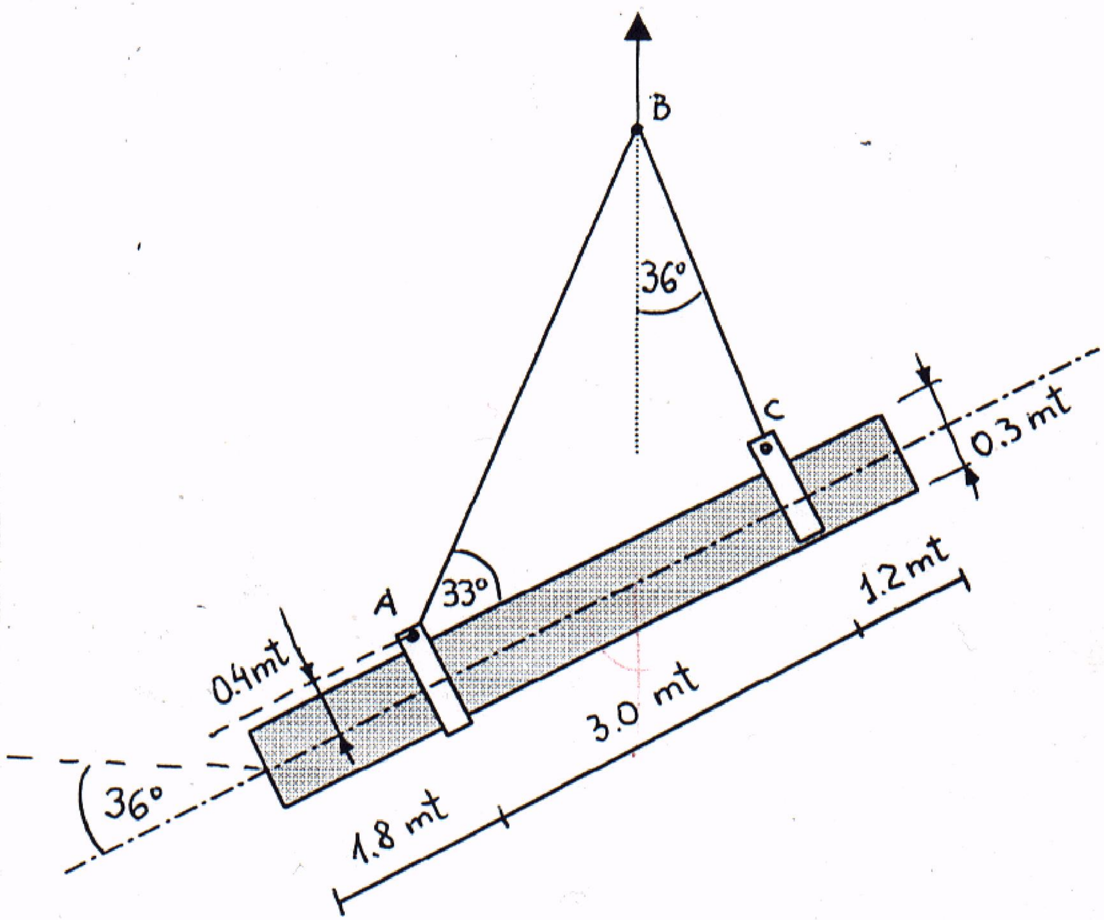
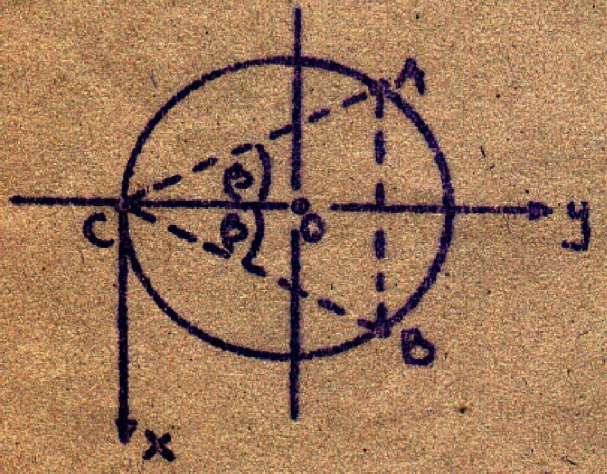
2. Un tubo de acero de 30 mm de diámetro exterior y que pesa 480 kg se sostiene mediante soportes fijados rígidamente, en la posición que se indica en la figura. Dibuje los diagramas de fuerza normal (N), fuerza cortante (V) y momento (M) para esta configuración. Las uniones A, B y C son articuladas.

