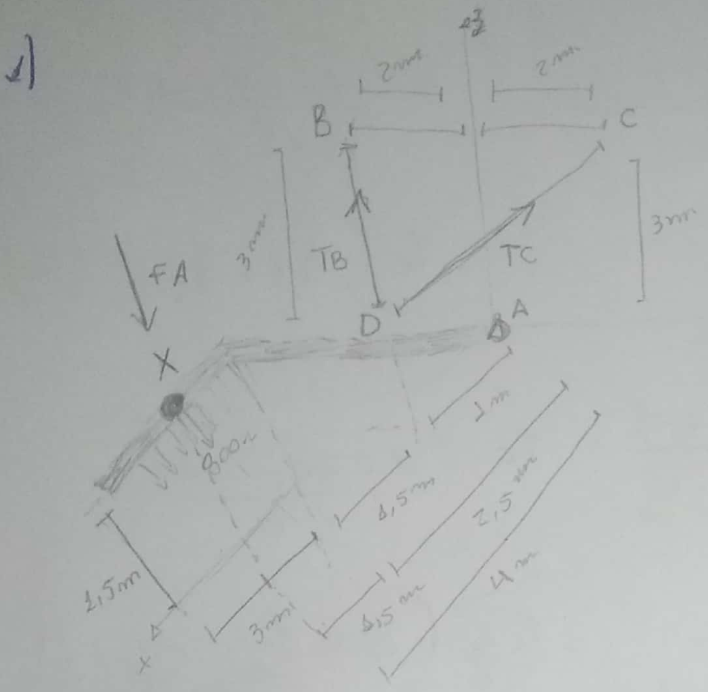
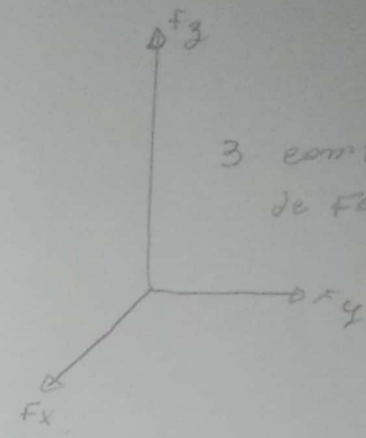
Dionatas santos Brito

1)





3 componentes de forçA

AD = D - A

Componentes / Posições

A = $0\hat{i} + 0\hat{j} + 0\hat{k}$ (origem)

B = $0\hat{i} - 2\hat{j} + 3\hat{k}$

C = $0\hat{i} + 1\hat{j} + 3\hat{k}$

D = $1\hat{i} + 0\hat{j} + 1\hat{k}$

X = $4\hat{i} + 0\hat{j} + 1{,}5\hat{k}$

distancias entre pontos

$AD = (1-0)\hat{i} + (0-0)\hat{j} + (1-0)\hat{k}$
$= 1\hat{i} + 0\hat{j} + 1\hat{k}$

$AX = (4-0)\hat{i} + (0-0)\hat{j} + (1{,}5-0)\hat{k}$
$= 4\hat{i} + 0\hat{j} + 1{,}5\hat{k}$

$DB = (0-1)\hat{i} + (-2-0)\hat{j} + (3-1)\hat{k}$
$= -1\hat{i} - 2\hat{j} + 2\hat{k}$

$DC = (0-1)\hat{i} + (+1-0)\hat{j} + (3-1)\hat{k}$
$= -1\hat{i} + 1\hat{j} + 2\hat{k}$

Com a força concentrada no ponto x, podemos calcular a força ResulTante no ponto A.

$F_{A_R} = F \cdot d$
$= 800 \cdot 3$

$\boxed{F_{A_R} = 2400\,N}$

②

calculando as trações e forças

Ⓐ $\vec{T_B} = T_B \cdot \frac{DB}{|DB|} \Rightarrow = T_B \frac{(-1\hat{i} - 2\hat{j} + 2\hat{k})}{\sqrt{1^2 + 2^2 + 2^2}} = T_B \frac{(-1\hat{i} - 2\hat{j} + 2\hat{k})}{\sqrt{9}}$

$= T_B \left(-\frac{1}{3}\hat{i}, -\frac{2}{3}\hat{j}, +\frac{2}{3}\hat{k}\right)$

