UNIVERSIDAD MAYOR DE SAN SIMÓN
FACULTAD DE CIENCIAS Y TECNOLOGÍA

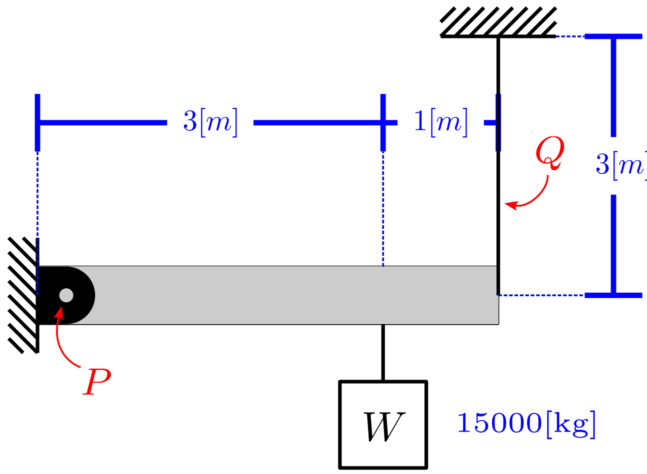
PRACTICA No. 2

Estudiante:
Caballero Burgoa, Carlos Eduardo.
Carrera:
Ingeniería Electromecánica.

Docente:
Ing. Guido Gómez Ugarte.

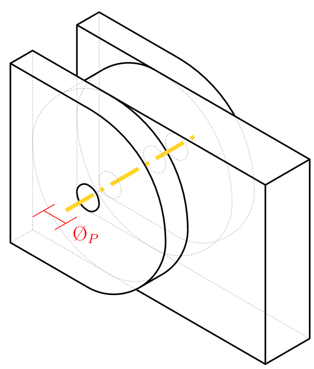
Fecha de entrega: 30 de Septiembre del 2022.

PROBLEMA 1:

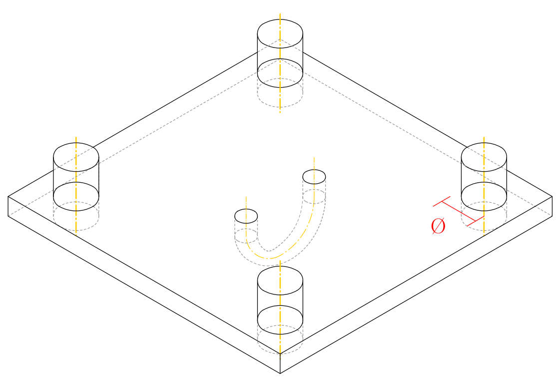


Hallar:

1. Reacciones.
2. Ø del pasador P (SAE1010, $\sigma_f = 2100[kg/cm^2]$, $n = 2$).



3. Ø del cable Q (SAE1040, $\sigma_f = 4200[kg/cm^2]$, $n = 2$).
4. Ø de los pernos de anclaje (SAE1020, $\sigma_f = 2500[kg/cm^2]$, $n = 2$).

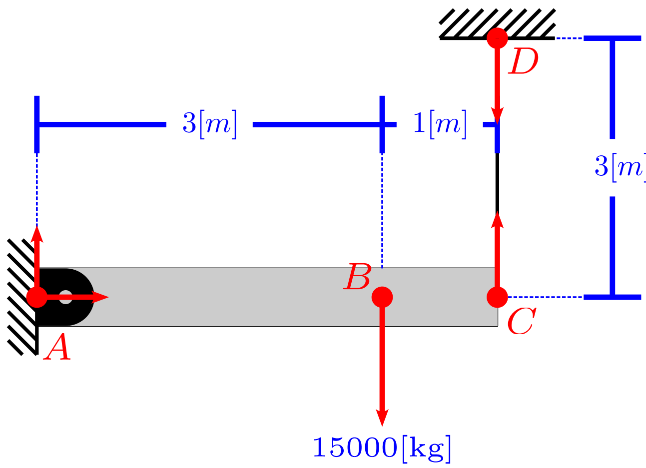


Solución:

Sistema no concurrente:
Se plantean las ecuaciones de equilibrio:

