CORRIGE DU SUJET 1

CORRIGE DE L'EXERCICE 1

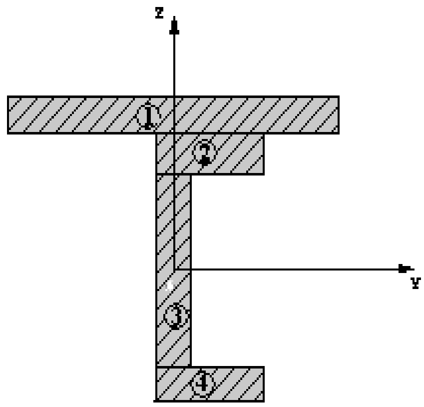
On subdivise la section en trois rectangles de 120 mm × 20 mm et un autre de 240 mm × 20 mm.

- Le centre de gravité de la section:

$$Y_G = \frac{\sum y_i S_i}{\sum S_i} = \frac{2 \times 50 \times 2400}{3 \times 120 \times 20 + 240 \times 20} = 20\text{mm}$$

$$Z_G = \frac{\sum z_i S_i}{\sum S_i} = \frac{90 \times 240 \times 20}{3 \times 120 \times 20 + 240 \times 20} = 36\text{mm}$$

- Les moments d'inertie centraux:



$$I_y = \sum I_{yi} + \sum S_i a_i^2$$
$$I_z = \sum I_{zi} + \sum S_i b_i^2$$
$$I_{yz} = \sum I_{yzi} + \sum S_i a_i b_i$$

$$I_y = \frac{20 \times 120^3}{12} + 2 \times \frac{120 \times 20^3}{12} + \frac{240 \times 20^3}{12} + 2400 \times 36^2 + 2400 \times 34^2 + 2400 \times 106^2 + 4800 \times 54^2 = 50.05 \times 10^6 \text{mm}^4$$

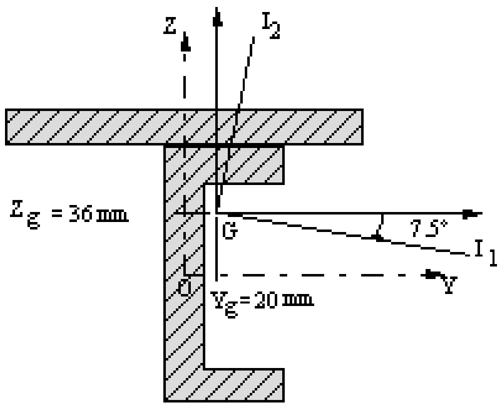
$$I_z = \frac{120 \times 20^3}{12} + 2 \times \frac{20 \times 120^3}{12} + \frac{20 \times 240^3}{12} + 2400 \times 20^2 + 2 \times 2400 \times 30^2 + 4800 \times 20^2 = 36.08 \times 10^6 \text{mm}^4$$

$$I_{yz} = 2400 \times 30 \times (-106) + 2400 \times 20 \times 36 + 2400 \times 30 \times 36 + 4800 \times 20 \times 54 = 1.87 \times 10^6 \text{mm}^4$$

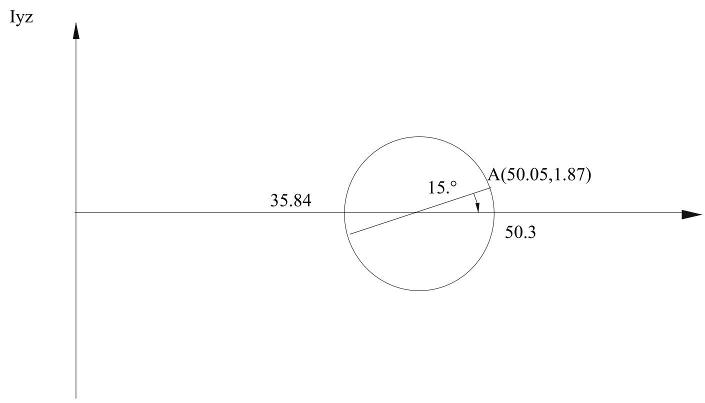
Les moments d'inertie principaux et centraux et leur orientation :