Ⓑ $\vec{T_C} = T_C \cdot \frac{DC}{|DC|} \Rightarrow = T_C \cdot \frac{(-1\hat{i} + 1\hat{j} + 2\hat{k})}{\sqrt{1^2 + 1^2 + 2^2}} = T_C \cdot \frac{(-1\hat{i} + 1\hat{j} + 2\hat{k})}{\sqrt{6}}$

$= T_C \cdot \left(\frac{-1}{\sqrt{6}}\hat{i}, \frac{1}{\sqrt{6}}\hat{j}, +\frac{2}{\sqrt{6}}\hat{k}\right)$

Ⓒ $\vec{F_A} = F_{AR} \cdot (0\hat{i}, 0\hat{j}, -1k)$

①

$\vec{T_{T_B}} = AD \cdot T_B$

$= T_B \cdot \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} & \hat{i} & \hat{j} \\ 1 & 0 & 1 & 1 & 0 \\ -1 & -2 & 2 & -1 & -2 \end{vmatrix} = T_B \cdot (+2\hat{i} - 2\hat{j} - 1\hat{j} - 2k)$

$0 \quad +2\hat{i} \quad -2\hat{j} \quad 0\hat{i} \quad -1\hat{j} \quad -2k$

$= T_B(2\hat{i} - 3\hat{j} - 2k)$

$= \frac{T_B}{3}(2\hat{i} - 3\hat{j} - 2k)$

②

$\vec{T_C} = AD \cdot T_C$

$= T_C \cdot \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} & \hat{i} & \hat{j} \\ 1 & 0 & 1 & 1 & 0 \\ -1 & 1 & 2 & -1 & 1 \end{vmatrix} = T_C \cdot (-1\hat{i} - 2\hat{j} - 1\hat{j} + 1\hat{k})$

$0k \quad -1\hat{i} \quad -2\hat{j} \quad -1\hat{j} \quad 1\hat{k} \quad 0\hat{j}$

$= T_C \cdot (-1\hat{i} - 3\hat{j} + 1k)$

$= \frac{T_C}{\sqrt{6}} \cdot (-1\hat{i} - 3\hat{j} + 1\hat{k})$

... continuando

$\rightsquigarrow T_C = 5225{,}58 \rightsquigarrow \cong +\frac{12800}{\sqrt{6}}$

$$T_B = \frac{\sqrt{6}}{4} \cdot T_C$$

$$= \frac{\cancel{\sqrt{6}}}{4} \cdot \frac{+12800}{\cancel{\sqrt{6}}}$$

$$= \frac{+12800}{4}$$

$T_B = +3200\ N$ e $T_C = +5225{,}58\ N$

\# SUBSTITUINDO O VALOR DE Tc e TB NAS EQUAÇÕES "A" e "B" → Pág 2

$$\vec{T}_B = \left(-\frac{1}{3}\hat{\imath}, -\frac{2}{3}\hat{\jmath} + \frac{2}{3}\hat{k}\right) \cdot T_B$$

$$= \left(-\frac{3200}{3}\hat{\imath}, -\frac{6400}{3}\hat{\jmath} + \frac{6400}{3}\hat{k}\right) \cdot +3200$$

$$= \left(-1066{,}67\hat{\imath}; -2133{,}33\hat{\jmath}, +2133{,}33\hat{k}\right)$$

$$\vec{T}_C = \left(-\frac{1}{\sqrt{6}}\hat{\imath}, \frac{1}{\sqrt{6}}\hat{\jmath}; \frac{2}{\sqrt{6}}\hat{k}\right) \cdot T_C$$

$$= \left(-\frac{1}{\sqrt{6}}\hat{\imath}, \frac{1}{\sqrt{6}}\hat{\jmath}, \frac{2}{\sqrt{6}}\hat{k}\right) \cdot \frac{+12800}{\sqrt{6}}$$

$$= \left(-\frac{12800}{6}\hat{\imath}, +\frac{12800}{6}\hat{\jmath}, +\frac{25600}{6}\hat{k}\right)$$

$$= \left(-2133{,}33\hat{\imath}, +2133{,}3\hat{\jmath}, +4266{,}67\hat{k}\right)$$

(4)

(3)

$$T_{TA} = AX \cdot F_A \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} & \hat{i} & \hat{j} \\ 4 & 0 & -1{,}5 & 4 & 0 \\ 0 & 0 & -1 & 0 & 0 \end{vmatrix} = F_A \cdot 4\hat{j}$$

$$= F_A \cdot \quad 0 \quad 0 \quad -4\hat{j} \quad 0\hat{i} \quad 0\hat{j} \quad 0\hat{k}$$

$$= 1200 \cdot +4\hat{j}$$

$$= 9600\,(+\hat{j})$$

através das equações (1), (2), (3)