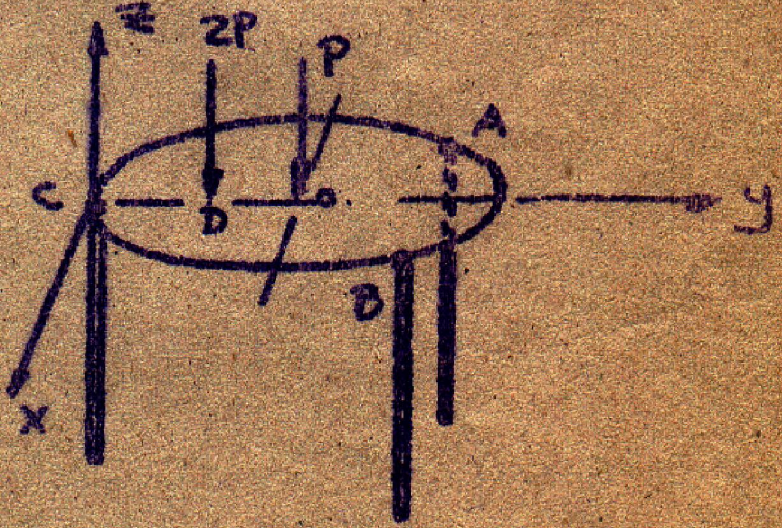


② Para el problema de la figura determinar:

a) Las reacciones en A, B y C.

b) El ángulo de inclinación de la mesa con respecto al eje y.



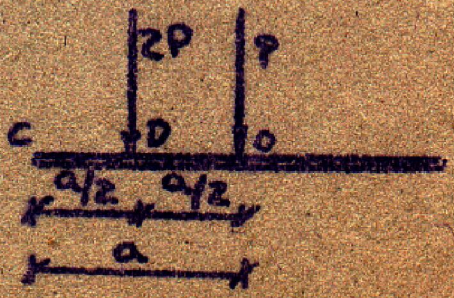


Datos para las barras:

E (módulo de Young)

ℓ (largo)

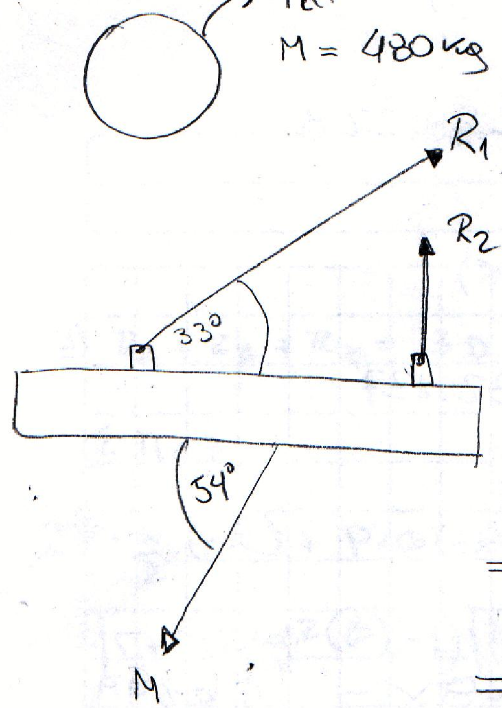
d (diámetro)



P1

$\phi_{ext} = 30\ mm$

$M = 480\ kg$



Σy:

$$R_1 \cdot sen(33) + R_2 = M \cdot \sin 54$$

Σx:

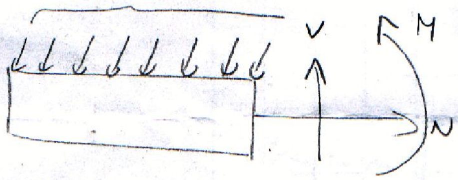
$$R_1 \cos(33) = M \cdot \cos(54)$$

$$\Rightarrow R_1 = 336,41\ [kg]$$

$$\Rightarrow R_2 = 205,106\ [kg]$$

Diagramas:

80 kg/m



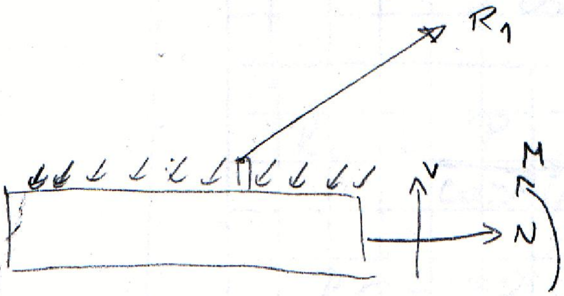
$0 \leq x < 1,8$

$$V = 80 \times \sin(54) = 64,7214 \cdot x$$

$$N = 80 \times \cos(54) = 47,0228\ x$$

$$M + 80 \cdot \sin(54) \cdot \frac{x^2}{2} = 0$$

$$M = -32,3607\ x^2$$



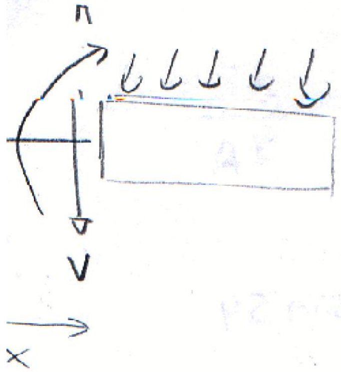
$$V = 64,7214\ x - 183,222$$

$$N = 47,0228x - 282,137$$

$$M = -32,3607\ x^2 + 183,222(x - 1,8)$$

$$+ 282,137 \times 0,4$$

$$M = -32,3607x^2 + 183,222x - 216,945$$



$$V = -64{,}7214 \cdot (6 - x)$$

$$V = 64{,}7214\,x - 388{,}328$$

$$N = -47{,}0228\,(6 - x)$$

$$N = 47{,}0228\,x - 282{,}137$$

$$M = -64{,}7214\,\frac{(6 - x)^2}{2}$$

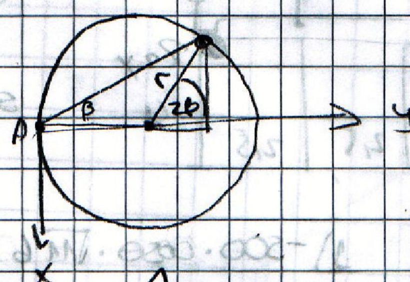
(x) kg

$$M = -32{,}3607\,x^2 + 388{,}328\,x - 1164{,}9$$

$$\cos^2(\beta) - \sin^2(\beta) = \cos(2\beta)$$
$$\cos^2(\beta) + \sin^2(\beta) = 1$$

$$2\cos^2(\beta) = 1 + \cos(2\beta)$$

1) $R_A + R_B + R_C = 3P$



ΣM_A:

$$\cancel{2}P \cdot \frac{a}{\cancel{2}}(-\hat{x}) + P \cdot a(-\hat{x})$$

$\hat{y}: r + r\cos(2\beta)$

$$+\left[r + r(2\cos^2(\beta) - 1)\right](R_A + R_B)\ \hat{x} \quad r + r(2\cos^2(\beta) - 1)$$

$= 0$

$$\cancel{r\sin(2\beta)} \cdot R_A\ \hat{y} + \cancel{r\sin(2\beta)}(-\hat{y})\ R_B = 0$$

$$R_A = R_B$$

$$2R_a \cdot \left[r + r(2\cos^2(\beta) - 1)\right] = 2Pa$$

$r = a$

$$\cancel{2}R_a \cancel{a}\left[\cancel{1} + (2\cos^2(\beta) - \cancel{1})\right] = \cancel{2}P\cancel{a}$$

$$\boxed{R_a = \frac{P}{2\cos^2(\beta)} = R_B}$$

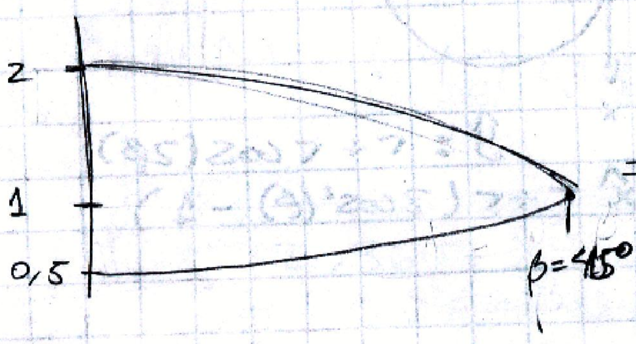
$$R_C + \frac{P}{\cos^2(\beta)} = 3P$$

$$R_C = \frac{3P\cos^2(\beta) - P}{\cos^2(\beta)}$$

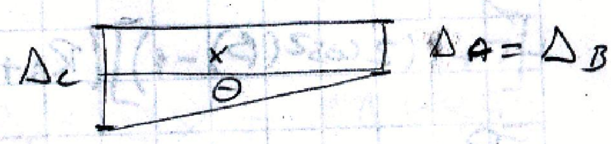
$$\boxed{R_C = P\left(3 - \frac{1}{\cos^2\beta}\right)}$$

$$\Delta = \frac{FL}{AE} \qquad \Delta_C = \frac{P\left(3 - \frac{1}{\cos^2\beta}\right) \cdot L}{\frac{\pi d^2}{4} E}$$

$$\Delta_A = \Delta_B = \frac{P \quad L}{2\cos^2\beta \cdot \frac{\pi d^2}{4} \cdot E}$$



$\Longrightarrow$



$$\theta = \mathrm{Arctg}\left(\frac{\Delta_C - \Delta_A}{x}\right) \qquad \Delta_C - \Delta_A = \frac{4LP}{\pi d^2 E}\left(3 - \frac{1}{\cos^2\beta} - \frac{1}{2\cos^2\beta}\right)$$

$x = a + a\cos(2\beta)$

$x = 2a\cos^2\beta$

$$\theta = \mathrm{Arctg}\left(\frac{\frac{4LP}{\pi d^2 E}\frac{\left(6\cos^2\beta - 2 - 1\right)}{\cancel{2}\cos^2\beta}}{\cancel{2}a\cos^2\beta}\right)$$

$$\boxed{\theta = \mathrm{Arctg}\left(\frac{4LP\left(6\cos^2\beta - 3\right)}{\pi d^2 E a \cos^4\beta}\right)}$$