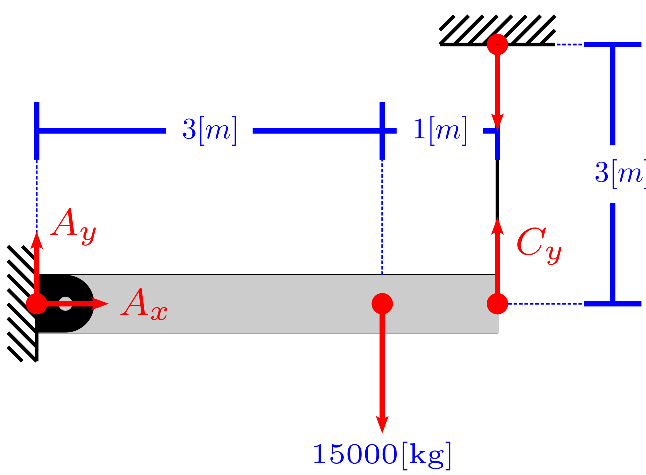
$$\sum F_x = 0$$
$$\sum F_y = 0$$

Se consideran los siguientes puntos para el calculo de momentos:



$$\sum M_A = 0$$
$$\sum M_B = 0$$
$$\sum M_C = 0$$

Variables: A_x, A_y, C_y.



$\sum F_x = 0$:

$$A_x = 0$$

$\sum F_y = 0$:

$$A_y - 15000 + C_y = 0$$
$$A_y + C_y = 15000$$

$\sum M_A = 0$:

$$15000(3) - C_y(4) = 0$$
$$4C_y = 45000$$
$$C_y = 11250$$

$\sum M_B = 0$:

$$A_y(3) - C_y(1) = 0$$
$$3A_y - C_y = 0$$

$\sum M_C = 0$:

$$A_y(4) - 15000(1) = 0$$
$$4A_y = 15000$$
$$A_y = 3750$$

$$\boxed{\begin{aligned} A_x &= 0[\text{kg}] \\ A_y &= 3750[\text{kg}] \\ C_y &= 11250[\text{kg}] \end{aligned}}$$

Por tanto:

$$\boxed{\text{Sistema isoestático}}$$

Ø del pasador P (Tensión cortante):

$$\tau \leq \bar{\tau}$$
$$\frac{F}{2A} \leq \frac{0.5\sigma_f}{n}$$
$$\frac{F}{2(\frac{\pi}{4}\text{Ø}^2)} \leq \frac{0.5\sigma_f}{n}$$
$$\sqrt{\frac{n\,F(4)}{2\,\pi(0.5)\sigma_f}} \leq \text{Ø}$$
$$\sqrt{\frac{4\,n\,F}{\pi\sigma_f}} \leq \text{Ø}$$
$$\sqrt{\frac{4(2)(3750)}{\pi(2100)}} \leq \text{Ø}$$
$$2.1324[cm] \leq \text{Ø}$$

$$\boxed{\begin{aligned} &\text{Ø} \geq 21.324[mm] \\ &\text{Ø} = \frac{7''}{8} \end{aligned}}$$

Ø del cable Q (Tensión de tracción):

$$\sigma \leq \bar{\sigma}$$
$$\frac{F}{A} \leq \frac{\sigma_f}{n}$$
$$\frac{F}{\frac{\pi}{4}Ø^2} \leq \frac{\sigma_f}{n}$$
$$\sqrt{\frac{n\,F(4)}{\pi\sigma_f}} \leq Ø$$
$$\sqrt{\frac{4\,n\,F}{\pi\sigma_f}} \leq Ø$$
$$\sqrt{\frac{4(2)(11250)}{\pi(4200)}} \leq Ø$$
$$2.6117[cm] \leq Ø$$

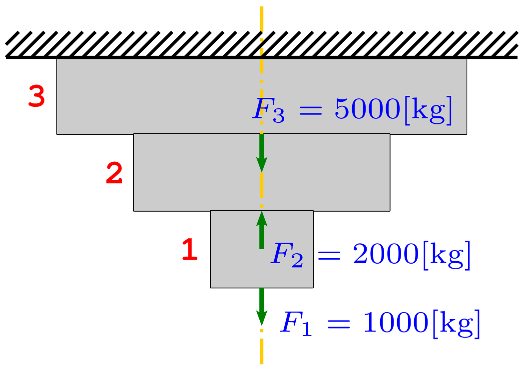
$$\boxed{\begin{array}{l} Ø \geq 26.117[mm] \\ Ø = 1\frac{1}{16}'' \end{array}}$$