(1) $T_B = (2\hat{i}, -3\hat{j}, -2\hat{k}) \dfrac{T_B}{3}$

$$= \left(\frac{2}{3}\hat{i}, -\hat{j}, -\frac{2}{3}\hat{k}\right) \cdot T_B$$

(2) $T_C = (-1\hat{i}, -3\hat{j}, +1\hat{k}) \cdot \dfrac{T_C}{\sqrt{6}} \cdot \dfrac{\sqrt{6}}{\sqrt{6}}$

$$= \left(\frac{-1\sqrt{6}}{6}\hat{i}, -\frac{3\sqrt{6}}{6}\hat{j}, +\frac{1\sqrt{6}}{6}\right) T_C$$

(3) $T_{FA} = (0\hat{i}, +9600\hat{j}, 0)\ N$

Juntando as componentes

$$\left(\underbrace{\frac{2T_B}{3} - \frac{\sqrt{6}}{6}T_C + 0}_{\bullet}\right)\hat{i} + \left(\underbrace{-T_B - \frac{3\sqrt{6}}{6} + 9600}_{\bullet\bullet}\right)\hat{j} + \left(\underbrace{-\frac{2}{3}T_B + \frac{\sqrt{6}}{6}T_C + 0}_{\bullet\bullet\bullet}\right)\hat{k}$$

