frac{0,1}{2}}{\frac{\pi}{32} (0,1^4 - 0,08^4)} = \frac{236125}{1,16 \times 10^{-5}}$$

$$\Rightarrow [\sigma_T = 20,366 \times 10^6 \text{ [Pa]}]$$

$$\begin{aligned}\sigma_{1,2} &= \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} \\ &= \frac{-0,16 \times 10^6}{2} \pm \sqrt{\left(\frac{0,16 \times 10^6}{2}\right)^2 + (20,366 \times 10^6)^2} \\ &= -0,08 \times 10^6 \pm \sqrt{6,4 \times 10^9 + 4,15 \times 10^{14}} \\ &= -0,08 \times 10^6 \pm 20,366 \times 10^6\end{aligned}$$

$$\Rightarrow \begin{cases} \sigma_1 = 20,286 \times 10^6 \\ \sigma_2 = -20,446 \times 10^6 \end{cases} \quad \begin{cases} \sigma_{\max} = 20,366 \times 10^6 \end{cases}$$

* Plano x-z (El mas critico)



$$\begin{aligned}M(x) &= -2,25 \times 10^3 \times \left(3 + 0,75 \frac{x}{2}\right) \\ [M(x) &= -7,59 \times 10^3] \\ [N &= -2 \times 10^3] \\ [T &= 2,36 \times 10^3]\end{aligned}$$

$$\Rightarrow \sigma_{T/c} = -0,16 \times 10^6$$

$$\sigma_f = -\frac{\tau_{12}}{I_z} = \frac{7,59 \times 10^3 \times \frac{0,1}{2}}{\frac{\pi}{64} (0,1^4 - 0,08^4)} = \frac{759}{5,79 \times 10^{-6}}$$

$$\Rightarrow [\sigma_f = 131,09 \times 10^6 \text{ [Pa]}]$$

$$[\sigma_T = 20,366 \times 10^6 \text{ [Pa]}]$$

$$\therefore \sigma_x = 131,09 \times 10^6 - 0,16 \times 10^6 = 130,93 \times 10^6$$

$$\Rightarrow \sigma_{1,2} = \frac{130,93 \times 10^6}{2} \pm \sqrt{\left(\frac{130,93 \times 10^6}{2}\right)^2 + (20,366 \times 10^6)^2}$$

$$\sigma_{1,2} = 65,465 \times 10^6 \pm 68,56 \times 10^6$$

$$\Rightarrow \left[\begin{array}{l} \sigma_1 = 134,025 \times 10^6 \text{ [Pa]} \\ \sigma_2 = -3,085 \times 10^6 \text{ [Pa]} \end{array} \right] \left[\begin{array}{l} \sigma_{\max} = 68,56 \times 10^6 \end{array} \right]$$

* NO ES NECESARIO QUE SE ANALICEN AMBOS PLANOS. Si el alumno identifica el más crítico inmediatamente, estaría bien.

• **Punto B**

* Plano x-y
(el más crítico)

$$\left[\begin{array}{l} \sigma_{T/c} = -0,16 \times 10^6 \end{array} \right]$$

$$\sigma_f = \frac{2,1 \times 10^3 \times 0,1/2}{\frac{\pi}{64} (0,1^4 - 0,08^4)} = \frac{210}{5,79 \times 10^{-6}}$$

$$\left[\sigma_f = 36,27 \times 10^6 \right]$$

$$\left[\sigma_T = 20,366 \times 10^6 \text{ [Pa]} \right]$$

$$\sigma_x = 36,27 \times 10^6 - 0,16 \times 10^6 = 36,11 \times 10^6$$

$$\Rightarrow \sigma_{1,2} = \frac{36,11 \times 10^6}{2} \pm \sqrt{\left(\frac{36,11 \times 10^6}{2}\right)^2 + 4,15 \times 10^{14}}$$

$$\sigma_{1,2} = 18,055 \times 10^6 \pm 27,22 \times 10^6$$

$$\rightarrow \left[\begin{array}{l} \sigma_1 = 45,28 \times 10^6 \text{ [Pa]} \\ \sigma_2 = -9,17 \times 10^6 \text{ [Pa]} \end{array} \right] \left[\begin{array}{l} \sigma_{\max} = 27,22 \times 10^6 \end{array} \right]$$

* Del plano x-z se infiere que no hay σ_f (pues $y=0$) entonces los est. ppales serían menores.

Círculo Mohr PUNTO crítico

• Ponto A - plano xz

$$\text{Centro} = \frac{\sigma_x + \sigma_y}{2} = 65,465 \times 10^6$$

$$\tau_{\text{res x}} = 68,56 \times 10^6$$

$$\sigma_1 = 134,025 \times 10^6$$

$$\sigma_2 = -3,095 \times 10^6$$

$\Rightarrow$