Ø de los pernos de anclaje (Tensión de tracción):

$$\tau \leq \bar{\tau}$$
$$\frac{F}{4A} \leq \frac{\sigma_f}{n}$$
$$\frac{F}{4(\frac{\pi}{4}Ø^2)} \leq \frac{\sigma_f}{n}$$
$$\sqrt{\frac{n\,F}{\pi\sigma_f}} \leq Ø$$
$$\sqrt{\frac{2(11250)}{\pi(2500)}} \leq Ø$$
$$1.6926[cm] \leq Ø$$

$$\boxed{\begin{array}{l} Ø \geq 16.926[mm] \\ Ø = \frac{11}{16}'' \end{array}}$$

PROBLEMA 2:



Hallar:

1. $\varnothing_1$, $\varnothing_2$, $\varnothing_3$ (SAE1020, $\sigma_f = 2500[kg/cm^2]$, $n = 2$).

Solución:

$\varnothing_1$ (Tensión de tracción):

$$\sigma \leq \bar{\sigma}$$
$$\frac{F}{A} \leq \frac{\sigma_f}{n}$$
$$\frac{F}{\frac{\pi}{4}\varnothing^2} \leq \frac{\sigma_f}{n}$$
$$\sqrt{\frac{4\,n\,F}{\pi\sigma_f}} \leq \varnothing$$
$$\sqrt{\frac{4(2)(1000)}{\pi(2500)}} \leq \varnothing$$
$$1.0093[cm] \leq \varnothing$$

$$\boxed{\begin{array}{l} \varnothing \geq 10.093[mm] \\ \varnothing = \dfrac{13''}{32} \end{array}}$$

$\varnothing_2$ (Tensión de compresión):

$$\sigma \leq \bar{\sigma}$$
$$\frac{F}{A} \leq \frac{2\,\sigma_f}{n}$$
$$\frac{F}{\frac{\pi}{4}\varnothing^2} \leq \frac{2\,\sigma_f}{n}$$

$$\sqrt{\frac{4\,n\,F}{2\,\pi\sigma_f}} \leq \text{Ø}$$

$$\sqrt{\frac{4(2)(2000)}{2\,\pi(2500)}} \leq \text{Ø}$$

$$1.0093[cm] \leq \text{Ø}$$

$$\boxed{\begin{array}{l} \text{Ø} \geq 10.093[mm] \\ \text{Ø} = \dfrac{13''}{32} \end{array}}$$

Ø_3 (Tensión de tracción):

$$\sigma \leq \bar{\sigma}$$

$$\frac{F}{A} \leq \frac{\sigma_f}{n}$$

$$\frac{F}{\frac{\pi}{4}\text{Ø}^2} \leq \frac{\sigma_f}{n}$$

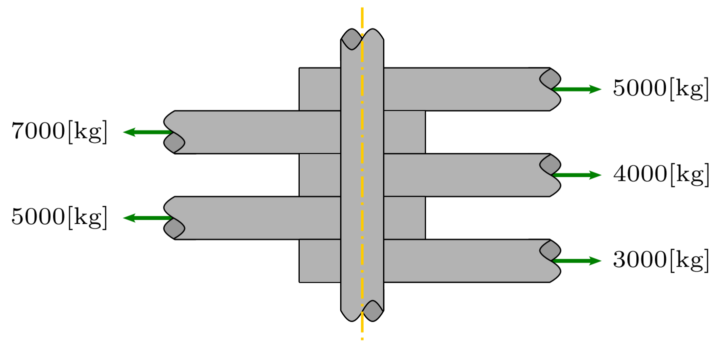
$$\sqrt{\frac{4\,n\,F}{\pi\sigma_f}} \leq \text{Ø}$$

$$\sqrt{\frac{4(2)(5000)}{\pi(2500)}} \leq \text{Ø}$$

$$2.2568[cm] \leq \text{Ø}$$

$$\boxed{\begin{array}{l} \text{Ø} \geq 22.568[mm] \\ \text{Ø} = \dfrac{15''}{16} \end{array}}$$