Resolvendo

• em $\hat{i}$

$$\frac{2T_B}{3} - \frac{\sqrt{6}}{6}T_C = 0 \quad \times 6$$

$$\frac{12T_B}{3} - \sqrt{6}\,T_C = 0$$

$$4T_B - \sqrt{6}\,T_C$$

$$\boxed{T_B = \frac{\sqrt{6}\,T_C}{4}}$$

| em $\hat{j}$ ••

$$-T_B - \frac{3\sqrt{6}}{6}T_C + 9600 = 0 \quad \times 6$$

$$-6T_B - 3\sqrt{6}\,T_C + 57600 = 0$$

$$-\frac{6\cdot\sqrt{6}\,T_C}{4} - 3\sqrt{6}\,T_C = -57600 \quad \times 4$$

$$-6\sqrt{6}\,T_C - 12\sqrt{6}\,T_C = -230400$$

$$T_C = -\frac{230400}{-18\sqrt{6}} = 5225{,}58\ N$$

ⓒ $= \left(0\hat{i}, 0\hat{j}, -1\hat{k}\right) \cdot F_{AR}$

$= \left(0\hat{i}, 0\hat{j}, -1\hat{k}\right) \cdot 2400$

$= \left(0\hat{i}, 0\hat{j}, -2400\hat{k}\right)\ N$

\# Encontrando as forças

$\sum F_x = 0 \qquad \sum F_y = 0 \qquad \sum F_z = 0$

Em x

$\sum F_x = 0$

$A_x + (T_B + T_C) = 0$

$A_x = -(T_B + T_C)$

$= -\left(-\frac{3200}{3} - \frac{12800}{6}\right)$

$\boxed{A_x = +3200\ N}$

Em y

$\sum F_y = 0$

$A_y + T_B + T_C = 0$

$A_y = -T_B - T_C$

$A_y = -\left(-\frac{6400}{3} + \frac{12800}{6}\right)$

$\boxed{A_y = 0\ N}$

Em z

$\sum F_z = 0$

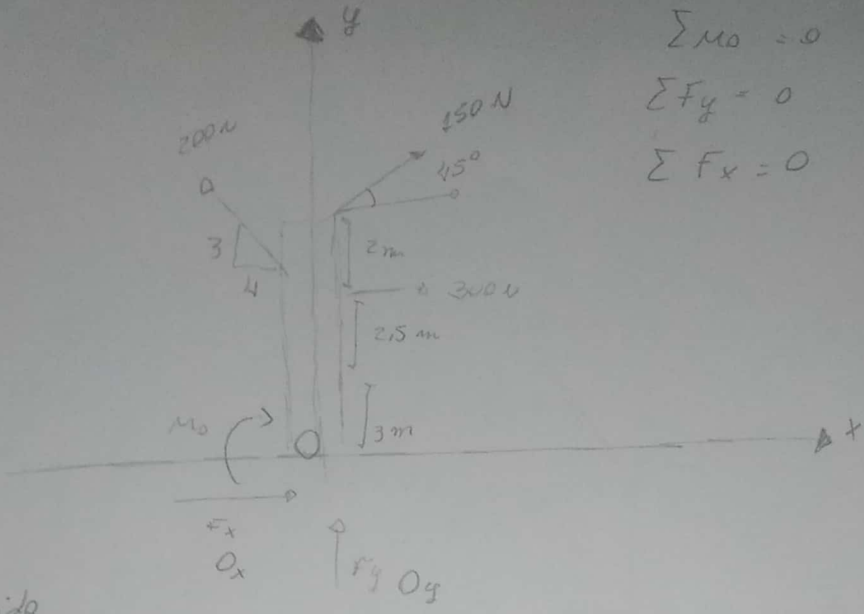
$A_z + T_B + T_C = 0$

$A_z = -T_B - T_C$

$A_z = -\left(+\frac{6400}{3} + \frac{25600}{6}\right)$

$\boxed{A_z = 6400\ N}$

② –



$\sum M_O = 0$

$\sum F_y = 0$

$\sum F_x = 0$

adotando o sentido ↻ para o momento

em x

$\circlearrowright \sum F_x = 0$

$= -300 + (200 \cdot \cos\theta) - (\cos 45^\circ \cdot 150 + O_x) = 0$

$= -300 + 200 \cdot 0,8 - \cos 45^\circ \cdot 150 + O_x = 0$

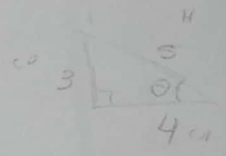
$O_x = 300 + \cos 45^\circ \cdot 150 - 200 \cdot 0,8$

$O_x = 300 + 106,06 - 160$

$\boxed{O_x = 246,6\ N}$

$sen\left(\frac{3}{5}\right) =$

$\cos\left(\frac{4}{5}\right) =$



$\theta = arctg\left(\frac{3}{4}\right) = 36,87^\circ$

$sen\,\theta = 0,6^\circ$

$\cos\theta = 0,8^\circ$

em y

$\circlearrowright \sum F_y = +200 \cdot sen\,\theta + O_y + 150 \cdot sen\,45^\circ$

$O_y = +200 \cdot 0,6 + 106,06$

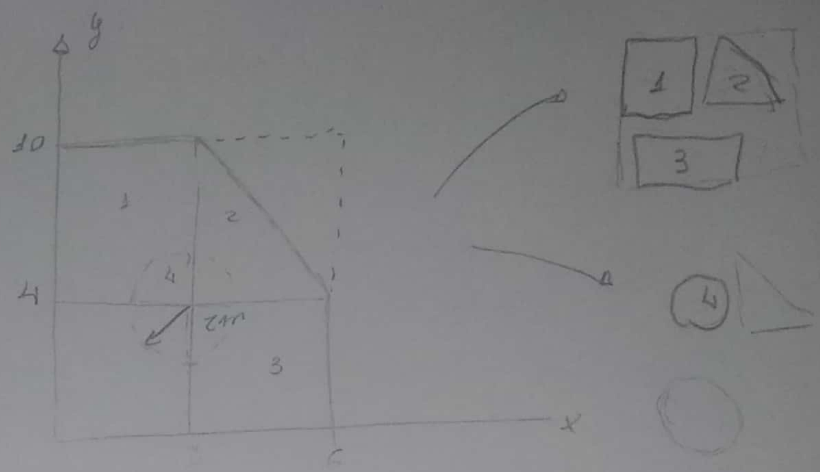
$\boxed{O = +126,06\ N}$

$\circlearrowright M_O = -150 \cos 45 \cdot 7,5 - 300 \cdot 3 + 200 \cdot \cos\theta$

$= -150 \cos 45 \cdot 7,5 - 900 + 200 \cdot 0,8$

$= \boxed{+815,49\ N}$

3_



	A (m)	$\bar{x}$	$\bar{y}$	$A\bar{x}$	$A\bar{y}$
FIGURA 1	18 m	1,5	7	27	126
FIGURA 2	9	4	6	36	54
FIGURA 3	24	3	2	72	48
FIGURA 4	12,56	3	4	-37,7	-50,27
Σ	38,434			97,30	177,74

