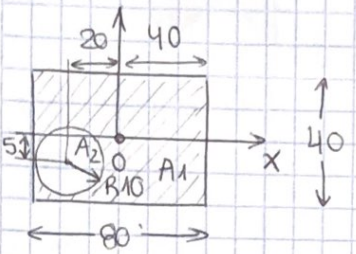


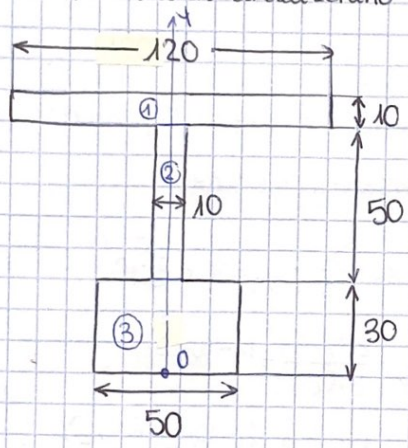
⊗ $A = A_1 - A_2$

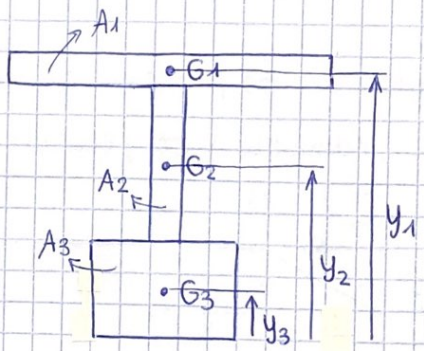
Bilatu masa-zentruaren posizioa

$$x_G = \frac{\Sigma x_i \cdot A_i}{\Sigma A_i} = \frac{0 \cdot 80 \cdot 40 - (-20)\,\pi \cdot 10^2}{80 \cdot 40 - \pi \cdot 10^2} = \boxed{2{,}1772\,m}$$

$$y_G = \frac{\Sigma y_i \cdot A_i}{\Sigma A_i} = \frac{0 \cdot 80 \cdot 40 - (-5)\,\pi \cdot 10^2}{80 \cdot 40 - \pi \cdot 10^2} = \boxed{0{,}5443\,m}$$

Kalkulatu irudiko profilaren grabitate-zentroaren posizioa eta berau gurutzatzen duten ardatzekiko inertzia-momentuak.

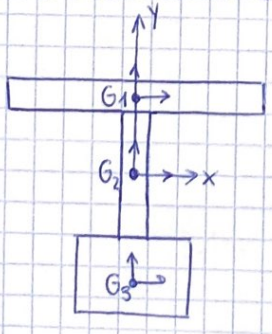




$x_G = 0$

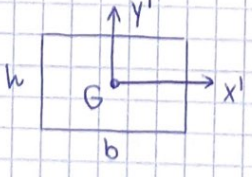
$$y_G = \frac{\Sigma y_i \cdot A_i}{\Sigma A} = \frac{\overbrace{120 \cdot 10}^{A_1} \cdot \overbrace{85}^{y_1} + 50 \cdot 10 \cdot 55 + 50 \cdot 30 \cdot 15}{1200 + 500 + 1500} = \underline{47{,}5\,mm}$$

Inertzia momentuak



$$I_X = I_{X_1} + I_{X_2} + I_{X_3}$$

$$I_Y = I_{Y_1} + I_{Y_2} + I_{Y_3}$$



$$I_{X'} = \frac{bh^3}{12}$$

$$I_{Y'} = \frac{h \cdot b^3}{12}$$

$$I_{x_1} = \underbrace{\frac{120\cdot 10^3}{12}}_{I_{x'}} + \underbrace{1200\,(85-47{,}5)^2}_{A_1\cdot d_1^2} = 1{,}7\cdot 10^6 mm^4$$

$$I_{y_1} = \frac{10\cdot 120^3}{12} + A_1\cdot 0^2 = 1{,}44\cdot 10^6 mm^4$$

$$I_{x_2} = \frac{10\cdot 50^3}{12} + 500\,(55-47{,}5)^2 = 1{,}32\cdot 10^5 mm^4$$

$$I_{y_2} = \frac{50\cdot 10^3}{12} = 4{,}16\cdot 10^3 mm^4$$

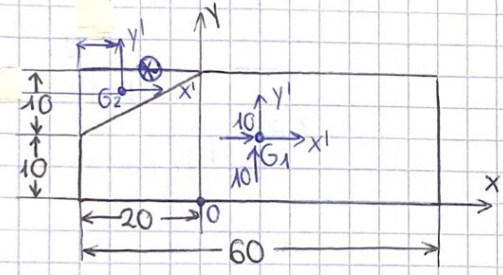
$$I_{x_3} = \frac{50\cdot 30^3}{12} + (50\cdot 30)(47{,}5-15)^2 = 1{,}7\cdot 10^6 mm^4$$

$$I_{y_3} = \frac{30\cdot 50^3}{12} = 3{,}125\cdot 10^5 mm^4$$

$$I_X = I_{x_1}+I_{x_2}+I_{x_3} = 3{,}53\cdot 10^6 mm^4$$

$$I_Y = I_{y_1}+I_{y_2}+I_{y_3} = 4{,}49\cdot 10^5 mm^4$$

X Kalkulatu irudiko profilaren grabitate-zentroaren posizioa O puntuarekiko. Ondoren, kalkulatu x eta y ardatzekiko inertzia-momentuak.



$\otimes\ x_2 = \frac{20}{3}\ ;\ y_2 = 10 + \frac{2}{3}\cdot 10$

$$x_G = \frac{\Sigma x_i\cdot A_i}{\Sigma A_i} = \frac{10\cdot 60\cdot 20 - ((-40/3)\cdot 10\cdot 20/2)}{60\cdot 20 - 10\cdot 20/2} \rightarrow$$

$x_i =$

↳ $x_G = 12{,}12 mm$

$$y_G = \frac{\Sigma y_i\cdot A_i}{\Sigma A_i} = \frac{10\cdot 60\cdot 20 - (10+20/3)\cdot(10\cdot 20)/2}{60\cdot 20 - (10\cdot 20)/2} = 9{,}4 mm$$

$$I_{x'} = \frac{b\cdot h^3}{36}$$

Inertzia-momentuak

$$I_{x_1} = \frac{60\cdot 20^3}{12} + 10^2\cdot 60\cdot 20 =$$

$$I_{y_1} = \frac{20\cdot 60^2}{12} + 10^2\cdot 60\cdot 20 =$$

$$I_{x_2} = \frac{20\cdot 10^3}{36} + \left(10+\frac{20}{3}\right)^2 - \frac{10\cdot 20}{2} =$$

$$I_{y_2} = \frac{10 \cdot 20^3}{36} + \left(-\frac{40}{3}\right)^2 \frac{10 \cdot 20}{2} =$$

$$I_x = I_{x_1} - I_{x_2}$$

$$I_y = I_{y_1} - I_{y_2}$$