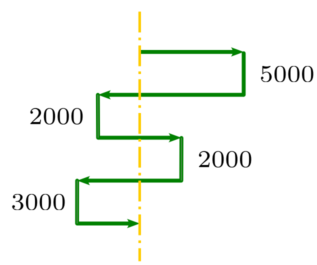
PROBLEMA 3:



Hallar:

1. Ø (SAE1010, $\sigma_f = 2100[kg/cm^2]$, $n = 2$).

Solución:



$$\tau \leq \bar{\tau}$$

$$\frac{F}{4A} \leq \frac{0.5\sigma_f}{n}$$

$$\frac{F}{\frac{\pi}{4}\text{Ø}^2} \leq \frac{0.5\sigma_f}{n}$$

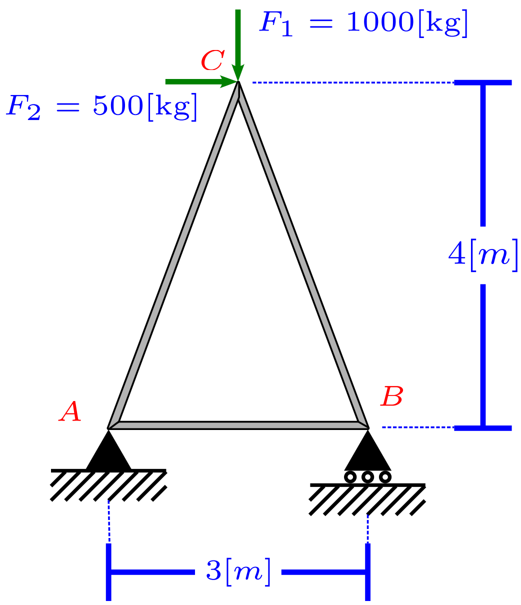
$$\sqrt{\frac{4\,n\,F}{\pi(0.5)\sigma_f}} \leq \text{Ø}$$

$$\sqrt{\frac{4(2)(5000)}{\pi(0.5)(2100)}} \leq \text{Ø}$$

$$3.4823[cm] \leq \text{Ø}$$

$$\boxed{\begin{aligned} &\text{Ø} \geq 34.823[mm] \\ &\text{Ø} = 1\frac{3}{8}'' \end{aligned}}$$

PROBLEMA 4:



Hallar:

1. Reacciones.
2. Ø del pasador A ($\sigma_f = 4200[kg/cm^2]$, $n = 2$).
3. $Ø_{AB}$, $Ø_{BC}$, $Ø_{CA}$ ($\sigma_f = 2100[kg/cm^2]$, $n = 2$).

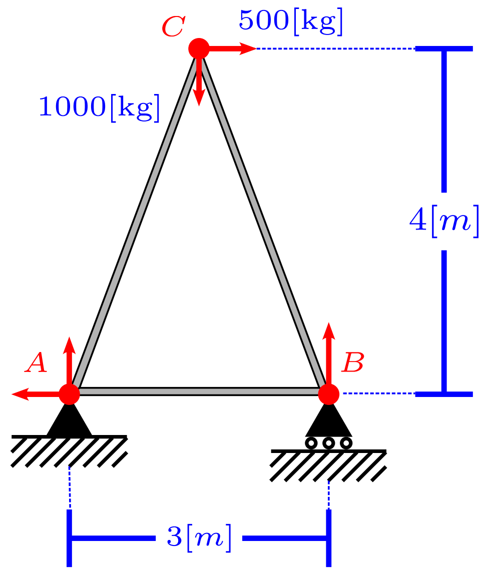
Solución:

Sistema no concurrente:
Se plantean las ecuaciones de equilibrio:

$$\sum F_x = 0$$

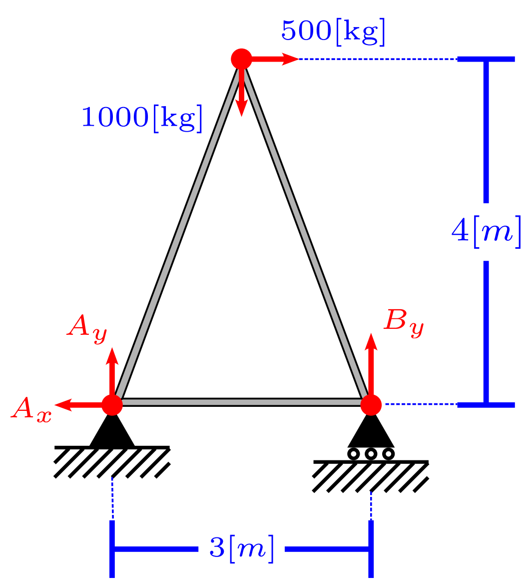
$$\sum F_y = 0$$

Se consideran los siguientes puntos para el calculo de momentos:



$$\sum M_A = 0$$
$$\sum M_B = 0$$
$$\sum M_C = 0$$

Variables: A_x, A_y, B_y.



$\sum F_x = 0$:

$$A_x - 500 = 0$$
$$A_x = 500$$

$\sum F_y = 0$:

$$A_y + B_y - 1000 = 0$$
$$A_y + B_y = 1000$$

$\sum M_A = 0$:

$$500(4) + 1000(1.5) - B_y(3) = 0$$
$$3B_y = 3500$$
$$B_y = 1166.7$$

$\sum M_B = 0$:

$$A_y(3) + 500(4) - 1000(1.5) = 0$$
$$3A_y = -500$$
$$A_y = -166.67$$

$\sum M_C = 0$:

$$A_x(4) + A_y(1.5) - B_y(1.5) = 0$$
$$4A_x + 1.5A_y - 1.5B_y = 0$$

$$\boxed{\begin{array}{l} A_x = 500[\text{kg}] \\ A_y = -166.67[\text{kg}] \\ B_y = 1166.7[\text{kg}] \end{array}}$$

Por tanto:

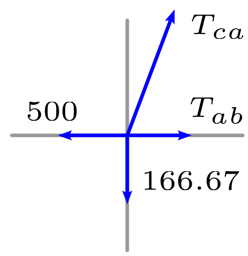
$$\boxed{\text{Sistema isoestático}}$$

Ø del pasador A (Tensión cortante):

$$\tau \leq \bar{\tau}$$
$$\frac{F}{2A} \leq \frac{0.5\sigma_f}{n}$$
$$\frac{F}{2(\frac{\pi}{4}Ø^2)} \leq \frac{0.5\sigma_f}{n}$$
$$\sqrt{\frac{n\,F(4)}{2\,\pi(0.5)\sigma_f}} \leq Ø$$
$$\sqrt{\frac{4\,n\,\sqrt{A_x^2 + A_y^2}}{\pi\sigma_f}} \leq Ø$$
$$\sqrt{\frac{4(2)\sqrt{500^2 + 166.67^2}}{\pi(4200)}} \leq Ø$$
$$0.5653[cm] \leq Ø$$

$$\boxed{\begin{array}{l} \varnothing \geq 5.653[mm] \\ \varnothing = \dfrac{15''}{64} \end{array}}$$

$\varnothing_{AB}$, $\varnothing_{BC}$, $\varnothing_{CA}$:
Se hallan las tensiones:



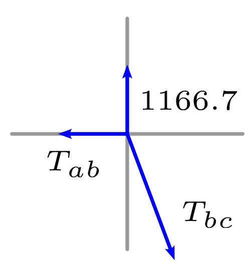
$$\sum F_x = 0$$

$$T_{ab} + T_{ca}\left(\frac{1.5}{\sqrt{1.5^2+4^2}}\right) = 500$$

$$\sum F_y = 0$$

$$T_{ca}\left(\frac{4}{\sqrt{1.5^2+4^2}}\right) = 166.67$$

$$\begin{cases} T_{ca} = 178 \\ T_{ab} = 437.5 \end{cases}$$



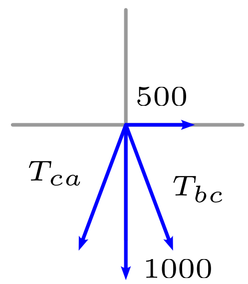
$$\sum F_x = 0$$

$$T_{bc}\left(\frac{1.5}{\sqrt{1.5^2+4^2}}\right) - T_{ab} = 0$$

$$\sum F_y = 0$$

$$T_{bc}\left(\frac{4}{\sqrt{1.5^2+4^2}}\right)=1167.7$$

$$\begin{cases} T_{bc}=1246 \\ T_{ab}=437.50 \end{cases}$$



$$\sum F_x=0$$

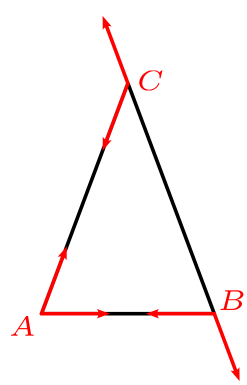
$$500+T_{bc}\left(\frac{1.5}{\sqrt{1.5^2+4^2}}\right)=T_{ca}\left(\frac{1.5}{\sqrt{1.5^2+4^2}}\right)$$

$$\sum F_y=0$$

$$1000+T_{ca}\left(\frac{4}{\sqrt{1.5^2+4^2}}\right)+T_{bc}\left(\frac{4}{\sqrt{1.5^2+4^2}}\right)=0$$

$$\begin{cases} T_{bc}=-1246 \\ T_{ca}=178 \end{cases}$$

Por tanto, las tensiones son:



Ø_{ab} (Tensión de tracción):

$$\sigma \leq \bar{\sigma}$$

$$\frac{T_{ab}}{A} \leq \frac{\sigma_f}{n}$$

$$\frac{T_{ab}}{\frac{\pi}{4}\text{Ø}^2} \leq \frac{\sigma_f}{n}$$

$$\sqrt{\frac{4\,n\,T_{ab}}{\pi\sigma_f}} \leq \text{Ø}$$

$$\sqrt{\frac{4(2)(437.5)}{\pi(2100)}} \leq \text{Ø}$$

$$0.7284[cm] \leq \text{Ø}$$

$$\boxed{\begin{array}{l} \text{Ø} \geq 7.284[mm] \\ \text{Ø} = \frac{5}{16}'' \end{array}}$$

Ø_{bc} (Tensión de compresión):

$$\sigma \leq \bar{\sigma}$$

$$\frac{T_{bc}}{A} \leq \frac{2\,\sigma_f}{n}$$

$$\frac{T_{bc}}{\frac{\pi}{4}\text{Ø}^2} \leq \frac{2\,\sigma_f}{n}$$

$$\sqrt{\frac{4\,n\,T_{bc}}{2\,\pi\sigma_f}} \leq \text{Ø}$$

$$\sqrt{\frac{4(2)(1246)}{2\,\pi(2100)}} \leq \text{Ø}$$

$$0.8692[cm] \leq \text{Ø}$$

$$\boxed{\begin{array}{l} \text{Ø} \geq 8.692[mm] \\ \text{Ø} = \frac{11}{32}'' \end{array}}$$

Ø_{ca} (Tensión de tracción):

$$\sigma \leq \bar{\sigma}$$

$$\frac{T_{ca}}{A} \leq \frac{\sigma_f}{n}$$

$$\frac{T_{ca}}{\frac{\pi}{4}\text{Ø}^2} \leq \frac{\sigma_f}{n}$$

$$\sqrt{\frac{4\,n\,T_{ca}}{\pi\sigma_f}} \leq \text{Ø}$$

$$\sqrt{\frac{4(2)(178)}{\pi(2100)}} \leq \text{Ø}$$

$$0.4646[cm] \leq \text{Ø}$$

$$\boxed{\begin{array}{l} \varnothing \geq 4.646[mm] \\ \varnothing = \dfrac{3}{16}'' \end{array}}$$

El diámetro es el máximo de los diámetros hallados:

$$\boxed{\begin{array}{l} \varnothing_{\text{max}} = max(\varnothing_{ab}, \varnothing_{bc}, \varnothing_{ca}) = 8.692[mm] \\ \varnothing_{\text{max}} = \dfrac{11}{32}'' \end{array}}$$