Figura 1

$\bar{x} = \frac{3}{2} = 1,5\ m$

$\bar{y} = 4 + \frac{(10-4)}{2} = 7\ m$

$A = 6 \cdot 3 = 18\ m^2$

$\bar{x}.A = 27\ m^2$

$\bar{y}.A = 126\ m^2$

Figura 2

$\bar{x} = 4$

$\bar{y} = 6$

$A = \frac{6 \cdot 3}{2} = 9\ m^2$

$\bar{x}.A = 36\ m^2$

$y.A = 54\ m^2$

Figura 3

$\bar{x} = 3\ m$

$\bar{y} = 2\ m$

$A = 4 \times 6 = 24\ m^2$

$\bar{x}A = 72\ m^2$

$\bar{y}A = 48\ m^2$

$I_{x'} = \frac{\pi r^4}{4}$ } para circulo

$I_{y'} = 4$

$I_x = \frac{b h^3}{36}$ > para triangulo

$I_y = \frac{b^3 . h}{36}$

Figura 4

$\bar{x} = 3\ m$

$\bar{y} = 4\ m$

$A = \pi . r^2 = \pi . 2^2 = 12,56\ m$

$\bar{x}.A = -37,7\ m^2$

$\bar{y}.A = -50,27\ m^2$

$I_{x'} = \frac{b h^3}{12}$ } retangulo

$I_{y'} = \frac{b^3 . h}{12}$

momento de Inercia

$$I_x = I_x' + d_y^2 \cdot A \quad e \quad I_y = I_y' + d_x^2 A$$

FIGURA (RETANGULO 1)