$$\text{tg} 2\alpha_0 = \frac{2 \times 1.87}{36.08 - 50.05} \Rightarrow \alpha_0 = -7.5°$$

$$I_{1,2} = \frac{50.05 + 36.08}{2} \pm \sqrt{\left(\frac{50.05 - 36.08}{2}\right)^2 + 1.87^2} \Rightarrow \begin{array}{l} I_1 = 50.30 \times 10^6 \text{mm}^4 \\ I_2 = 35.84 \times 10^6 \text{mm}^4 \end{array}$$



On trace le cercle de Mohr:



CORRIGE DE L'EXERCICE 2

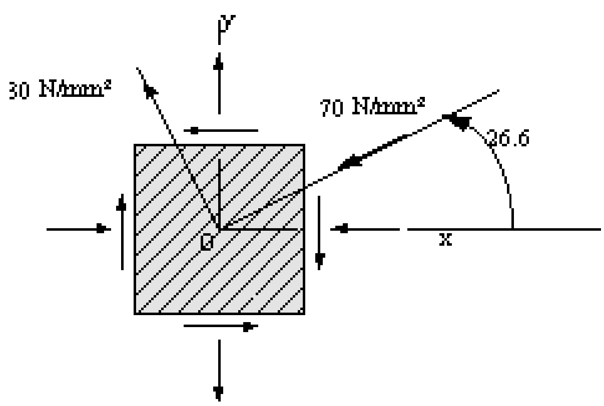
L'orientation de contraintes principales:

$$\mathrm{tg}2\theta_0 = \frac{2\times(-40)}{-50-10} = 1.33 \Rightarrow \theta_0 = 26.57°$$

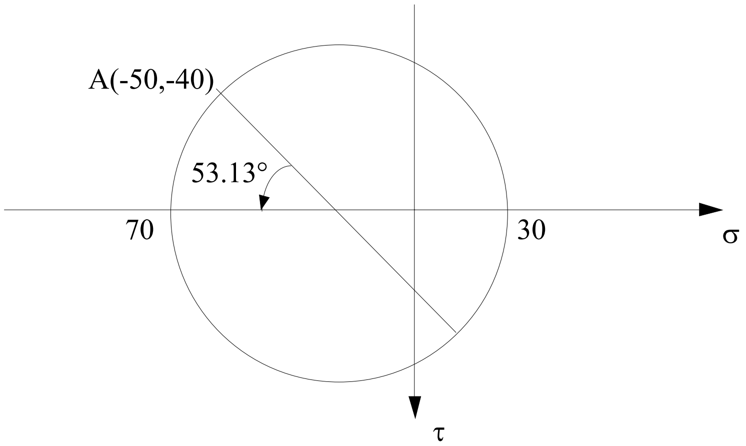
Les contraintes principales:

$$\sigma_{1,2} = \frac{-50+10}{2} \pm \sqrt{\left(\frac{-50-10}{2}\right)^2 + 40^2} \Rightarrow \begin{array}{l} \sigma_1 = 30\mathrm{N/mm^2} \\ \sigma_2 = -70\mathrm{N/mm^2} \end{array}$$

Orientation des axes principaux sur la facette initiale:



Tracé du cercle de Mohr:



CORRIGE DE L'EXERCICE 3

Calcul des réactions:

$$\sum F \uparrow = 0 \Rightarrow V_A + V_B = 60 \quad (1)$$

$$\sum F \rightarrow = 0 \Rightarrow H_A - H_B = 0 \quad (2)$$

$$\sum M_{/A} = 0 \Rightarrow V_B(10\sqrt{2} + 5\sqrt{5}) + 5H_B = 60(10\sqrt{2} + 2) \quad (3)$$

$$\sum M_{/Cd} = 0 \Rightarrow V_B(5\sqrt{2}) - 5H_B = 60 \times 2 \quad (4)$$

de (3) et (4)

$V_B = 29.8\text{kN}$ et $H_B = 42.7\text{kN}$

et de (1) et (2) on obtient:

$V_A = 30.2\text{kN}$ et $H_A = 42.7\text{kN}$

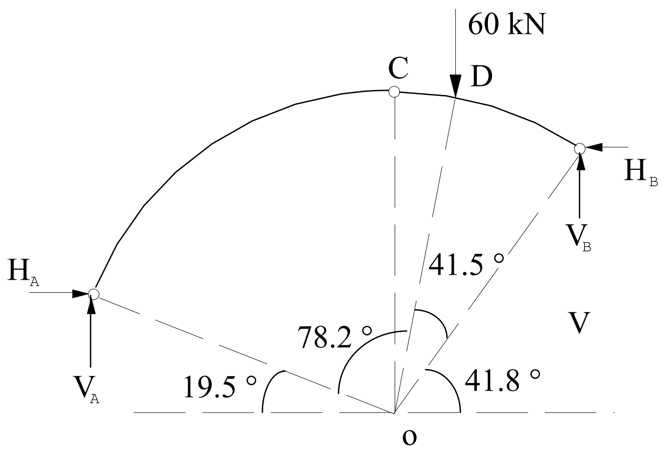


Diagramme des efforts internes:

Tronçon AD $0 \leq \theta \leq 78.2$

$N = -30.2\cos(19.47 + \boldsymbol{\theta}) - 42.7\sin(19.47 + \boldsymbol{\theta})$

$N(0) = -42.72$ kN , $N(70.5) = -42.7$ kN, $N(78.2) = -38.3$

$T = 30.2\sin(19.47 + \boldsymbol{\theta}) - 42.7\cos(19.47 + \boldsymbol{\theta})$

$T(0)= -30.17$ kN, $T(70.5)= 30.2$ kN, $T(78.2)= 35.62$, $T(\theta)= 0 \Rightarrow \theta = 35.3$

$M=30.2\times15[\cos19.47-\cos(19.47 + \boldsymbol{\theta})]- 42.7\times15[\sin(19.47 + \boldsymbol{\theta}) - \sin19.47)]$

$M(0) = 0$, $M(70.5) = 0$, $M(78.2) = 66.18$, $M_{max} = M(35.3) = -143.7$

Tronçon BD $0 \leq \theta \leq 40.54$

$N = -29.8\cos(41.8 + \boldsymbol{\theta}) - 42.7\sin(41.8 + \boldsymbol{\theta})$

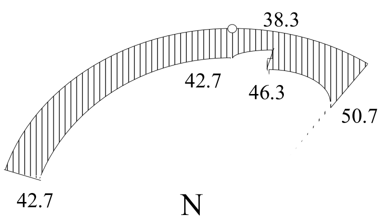
$N(0) = -50.68$ kN , $N(40.54) = -46.3$ kN

$T = -29.8\sin(41.8 + \boldsymbol{\theta}) + 42.7\cos(41.8 + \boldsymbol{\theta})$

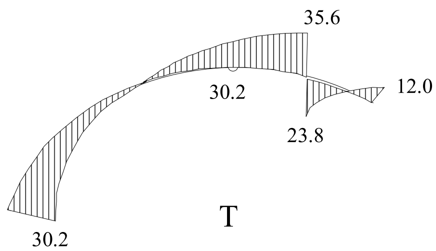
$T(0) = 11.97$ kN, $T(40.54) = -23.84$ kN, $T(\theta) = 0 \Rightarrow \theta = 13.3$

$M= 29.8 \times 15[\cos41.8 - \cos(41.8 + \boldsymbol{\theta})] - 42.7\times15[\sin(41.8 + \boldsymbol{\theta}) - \sin41.8)]$

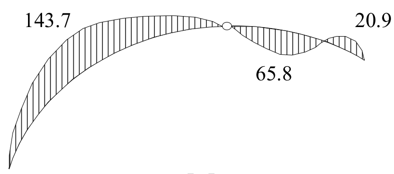
$M(0) = 0$, $M(40.54) = 65.81$, $M_{max} = M(13.3) = -20.91$



N



T



M