$$I_{x_1} = \frac{b \cdot h^3}{12} \cdot d_y^2 \cdot A$$

$$= \frac{3 \cdot 6^3}{12} \cdot 7^2 \cdot 18 =$$

$$= 54 + 882$$

$$= 936\,m^2$$

Figura 2

$$I_{x_2} = \frac{b \cdot h^3}{12} + d_y^2 \cdot A$$

$$= \frac{3 \cdot 6^3}{36} + 9 \cdot 6^2$$

$$= 18 + 324$$

$$= 342\,m^2$$

Figura 3

$$I_{x_3} = b \cdot h^3 \cdot d_y^2 \cdot A$$

$$= \frac{6 \cdot 4^3}{12} + 2^2 \cdot 24$$

$$= 32 + 96$$

$$= 128\,m^2$$

Figura 4

$$I_{x_4} = -\frac{\pi \cdot 16}{4} + 4\pi \cdot 2^2$$

$$= 213,63\,m^2$$

somatoria $I_x = I_{x_1} + I_{x_2} + I_{x_3} - I_{x_4}$

é negativo, pois é necessario Tirar o circulo

$$= 936 + 342 + 128 - 213,63$$

$$= 1192.37\,m^2$$

... continuando

Em y

-> FORMULA $I = I_y' + dx^2 . A$

Figura 1

$$I_{y1} = \frac{6 . 3^3}{12} + 1,5^2 . 18$$

$= 13,5 + 40,5$

$= 54\ m^2$

Figura 2

$$I_{y2} = \frac{6 . 3^3}{36} + 4^2 . 9$$

$= 4,5 + 114$

$= 148,5\ m^2$

Figura 3

$$I_{y3} = \frac{4 . 6^3}{12} + 3^2 . 24$$

$= 72 + 216$

$= 288\ m^2$

Figura 4

$$I_{y4} = \frac{\pi . 2^4}{4} + 4\pi . 3^2$$

$= 125,66\ m^4$

novamente retirando a parcela do círculo 4

Somatória em y

$I_y = I_{y1} + I_{y2} + I_{y3} - I_{y4}$

$= 54 + 148,5 + 288 - 125,66$

$= 364,84\ m^2$ //

3 = 4 = mesmo triangulo

4) Questão

ΣA_i

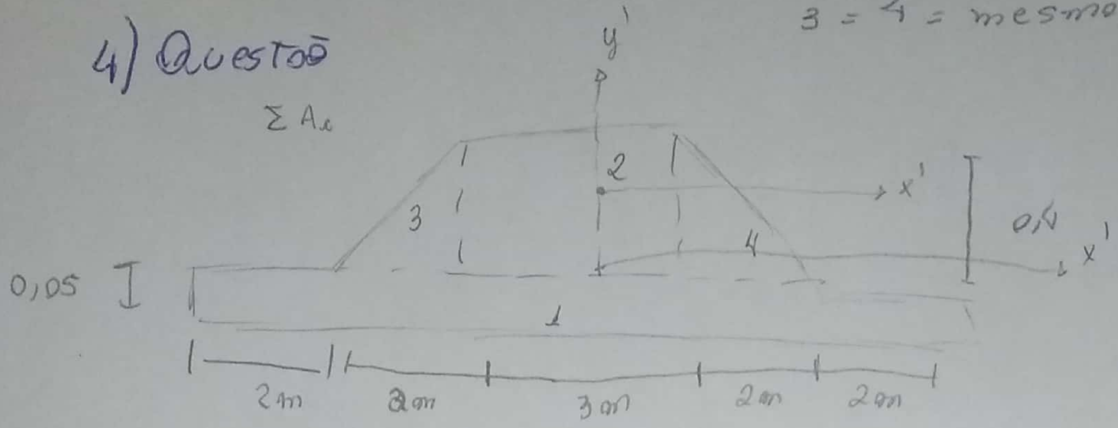


FIGURA	Y (m)	A (m²)
1	$\frac{0,05}{2}$ = 0,025	1,1 . 0,05 = 0,05
2	$0,05 + \frac{0,4}{2}$ = 0,025	0,3 x 0,4 = 0,12
3	$0,05 + \frac{1}{3} \cdot 0,04$ = 0,1833	$\frac{0,02 \cdot 0,4}{2}$ = 0,04
4	$0,05 + \frac{1}{3} \cdot 0,4$ = 0 , 18,33	$\frac{0,2 \cdot 0,4}{2}$ = 0,04

não há componente em x, pois apenas varia em y

$$\bar{Y} = \frac{(0,025 \cdot 0,055) + (0,25 \cdot 0,12) + (0,1833 \cdot 0,04) + (0,1833 \cdot 0,04)}{0,055 + 0,12 + 0,04 + 0,04}$$

$$\boxed{\bar{Y} = 0,1805\ m}$$

calculando momento de Inercia

$$I_x = I_x' + d_y^2 \cdot A$$

$$I_{x_1} = \frac{1,1 \cdot 0,05^2}{12} + (0,1805 - 0,025)^2 \cdot 0,055$$

$$= 1.341 \cdot 10^{-3}\ m^4$$

retângulo

$$I_x = \frac{b \cdot h^3}{12}$$

$$I_{x_2} = \frac{0,3 \cdot 0,4^3}{12} + (0,1805 - 0,25)^2 \cdot 0,12$$

$$I_{x_2} = 2,179 \cdot 10^{-3}\ m^4$$

Triângulo

$$I_x = \frac{b \cdot h^3}{36}$$

$$I_{x_3} = \frac{0,2 \cdot 0,4^2}{36} + (0,1805 - 0,1833)^2 \cdot 0,04$$

$$I_{x_3} = 3,558 \cdot 10^{-4}\ m^4$$

como $I_{x_3} = I_{x_4}$, o calculo sera o mesmo

$I_{x_3} = I_{x_4}$ } mesmo base, mesma altura } = mesmo Triangulo

$$I_{x_4} = 3,558 \cdot 10^{-4}\ m^4$$

somatoria

$$I_x = I_{x_1} + I_{x_2} + I_{x_3} + I_{x_4}$$

$$= 1,341 \cdot 10^{-3} + 2,179 \cdot 10^{-3} + 3,558 \cdot 10^{-4} + 3,55 \cdot 10^{-4}$$

$$= \boxed{4,2317 \cdot 10^{-3}\ m^4}$$

... continuando

encontrando em y

$$I_y = I_{y}' + dx^2 . A$$

Figura 1

$$I_{y1} = \frac{(1,1)^3 . 0,005}{12} + 0,055$$

$$= 5.55 . 10^{-3} m^4$$

$$I_{y2} = \frac{(0,3)^3 . 0,4}{12} + 0,012$$

$$= 9 . 10^{4} m^4$$

$$I_{y3} = \frac{(0,2)^3 . 0,4}{36} + (0,15 + \frac{1}{3} . 0,02^2) . 0,04$$

$$= 1,97 . 10^{-3} m^4$$

$$I_{y4} = \text{como } I_{y4} = I_{y3}$$ } ambos são Triangulos de mesma base memo altura

$$= 1,97 . 10^{-3} m^4$$

Somatoria

$$I_y = I_{y1} + I_{y2} + I_{y3} + I_{y4}$$

$$= 5,55 . 10^{-3} + 9 . 10^{-4} + 1,97 . 10^{-3} + 1,97 . 10^{-3}$$

$$= 0,01039$$

$$= 10,39 . 10^{-3} m^4$$